The Efficacy of Pavlik Harness as a Treatment of Developmental Dislocation of the Hip

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ABSTRACT

Objective: To evaluate the efficacy of using a Pavlik harness Orthosis in reducing dislocated hips in patients with developmental dislocation of the hip.

Methods: This is a prospective study done on patients who visited the pediatric orthopedics clinic in the Royal Medical Services in the period between October 2010 and June 2015. Each patient diagnosed by radiography and fulfilled the inclusion criteria was examined prior to the application of a dynamic flexion abduction orthosis (Pavlik Harness orthosis) and then the Orthosis application is checked by one of the authors whom are a senior consultant pediatric orthopedic surgeon and four pediatric orthopedic specialists. After that, a follow up period of two weeks is given to those patients who present with a dislocated hip in the age between three to six months. The patients were reevaluated after two weeks by clinical examination of both hips and by radiography while maintaining the Pavlik harness orthosis applied on the patient.

Results: In this study 133 patients had fulfilled the inclusion criteria. The number of dislocated hips was 184. We found that there were 82 patients 61.6% who presented with unilateral hip dislocation and 51 patients 38.4% who presented with bilateral hip dislocation. Female:Male ratio of 6.4:1 . 128 hips 69.7% achieved reduction after the application of a pavlik harness orthosis at two weeks follow up. And 56 hips 30.3% diagnosed as a case of failed hip reduction and underwent closed reduction under general anesthesia with or without Adductor tendon tenotomy and static hip spica cast application. 3 patients 2.2% developed femoral Nerve palsy that fully recovered after discontinuity of Orthosis application.

Conclusion: The use of Pavlik Harness Orthosis is an effective method of treating patients who present with a dislocated of hip in the age between three to six months. The younger the patient the better the outcome.

Keywords: Developmental Dislocation of the Hip

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Introduction

Developmental dysplasia of the hip is a common pediatric orthopedic disorder; it could be presented with a spectrum of pathology ranging from acetabular dysplasia to hip subluxation to frank dislocation of the hips. (1) Nowadays, it is recognized that Pavlik Harness is the gold standard treatment for patients with developmental dysplasia of the hip. (1-4) The device was developed by Arnold Pavlik in 1944, (5) were he published his experience in treating developmental dysplasia of the hip with his harness, its principle & its results. (6) In our practice, we still have many cases with frankly dislocated hips. The literature documents that Pavlik Harness treatment of dislocated hips -regardless of reducibility- has a success rate of 61-99%. (7) The purpose of our study is to assess the efficacy of using Pavlik harness in reducing dislocated hips in patients with developmental dislocation of the hip.
Method
This is a prospective study that was approved by the Royal Medical Services ethical committee. The study was done on patients whom were treated in the pediatric orthopedics clinic in the Royal Medical Services in the period between October 2010 and June 2015.

For each patient to be included in the study, the patient must meet the following inclusion criteria:
1. Age between three to six months.
2. Frank dislocation of the hip.
3. No previous treatment.
4. Not associated with a neuromuscular disorder.
5. Not diagnosed as a teratologic type of hip dislocation.

Each patient was examined prior to the application of a dynamic flexion abduction orthosis (Pavlik Harness Orthosis) with support of the diagnosis by a radiograph (Figure 1a). Once the diagnosis was established the Pavlik harness orthosis was applied on the same day of diagnosis and follow up was on outpatient basis. The pavlick harness orthosis was used as described by Arnold Pavlik, were its adjusted and checked by one of the authors whom are a pediatric orthopedic senior consultant or a pediatric orthopedic specialist to obtain more than 100° of hip flexion while avoiding posterior harness tensioning to prevents forced abduction. Instructions were given to parents on how to take care of the pavlik harness orthosis and how to deal with the baby while it is applied. Clinical re-assessment for the patient & the pavlik harness orthosis position done one week later. By the end of the second week, clinical and radiographic assessments of the hip position were done while maintaining the pavlik harness orthosis applied on the patient. If the hip is relocated by radiography assessment (Figure 1B) with a wide safety zone on clinical examination, Pavlik harness treatment will be continued until acetabular index recovery to be followed by hip remodeling (Figure 1C). On the other hand, those who failed to do so Figure 2, other modality of treatment need to be started. Other demographic data was obtained about each infant, such as the age of the patient, sex, side of pathology, unilateral or bilateral dislocation, family history and other risk factors for developmental dysplasia of the hip.

![Fig 1A: A 3 month old patient with left sided hip dislocation.](image)

![Fig 1B: successfully reduced hip after two weeks of Pavlik Harness application showing the hyper flexion position.](image)

![Fig 1C: 14 month follow-up showing development of the hip and remodeling of the acetabulum.](image)

![Fig 2: Two weeks after application of Pavlik Harness showing right sided hip dislocation.](image)

Results
In this study 133 infants had fulfilled the inclusion criteria. The mean age of patients included was 126 days at the time of onset of treatment. The number of dislocated hips was 184. We found that there were 82 infants 61.6% who presented with unilateral hip dislocation and 51 infants 38.4% who presented with bilateral hip dislocation. Right sided dislocation 77 hips 41.8% and left sided dislocation 107 hip 58.2%. Table I Female: Male ratio of 6.4:1. 128 hips 69.6% achieved reduction after the application of a pavlik harness orthosis at two weeks follow up. And 56 hips 30.4% diagnosed as a case of failed hip reduction and underwent closed reduction under general anesthesia with or without Adductor tendon tenotomy and static hip spica cast application. Among risk factors to failure we found that male sex has a higher failure rate.
of 37.5% rather than female sex which had a failure rate of 29.4%. Also bilateral presentation failure rate was 35.3% which is more than the failure rate in unilateral presentation 24.4%. The younger the patient presents the higher the chance for successfulness of this method and the older the patient at time of initiation of this method of treatment the higher the chances for failure Figure 3, Which clearly shows that the chance of failure in older patients as in the case of the 6th month presentation reaches up to 44.4% while a younger patient age at presentation as in the case of the 3rd month presentation has a failure rate of only 13.9%.

3 infants 2.2% developed femoral Nerve palsy that fully recovered after discontinuity of Pavlik Harness Orthosis application. They were considered as failed cases and were managed by other modalities for the treatment of developmental dislocation of the hip.

Table 1: showing high female to male ratio and a high left to right ratio

<table>
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<th></th>
<th>Failed</th>
<th>successful</th>
<th>Grand Total</th>
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<tr>
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</tr>
<tr>
<td>Grand Total</td>
<td>56</td>
<td>128</td>
<td>184</td>
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Fig 3: in columns; showing increased successfulness and decreased failure of method at younger age presentation

Discussion

In 1957, Arnold Pavlik published his method of dynamic treatment of developmental dislocation of the hip, were he noticed that previous treatment result in high rate of avascular necrosis of the femoral head. (5) The basic principle of this device is allowing dysplastic hips to move within the safe zone (The arc of movement that is created between adduction that would lead to dislocation and abduction that keeps the hips located) as defined by Ramsy et al. (8) Pavlik Harness Orthosis, although being a safe device, with low complication rate, it's inexpensive, easy to apply, and allow radiographic evaluation without the need for removal; the mothers tend to dislike it and consider it as a complex and difficult to manage in comparison to the simplicity of abduction splint. However, Pavlik harness is not suitable for all hips, according to harris et al, (7) he recommended to abandon treatment once there is no adequate sense of reduction felt after 2 weeks of trial; in hips that need extreme positioning to achieve reduction, and in children older than 8 months. Many studies showed that Pavlik Harness treatment of dislocated hips achieve reduction in more than 60% of cases. (7-9) It does that simply by shifting the dislocated hips from posterior-superior position to posterior position in relation to acetabulum during hip flexion by the device. And then, by gradual abduction of the hips, which is dependent mainly on the weight of the lower limb, it gently stretches the adductor muscle; which is usually tight and gradually slide the femoral head over the posterior rim of acetabulum until it is seated within the socket of the acetabulum. (10) We agree with earlier studies to discontinue treatment with Pavlik harness in dislocated hips if after two weeks those hips still show evidence of instability. Continuation of treatment beyond this period may lead to deformation of femoral head and exaggeration of secondary changes which make further conservative treatment more difficult. (11) In those patients were Pavlik Harness Orthosis failed to reduce the hips, other treatment options were adopted, like the use of more static devices, closed reduction and spica cast and in some cases open reduction and capsuloraphy. Many studies evaluate the factors that might contribute to failure of Pavlik Harness Orthosis in treating dislocated hips. In Mubarak et al study, (12) he attributed failure to: physician mismanagement, poor quality of the harness & improper use of it. So, we tried to overcome this cause by limiting the decision to the pediatric orthopedics team and by choosing the best quality of the harness available in Jordan. But he also noted that no anatomical factors were recognized to contribute to the failure. Vadillo, he found that a more teratological than mechanical hip dislocation could be the reason for failure of Pavlik Harness Orthosis, (13) which were excluded in our study according to the inclusion criteria. Viere and Alatar concluded that the time of initiation of treatment
determine the chance of success (14,15) and the data we have supports the same conclusion having the success rate in relation to the age as follows 3rd month 86.1%, 4th month 69.3%, 5th month 58% and the 6th month 55.6% Figure 3. In one study by Omeroglu et al, they concluded that Pavlik Harness Orthosis treatment is less effective in children over 4 months of age, (16) and if we compare this data to the failure rates related to age we get the same conclusion, as we have found that the failure rate under the age of 4 months is 22.7% and in patients over the age of 4 months the failure rate was 43.1% Some use the findings on ultrasound to predict failure, in a work of Novais et al, they showed that ultrasound classification have prognostic implication, where patient with Graf type IV at a higher risk of treatment failure. (17) Other debatable factor is male sex (18), we found that male sex has a higher chance of failure by 37.5% while in female sex its only 29.4%. Another debatable factor Bilateral involvement (14,19), in which is found to be a risk factor of failure in our study with a failure rate of 35.3% and in the case of unilateral the rate is 24.4%. On the other hand, those who showed successful reduction of the hip at two weeks evaluation, we continue their treatment with Pavlik Harness Orthosis until anatomical healing by judging through 2 main parameters 1. By radiography, through establishing that the acetabular index measurement is less than 30 degrees. 2. By clinical assessment of a stable hip after removal of the orthosis. Regarding the duration of Pavlik harness use we used the pavlik harness for at least 8 weeks in the patients older than 4 months then we transformed to static abduction orthosis until reaching the parameters of anatomical healing mentioned before. But if the child is less than 4 months old we kept the pavlik harness orthosis until the age of 6 months and then only if we have not reached the parameters needed then the method was transformed to a static abduction orthosis.

**Conclusion**

We conclude that the use of Pavlik Harness Orthosis for the initial treatment of patients with developmental dislocation of the hips; if treated with a strict protocol has a high success rates. We also conclude that the younger the age at presentation the higher the chance for success. Risk factors for failure are male sex, bilateral presentation and older age at presentation.

**References**


