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Treatment of Developmental Dysplasia of the Hip by Pavlik's Stirrups

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Abstract **Purpose** : To assess the relationship between gender, clinical hip stability, sonographic pathology, and age at the start of treatment on the duration and outcome of treatment for developmental dysplasia of the hip [DDH], using Pavlik's stirrups.
Methods : Pavlik's stirrups were applied for treatment of DDH instantly upon the establishment of the diagnosis for 224 hips [197 belonging to girls, 27 to boys].
Results : No statistically significant differences were found between the studied parameters.
Conclusions : At the age of one year, all the treated hips were found to be clinically, sonographically and radiologically normal. No avascular necrosis was seen among the treated hips. We found Pavlik's stirrups to be simple, safe and highly efficient in the treatment of DDH.

Introduction

In his classic paper, first published in the Czech literature in 1950, entitled "Stirrups as an aid in the treatment of congenital dysplasia of the hip in children"[11], Arnold Pavlik described a new functional method of treatment of what we call today Developmental Dysplasia of the Hip [DDH]. He suggested using a device which brings the hip joint to flexion and, in this way, to gradual, non-violent, spontaneous reduction of the dysplastic and dislocated hip joint. In his most quoted article published in German in 1957, he reported his experience with the treatment of 1912 children[10].

Despite its simplicity and efficiency, Pavlik's method spread outside middle Europe only very slowly. In 1957, Pavlik was visited by Suzuki from Nagasaki who introduced this method of treatment in Japan[13]. Two years later, Pavlik's method was introduced to Blount in the United States by Erlacher[1] but it did not gain wide attention. In 1969, Fried reported 10 years of experience with this mode of treatment in Israel[2]. The largest series of long-term experience with the routine use of Pavlik's method was published by Grill et al in 1988, based on a multi-centre study supported by the European Paediatric Orthopaedic Society[3].

Many pitfalls in the use of Pavlik's method have been reported also[5][7][9][16]. In our opinion, the source of these is the incorrect use or faulty understanding of the principles described by Pavlik himself. Tight adjustment of the straps as suggested by Ramsey[12] or, even worse, preventing any movement of the babies as suggested by Iwasaki[6] leads to converting a dynamic method to a "passive mechanical" one,

Key words : developmental dysplasia of the hip, Pavlik's method, sonography

Table 1. Sonographic pathology at start of treatment

Type of pathology	Number of hips
IIa	58
IIc	50
III	48
D	43
IV	25

Table 2. Age at onset of treatment

Age	Number of hips
First 48 hours	45
First week	14
2^{nd}~4^{th} weeks	27
After 4 weeks, but no later than 12 weeks	138

Table 3. Duration of treatment compared to sonographic pathology

Type of pathology	Duration of treatment(days)
IIa	72.1±4.1
IIc	101±14.1
III	120±10.1
D	94±6.3
IV	107.9±10.4

Table 4. Duration of treatment compared to age at start of treatment

Age	Duration of treatment(days)
First 48 hours	80±6.5
First week	100±10.8
2^{nd}~4^{th} weeks	81±7.9
After 4 weeks, but no later than 12 weeks	78±3.6

in Pavlik's words[10]. We feel that this is the main reason for avascular necrosis [AVN] of the femoral head 'caused by' Pavlik's stirrups. Another problem is that many orthopaedic surgeons assume that reduction will occur immediately, or within 2-3 weeks, upon applying the device, not understanding the process of spontaneous, gradual, non-violent, self-reduction, and this despite Pavlik's statement that the principle of the method is not in shortening the duration of treatment[10][11].

Nevertheless, there are also some objective reasons for failure in the use of Pavlik's method. For example, there are hips with an hourglass deformity of the capsule, preventing sliding of the dislocated femoral head to the acetabulum. neglected stable high dislocation with an enlarged capsule stuck to the ilium, or persistent laxity of the joint capsule.

Despite the still-growing popularity of Pavlik's method in the treatment of DDH, we were unable to find a study dealing with the relationship between gender, sonographic and clinical pathology, age at the start of treatment, and duration and outcome of treatment. To answer these questions, we assessed patients we treated using Pavlik's method in a six-year period at a special DDH Clinic.

Patients and Methods

In January 1988, we introduced to our practice at the Out-Patient Clinic what we called combined clinical-ultrasonographic investigation of infant hips, using Ortolani's and Barlow's tests for clinical stability and Graf's method for sonographic pathology evaluation. In January 1992, we added systematic neonatal screening of neonates to the investigation.

Until December 1993, each baby diagnosed at our institution with hip pathology was treated immediately, using Pavlik's method[11]. In 151 children treated, clinical-sonographic pathology was found in a total of 224 pathological hips, 27 belonging to boys and 197 to girls. Clinically unstable were 164 hips [positive Ortolani/Barlow test], while 60 hips were found to be clinically stable, with varying degrees of severity of ultrasonographic pathology. Severity of sonographic pathology at the start of treatment is seen in Table 1. Treatment initiation is seen in Table 2. The chi-square test and the student's t test were used for statistical evaluation.

We assessed the influence of gender, clinical

stability, severity of sonographic pathology and age when treatment was started on the duration, outcome [success] of treatment and AVN rate.

Results

There was no statistical difference in duration of treatment in comparing boys to girls : 72 days (range, 32~112 days) to 86 days (range, 34~138 days). For clinically unstable and stable hips, duration of treatment was virtually the same : 86 days (range, 31~139 days). Although the severity of the sonographic pathology had no statistical influence on duration of treatment, there was some tendency for prolonged treatment for more severe pathology (Table 3). Noteworthy is the observation that age when treatment was initiated had no significant influence on duration of treatment (Table 4). We believe that this is because treatment was started relatively early, prior to the age of three months.

Only 7.14% (16 hips) were not reduced using Pavlik's method, but we were unable to find an exact reason for this. Some tendency for failure of treatment may be in more severe pathology but the numbers are too small for statistical evaluation. Also, hips whose treatment was initiated after the age of 6 weeks tended to fail. Initial sonographic pathology of these 16 hips [one belonging to a boy and 11 (7 unilateral, 4 bilateral) to girls] is described in Table 5. At the time of diagnosis, nine hips were clinically unstable and seven were stable. Treatment was initiated in three of these hips at the age of 48 hours, one hip at the age of two weeks, and the remaining 12 hips beyond the age of 12 weeks. All 16 hips were treated by closed reduction and POP spica cast, and/or by various surgical procedures.

Table 5. Distribution of hip sonography treatment failure

Type of pathology	Number of hips
IIa	3
IIc	1
III	4
D	2
IV	6

At the age of one year, all 208 hips treated successfully by Pavlik's method showed no signs of AVN, were clinically stable, had a full range of movement and were radiologically normal.

Discussion

In 1957, Pavlik published a summary of his experience with a functional method of treatment using a harness with stirrups as an aid in the treatment of DDH[2]. He achieved a healing rate of 84.08% for dislocated hips [15.82% of dislocated hips did not reach normality] and a 100% healing rate for dysplasias and subluxations (94.72% of all hips). In the group of dislocated hips, AVN of the femoral head occurred in 18% after further treatment using passive mechanical methods (closed reduction, casting, etc), i.e., 0.94% AVN for all children originally treated by his functional methods. In our opinion, the reasons for failure of treatment were delayed start of treatment, especially at the beginning, and full dislocation which developed as a result of this.

The most comprehensive study of the treatment of DDH was published by Grill et al in 1988[3], reporting 3611 hips of 2636 babies treated at six European institutions. The reported rate of AVN as a result of treatment was 2.38%. If treatment was started before the age of three months, this rate was even lower. The healing rate was 80% for subluxated-dislocated hips and 95.35% for dysplastic hips, a total healing

rate of 95%.

Iwasaki reported a rate of 7.2% for children as out-patients and 28% for those treated as in-patients[6]. We see the reason for this as changing treatment from active movement to a passive mechanical process. According to the literature, success rates vary from 95.7%[15] to 20% in frankly dislocated hips, when treatment was started after the age of three weeks[4]. Many reports have stressed the benefits of ultrasound monitoring during treatment[4][7][8][14], as ultrasound enables the accurate determination of hip position in the harness and a shorter period of treatment, and helps in making the decision to abandon further treatment when spontaneous reduction is impossible.

In this study, we reached a reduction rate of nearly 93% and 0% incidence of AVN after treatment, similar to the results published by Pavlik and others[3][10][15]. We believe that four major factors contributed to these results :

1. Treatment was initiated in most of our patients before 12 weeks of age.

2. Every child was followed at three-week intervals during treatment, strictly following Pavlik's rules, using sonographic evaluation until hip reduction and stabilization were achieved.

3. Most patients were treated successfully in two-three months ; in the event of failure of treatment in this period, the patient was treated by other means.

4. Awareness of the importance of the understanding and treatment compliance on the part of the parents, who were instructed in the care and maintenance of the stirrups.

In conclusion, we believe that Pavlik's method is the treatment of choice for DDH in the under three month age group.

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