

# Effectiveness of Mom-Made Pavlik Harness for Maintaining Reduction of the Hip in DDH

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**Background:** Co-operation of the parent is a major factor for successful treatment of developmental dysplasia of the hip (DDH). The commercial Pavlik harness is too expensive and the parent may not understand or refuse its use. Regarding the function of the Pavlik harness and awareness of complications, a Mom-made Pavlik harness was developed.

**Objective:** To evaluate the effectiveness of Mom-made Pavlik harness in maintaining the reduction of DDH.

**Material and Method:** Infants with Ortolani positive DDH, ages up to five months, treated at Maharat Nakhon Ratchasima Hospital between October 2003 and September 2012, were analyzed, retrospectively. Irreducible DDH, neuromuscular DDH and hyperlaxity syndrome were excluded. A Mom-made Pavlik harness was used to maintain reduction after the initial two weeks of a hip spica cast. The success of treatment was evaluated by ultrasound of the hip. The center edge (CE) angle was measured from AP film at age one and four years.

**Results:** There were 24 infants, 35 hips with 11 bilateral, seven left and six right sides DDH. Thirty-two hips were successfully reduced (91.4%). Three hips had recurrent dislocation. Two of these were further managed by adductor tenotomy and closed reduction under general anesthesia and hip spica cast, followed by hip abduction brace. Another was treated by open reduction and Salter's innominate osteotomy. The average CE angle at age one and four years was 16.5 and 25.9 degree, respectively.

**Conclusion:** Treatment of the infants with DDH requires a long period of care not only in hospital but also at home. Therefore, it needs the diligence, intention and regularity by their parents to achieve a successful outcome. The Mom-made Pavlik harness represents the spirit of this resolution.

**Keywords:** Pavlik harness, DDH, Congenital dislocation of hip, Mom-made

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The Pavlik harness is known to be an effective method of treatment of developmental dysplasia of the hip (DDH) in infants<sup>(1,2)</sup>. Extension and adduction of the hip joint were prevented while hip motion within the safe zone was allowed. The safe zone is defined as the arc between the angle of adduction allowing dislocation and the angle of abduction that can be comfortably attained. The baby can kick the leg or extend the knee while the hip is in flexion and abduction position.

Many kinds of commercial Pavlik harness have been used under the principle of function created by Arnold Pavlik since 1945<sup>(3,4)</sup>. The Pavlik harness had success rates reported in treatment of the dislocated hip but reducible or Ortolani positive hip that ranged from 61-86%<sup>(5-7)</sup>. Parental compliance is a major factor for success. Mubarak et al reported that one-third of

Pavlik harness failures (6 of 18 hips) were caused by parental non-compliance<sup>(8)</sup>. McHale et al<sup>(9)</sup> reported that parental non-compliance allegedly led to 25% failure of treatment with the Pavlik harness. Pavlik harness was designed for outpatient treatment only if patient compliance was guaranteed<sup>(1)</sup>. The commercial Pavlik harness was too expensive for rural Thai people and the parents may be unaccustomed or refuse its use. Regarding the principle of Pavlik harness function and awareness of complications, a Mom-made Pavlik harness was developed (Fig. 1, 2).

The advantages of the Mom-made Pavlik harness provide the following important factors: promotes parent compliance to achieve success of treatment, cost effectiveness, can be applied easily, can be adjusted or reformed by Mom herself, can be washed and cleaned as normal clothes.

The disadvantages include the following: the need for the first model sample which created by one of the patient's Moms (Fig. 3), Mom's sewing skill may be limited, also having to teach Mom to apply continuously, adjust for the safe zone of hip and

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**Fig. 1** Mom's old cloth was sewn into a new lovely Mom-made Pavlik harness.

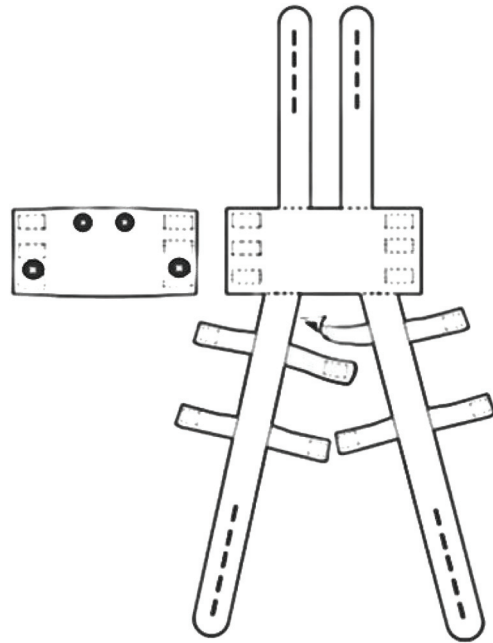


**Fig. 2** The baby can move both legs but the hips remain in the safe zone.

awareness of complications in the same manner as commercial Pavlik harness.

### Objective

To evaluate the effectiveness of the Mom-made Pavlik harness for maintaining the reduction of DDH in infants.



**Fig. 3** The first model of Mom-made Pavlik harness. Left side is the front body piece. Each button has to be tightly fixed in proper position. The right side is the rear piece with two upper and two lower strips which contains many buttonholes at each end. The lower strips have to be aligned outside the center of the hip joint and point toward the scapular tip.

### Material and Method

The medical records of all infants ages zero to five months treated for DDH at Maharat Nakhon Ratchasima Hospital between October 2003 and September 2012 were reviewed. The inclusion criteria consist of an initial clinical examination by senior pediatric orthopedic staff and pediatrician documenting that the Ortolani exam was positive, that the femoral head was initially dislocated but could be reduced by the Ortolani maneuver. Irreducible DDH such as arthrogyposis, neuromuscular DDH and hyperlaxity syndrome were excluded. All patients were initially treated by closed reduction and hip spica cast for two weeks then followed by a Mom-made Pavlik harness. The hip position in the Mom-made Pavlik harness was evaluated and adjusted by the orthopedic pediatrician every one to two weeks. An ultrasound of the hip was done after the Mom-made Pavlik harness was applied for two to four months or before weaning to confirm success of reduction. The AP film of both hips was reviewed at age 6, 12, 18, 24 and 48 months to follow the growth of femoral head in acetabulum or detect avascular necrosis. The center edge (CE) angle

was studied from an AP film of both hips at ages one and four years to determine the improvement of the acetabular coverage.

### Results

There were 24 infants with 35 hips having Ortolani positive DDH. The demographic data was shown in Table 1.

Thirty-two hips successfully maintained the reduction by the Mom-made Pavlik harness (91.4%). Failure to maintain reduction was found in three hips. Two of these had re-dislocation at two and four months during the Pavlik harness program, respectively. The other one was detected six months after being weaned off the Pavlik. Two of the re-dislocations were treated by percutaneous hip adductor tenotomy and a repeated closed reduction under general anesthesia and hip arthrography, then maintaining the reduction by hip spica cast for two months followed by the abduction brace. The other one was managed by open reduction and Salter's innominate osteotomy. The mean CE angle at age one year was 16.5 degree (range 10-25, SD 4.2). Sixteen cases (21 hips) that were followed-up until at least age four years, the mean CE angle was 25.9 degrees (range 20-31, SD 3.6). Growth and development of femoral head in acetabulum after treated with Mom-made Pavlik harness was shown as in Fig. 4. None of cases had osteonecrosis of the femoral head at the last follow-up X-ray (1.6-4years). Neither femoral nerve nor brachial plexus palsy from the Mom-made Pavlik harness occurred. In addition, Pavlik harness disease from excessive use was not found.

### Discussion

The successful reduction rate of Pavlik harness application varied among studies (Table 2). These may be due to the various designs of the Pavlik harness, the indication for Pavlik harness such as the varied range of age, irreducible hip or just dislocatable (Barlow positive) hip that were included or not. Moreover, some studies exclude poor parent compliance cases<sup>(9)</sup> to determine the other predictive factors for unsuccessful treatment.

**Table 1.** Demographic data of Ortolani positive DDH infants maintaining the reduction by Mom-made Pavlik harness

Demographic data	Detail
Sex	
Female	18 cases
Male	6 cases
Side	
Left	6 cases
Right	7 cases
Bilateral	11 cases
Age at first visit: mean (range, SD)	21.7 days (0-112, SD 29.2)
Duration of wearing: mean (range, SD)	17.7 weeks (8-22, SD 2.56)
Follow-up period: mean (range, SD)	4.4 years (1.6-8.0, SD 1.96)

DDH = developmental dysplasia of the hip

In 1981, Mubarak et al<sup>(8)</sup> reported the successful reduction rate of 84% (92 of 110 hips) for primary treatment with Pavlik harness in infant age within ten months that included subluxable, dislocatable and dislocated DDH. Six of 18 failure cases were caused by parent non-compliance. In 2001, Lerman et al<sup>(5)</sup> reported a successful reduction rate of 81% (111 of 137 hips), Pavlik harness was used as primary treatment in infant age within six months; indications included stable hip but ultrasound coverage less than 33%, dislocatable, dislocated but reducible and irreducible cases. The risk factors for failure are initial clinical exam and percentage of femoral head coverage shown in hip ultrasound. Initial irreducible cases combined with ultrasound that demonstrated coverage less than 20% may be candidates for alternative bracing, traction, or closed or open reduction. Grill et al<sup>(1)</sup> reported a multi-center study in 1988 that included infants between 2 days and 11 months of age. Those who had Ortolani positive with the Pavlik harness used as primary treatment had a success rate of 86% (638 of 742 hips). In 2009, Swaroop et al<sup>(10)</sup> added the parental education program at the time of



**Fig. 4** Growth and development of the femoral head in acetabulum after treated by Mom-made Pavlik harness were shown in AP film of both hips at age 6, 12, 18, 24 and 48 months respectively.

**Table 2.** Comparison of the success rate of Pavlik harness in DDH

Study	Population	Successful reduction rate
Mubarak et al. <sup>(8)</sup> (1981)	Age 0-10 months Pavlik harness was used as primary treatment	84% (92/110 hips)
Grill et al. <sup>(1)</sup> (1988)	Age 2 days-11months, multicenter study Pavlik harness was used as primary treatment	86% (638/742 Ortolani positive hips)
Lerman et al. <sup>(5)</sup> (2001)	Age 1-126 days Pavlik harness was used as primary treatment	81% (111/137 hips)
Klane et al. <sup>(6)</sup> (2010)	Age 0.1-4.3 months who Ultrasound within 4 weeks Pavlik harness was used as primary treatment	63% (72/115 Ortolani positive hips)
The present study	Include age 0-5 months Pavlik harness was used as secondary treatment after 2 weeks of hip spica cast	91% (32/35 Ortolani positive hips)

initial treatment with Pavlik harness in infants aged within six months who had Ortolani positive and reported the successful reduction rate at 85% (44 of 52 hips). In 2010, Klane et al.<sup>(11)</sup> reported the success rate of 63% (72 of 115 Ortolani positive hips) in infants age 0.1-4.3 months whose initial ultrasound of the hip had been done within four weeks and Pavlik harness was used as primary treatment. A femoral head positioned below the labrum is strongly associated with the success of Pavlik harness treatment whereas a hip with a femoral head that is located substantially superior and lateral to the labrum at initial ultrasound is associated with Pavlik harness treatment failure.

Mom-made Pavlik harness was used as secondary treatment for maintaining reduction after the hip spica cast. Its success rate was 91.4%. The high percentage of success of the Mom-made Pavlik harness may be first due to the initial irreducible cases being excluded. In Maharat Nakhon Ratchasima Hospital, the irreducible DDH such as arthrogyrosis in ages less than six months was treated by percutaneous adductor tenotomy and trial for closed reduction under fluoroscope and hip arthrogram, then maintained in a hip spica cast and followed by an abduction brace. For an irreducible hip, the open reduction of unilateral DDH with or without Salter's osteotomy was done before walking age. Second, the age range of the present study was 0-112 days which was lower than the other studies. In addition, the mean age at the first visit was only 21.7 days which may have enhanced the satisfactory result. The third reason may be the presumptive maintenance of reduction by hip spica cast for the first two weeks before the harness was readily sewn. The hip was allowed internal and external rotation in the fixed human position of hip flexion and abduction in the hip spica. This may be a suitable way

to create the depth of hip joint that initially grows very fast in the right direction. Moreover, the final reason for high success was the co-ordination of parents that participated in creating the Mom-made Pavlik harness for replacement of the hip spica cast which felt awkward while breast feeding and provided easier perineum care for their babies which encouraged their compliance. Even though the Mom-made Pavlik harness could solve the problem of parent compliance, failure still occurred. Failure of the commercial Pavlik harness had been reported 5 to 37% depending on many factors. Risk factors of failure that had been reported<sup>(5-8,10,11)</sup> were: the parent failed to have the child wear the harness or use it properly; poor-quality design and construction of Pavlik harness, improper use of the harness by a physician, bilateral sides, the initial clinical exam of Ortolani positive hip, delayed treatment beyond the age of 7 weeks, the initial irreducible hip but trial treated by the harness, the initial ultrasound showed acetabular coverage less than 20% and the femoral head located substantially superior and lateral to the labrum, which may be due to the deficiency of cartilaginous anlage or inverted labrum.

All of the Mom-made Pavlik harness failure cases were initially Ortolani positive. One of the bilateral cases had re-dislocation of the left side. None of failed cases had delayed treatment beyond the age seven weeks. An initial hip ultrasound was not done in the present study, so the initial coverage less than 20% or position of a femoral head, which implied deficiency of acetabular cartilaginous anlage and inverted labrum, could not be defined. Diligent and close follow-up for early detection and treatment of re-dislocation are necessary.

Osteonecrosis of the femoral head from excessive abduction in Pavlik harness had been



reported 0.5-8.8%<sup>(11)</sup>. Nevertheless, osteonecrosis from the Mom-made Pavlik harness have not been found. A larger number of DDH infants should be studied further.

The limitations of the present study are retrospective study, rather small numbers of cases and the variation of material used for Mom-made Pavlik harness. The cost of the Mom-made Pavlik harness ranged from 30 baht to 300 baht depending on the material used. However, its value from the mom's heart could not be measured.

### Conclusion

DDH is an orthopedic problem that requires a long period of care not only in hospital but also at home. Therefore, treatment of the infants with DDH needs their parents' exercising diligence, intention and regularity to achieve a successful outcome. The Mom-made Pavlik harness represents the spirit of this resolution. Mom-made Pavlik's harness could be an effective option for maintaining hip position after reduction of DDH in infant ages up to five months.

### What is already known on this topic?

Many commercial Pavlik harness had been used as the effective method for treatment of developmental dysplasia of the hip in infants with varied of successful outcome. But no studies about Mom-made Pavlik harness had been done before.

### What this study adds?

Mom-made Pavlik harness is a new lovely suit that represents Mom's fondness. It appeals Mom to get her baby to keep on wearing, unlike the commercial one that may look like an orthotic device. The effectiveness of Mom-made Pavlik harness in maintaining the reduction of the hip is not inferior to the commercial one when it is properly used and regularly checked. Because of its economical cost, the Mom-made Pavlik harness is a suitable choice for the rural district.

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### Potential conflicts of interest

None.

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**ผลการใช้ Mom-made Pavlik harness เพื่อการคงสภาพข้อสะโพกให้เข้าที่ในเบ้าสะโพกในทารกข้อสะโพกเคลื่อนแต่กำเนิด**

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**ภูมิหลัง:** ความร่วมมือของผู้ปกครองเป็นปัจจัยหนึ่งต่อความสำเร็จของการรักษา เนื่องจาก Pavlik harness สำเร็จรูปมีราคาแพง ผู้ปกครองอาจไม่คุ้นเคย และปฏิเสธที่จะใช้ ดังนั้น Mom-made Pavlik harness จึงถูกพัฒนาขึ้นโดยยึดการทำงานของ Pavlik harness อย่างปลอดภัย

**วัตถุประสงค์:** ประเมินผลสำเร็จของ Mom-made Pavlik harness ในการคงสภาพข้อสะโพกให้เข้าที่ในเบ้าสะโพก

**วัสดุและวิธีการ:** ศึกษาย้อนหลังทารกแรกเกิดจนถึงอายุ 5 เดือน ที่มีข้อสะโพกเคลื่อนแต่กำเนิด Ortolani positive ตั้งแต่เดือนตุลาคม พ.ศ. 2546 ถึง กันยายน พ.ศ. 2555 ประเมินความสำเร็จของ Mom-made Pavlik harness ในการคงสภาพข้อสะโพกไว้ในเบ้าด้วย ultrasound และวัดมุม center edge angle จากภาพถ่ายรังสีที่อายุ 1 และ 4 ปี

**ผลการศึกษา:** ทารก 24 ราย ข้อสะโพกเคลื่อนทั้งหมด 35 ข้อ ข้างซ้าย 7 ราย ขวา 6 ราย และทั้งสองข้าง 11 ราย ประสบความสำเร็จในการใช้ Mom-made Pavlik harness คงสภาพข้อสะโพกเข้าเบ้า 32 ข้อ (91.4%) มีการเคลื่อนที่ซ้ำ 3 ข้อ สองข้อได้รับการแก้ไขโดย adductor tenotomy, close reduction under general anesthesia และ hip spica cast อีกข้อหนึ่งได้รับการผ่าตัด open reduction and Salter's innominate osteotomy ค่าเฉลี่ยของ CE angle ที่อายุ 1 และ 4 ปี คือ 16.5 และ 25.9 องศา ตามลำดับ

**สรุป:** การรักษาข้อสะโพกเคลื่อนแต่กำเนิดในทารกนั้นใช้เวลารักษาต่อเนื่องยาวนาน จึงต้องอาศัยความขยัน ความตั้งใจ และความสม่ำเสมอที่เพิ่มมากขึ้นของผู้ปกครอง Mom-made Pavlik harness เป็นตัวแทนของความรักความผูกพันทางใจของแม่ที่ส่งผลให้การรักษาประสบความสำเร็จ

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