Original Article

นิพนธ์ต้นฉบับ

A Home Stretching Program to Prevent Recurrence of Clubfoot Deformity after Treatment with Ponseti Technique

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Abstract Ponseti casting technique is reported to have a high success rate in the treatment of idiopathic clubfoot. Recurrence after correction is not uncommon and may lead to recasting or surgery. So a new home stretching program was introduced to parents of patients with a view to reducing the recurrence rate and avoiding the foot abduction orthosis. Forty-nine idiopathic clubfeet treated by Ponseti technique and followed for at least 3 years were included in this study. All of the patients achieved initial correction by casting alone or casting and tendo achilles tenotomy. Home stretching scheme adapted from Ponseti manipulation technique was introduced to parents after the last cast was removed. Forty-seven of the 49 feet (96%) complied with the home stretching scheme. There were 19 recurrent feet. Seventy-four percent of the recurrent cases occurred within 4 months after the last cast. No recurrence found after 8 months from the last cast. The oldest age at which recurrence occurred was 1 year and 2 months old. No recurrence found after these patients started walking. Of the 19 recurrent feet, three feet were successfully treated by recasting only, twelve feet by recasting and percutaneous tendo achilles tenotomy, two feet by recasting and percutaneous tendo achilles lengthening. Two feet needed more extensive surgeries, one foot had open tendo achilles lengthening and posterior release, and one foot had posterior-medial release. This new home stretching program after initial correction of idiopathic clubfoot achieved high rate of compliance and avoided further extensive surgeries in most cases.

Key words: **clubfoot, Ponseti technique, home stretching, recurrence**

Introduction

The casting technique introduced by Ponseti has had a high success rate with the experience of more than 30 years.[1] Compared to more extensive surgical procedures, Ponseti's long-term outcomes have higher function, less pain, and slightly less stiffness.[2] Early in the study, Ponseti found 56 percent recurrence rate of the deformity which led to recasting, redo tendo achilles tenotomy and anterior tibialis tendon transfer or other extensive surgeries.[1] To decrease the high

recurrence rate, Ponseti later introduced foot abduction orthosis. The orthosis has to be worn full time for 3 months even during a nap and at night time for 2-4 years.[3] However, compliance with the foot abduction orthosis has been an issue.[4,5]

Another clubfoot treatment method so called the French physical therapy method had proven to be effective in the non-operative treatment of clubfeet. It combined stretching followed by taping and continuous passive motion with a machine. The contracted soft tissue of a clubfoot was gradually stretched. When used alone, this technique achieved 77 percent good and fair results. Only 23 percent needed surgery.[6] In those patients who needed subsequent surgery, less extensive releases were required. To maintain the treated foot in a corrected position, regular stretching of the foot may keep the tissue soft and prevent recurrence. Thai parents usually massage their babies' leg and feet based on their beliefs that this massage will help correcting the babies' physiologic bowed legs. The technique of baby massage to stretch the treated clubfoot as a home stretching program was modified. The effectiveness of this preventive scheme needs to be evaluated.

The purpose of this study was to evaluate the effectiveness of a new home stretching program with caregivers' participation with a view to reducing the recurrence rate and avoiding the orthosis.

Methodology

The prospective study was performed at the Center of Excellence in Orthopaedics, Lerdsin General Hospital during January 2000 - December 2007. Thirty-two patients (49 feet), who presented with idiopathic clubfeet with a minimum of 3-year follow-up after removal of the last cast, were enrolled. A detailed birth history was obtained. Clubfeet secondary to syndromic involvements were excluded.

There were 22 males and 10 females. Both feet were involved in 17 patients (53%). Prior treatment was noted in 22 patients (35 feet). Prior treatment included 14 patients (21 feet) with below the knee cast, 5 patients (9 feet) with above the knee cast, and 3 patients (5 feet) by observation only. The mean age at initial treatment of recurrence group was 14 days; range 1-149 days. Whereas the mean age at initial visit of the non-recurrence group was 24 days; range 1-1223 days. Rating of foot using Dimeglio[7] and Pirani[8,9] rating scale were done prior to each cast application. At the first visit, the median Dimeglio score for both recurrence and non-recurrence group were 10. The median Pirani score for recurrence and non-recurrence group were 5.5 and 4 respectively. All patients had their first casts applied on their first visit.

The technique of manipulation, casting and percutaneous tendo achilles tenotomy, as described by Ponseti[3], was followed. Correction of the relative pronation of the first metatarsal in the first cast, then gradually abducted the foot in the following casts. When metatarsus adductus, cavus and hindfoot varus were well corrected, a final cast was placed on for 3 weeks in a 15° dorsiflexed and 70° external rotation position. If this passive dorsiflexion was not possible, a percutaneous release of the tendo achilles tendon was performed, and the final cast was placed for 3 weeks. An average of 4 casts were applied to each foot on both recurrence and non-recurrence groups. Percutaneous tendo achilles tenotomy before application of the last cast was performed in 36 feet. Tenotomies were done in 29 feet of the non-recurrence group and 7 feet in the recurrence group.

On the day the last cast was removed, a foot stretching scheme was instructed to the caregivers. This stretching maneuver adapted from the manipulation technique of Ponseti before applying the last cast. For the right foot, each caregiver held the baby's right leg with one's left hand. The right foot was turned laterally until it was fully abducted, then bring the foot

into fully dorsiflexion position. The foot was dorsiflexed by applying pressure under the entire sole of the foot, not just under the metatarsal heads, to avoid a rocker-bottom deformity. The same technique was used for the left foot. The stretching maneuver was also practiced and rehearsed at the clinic. The caregivers were requested to show how they do the stretching every visit until it was certain that they did it correctly. The stretching was done regularly at home by the caregivers at least 30 times each session and not less than 3 sessions a day until the child reached 18 months old. Patients were followed every 1 or 2 weeks for the first 3 months then every 3 months. Data collection for each patient included sex, right or left foot, age at treatment onset, total number of casts applied, ratings of feet at each visit with Dimeglio[7] and Pirani[8,9] rating systems. Along with the rating of the feet, other details were noted, percutaneous tendo achilles tenotomy, complications with treatment, and compliance with the home stretching program. After casting was completed, the rating of feet was recorded at each visit to the clinic. Non-compliance with the treatment plan meant either incorrect stretching technique or the number of session and times of stretching in each session did not reach the proposed regimen. All castings and ratings were done by one surgeon.

Descriptive statistics were employed in data analysis. Chi square test was used to compare categorical variables between groups. Student's t-test was used to assess differences between two means of continuous data. All analyses were performed using SPSS program. A p-value of less than 0.05 was considered statistically significant.

Results

Recurrence of the deformity was found in 14 patients (19 feet, 38%). There were 9 males (12 feet) and 5 females (7 feet). Bilateral clubfeet with recurrence were found in 8 patients. Three patients who had bilateral clubfeet had recurrence of one side only. The distribution of the patients in the recurrence and non-recurrence groups were comparable in term of initial Dimeglio score, Pirani score, and number of cast applied. There were 21 of 30 feet in non-recurrence group and 14 of 19 feet in recurrence group received prior treatment at other hospital. The chi square test between recurrence and non-recurrence group showed no statistical significance for gender, lateral-

Table 1 Demographic data and comparison between non-recurrence and recurrence group (n = 49 feet)

Demographic data	Non-recurrence group	Recurrence group	p-value
Number of feet	30	19	
Gender (feet)			
Male	21	12	0.62
Female	9	7	
Laterality (feet)			
Right	17	9	0.53
Left	13	10	
Prior treatment (feet)			
Prior treatment	21	14	0.78
No prior treatment	9	5	
Mean age at initial treatment (days)	14 (4-149)	24 (1-223)	0.15

Chi-square tests were used in all of the above data except that t-test was used to determine the mean age at initial treatment

Table 2 Treatment for the recurrence (n = 19 feet)

Type of treatment	Non of patients	Age at recurrence (months)
Recast ($\bar{x}$)	3	7.5
Recast+TAT ($\bar{x}$)	7	7.5
Recast+TAL	1	14.0
TAL+posterior release	1	10.0
Postero-medial release	1	9.5

TAT= tendo achilles tenotomy, TAL = tendo achilles lengthening

ity, prior treatment at other hospitals.

The Student's t-test showed no statistical difference between the recurrence and non-recurrence groups for mean age at initial treatment with a p-value greater than 0.05. (Table 1)

There was a parent of only one bilateral clubfoot patient who did not comply with the stretching scheme. The compliance rate to the stretching scheme was 96 percent. Despite non-compliance with the stretching scheme, both feet in this non-compliant patient showed results.

Recurrence occurred at the mean of 63 days; range 25-224 days after the last cast. Seventy-four percent of the recurrent cases occurred within 126 days after the last cast. No recurrence found after 224 days from the last cast. The mean age when recurrence occurred was 231 days. The oldest age at which recurrence occurred was 427 days old. No recurrence found after these patients started walking.

Of the 14 recurrent patients (19 feet), three patients (3 feet) were successfully treated by recasting only, seven patients (12 feet) having recasting and percutaneous achilles tenotomy, one case (2 feet) having recasting and percutaneous achilles lengthening. Two feet needed more extensive surgeries, one foot had open tendo achilles lengthening and posterior release, and one foot had posterior-medial release. The patient who had percutaneous achilles lengthening was older than 1 year at the time of recurrence (427 days old at the time of recurrence). The patient who had tendo achilles lengthening and posterior release were 323 days old. The patient who had soft tissue release was 291 days old at the time of recurrence. (Table 2)

Discussion

Ponseti method of casting for clubfoot has gained more and more popularity. As noted by Cooper and Dietz[2], the long-term outcomes had higher function, less pain, and slightly less stiffness in these feet than in those with more extensive surgical procedures. It is obvious that this technique is easy to follow and has a high success rate. Recurrence was found to be 56 percent in the early experience of Ponseti.[1] The recurrence reduced to 38 percent in this study.

In later study, a foot abduction orthosis was used to reduce the recurrence rate. After the initial deformity was corrected and the last cast was removed, a foot abduction orthosis was applied full time for 3 months followed by wearing the orthosis at night time and during a nap time for 2-4 years.[3] In the report of Morcuende[5], using the orthosis reduce the recurrence rate to 10 percent after initial correction. Despite the reduction of recurrence rate, the foot abduction orthosis has some downsides. Non-compliance to the orthosis was the main factor in recurrence of the deformity in the report of Morcuende and Dobbs.[5,10] Wearing

the orthosis in older children is not well tolerated and is the major factor to discontinue the orthosis. Foot abduction orthosis is not a commonly available orthosis in Thailand. In addition, compared to the income of the patients, it is expensive.

It is a common belief of Thai parents to massage babies' legs and feet to help correcting their baby's physiologic bowed leg without any supporting scientific evidence. However, the methods of massage varies depend on ancestors' teach. The foot massage soothes baby while increases mother and child bonding as well. Consequently, it was easy to gain good co-operation from parents and caregivers when they were instructed to do the massage for the baby after clubfoot correction. Only one patient was non-compliant with the stretching plan whereas yielding good result in both feet. Yet it is difficult to draw conclusion from data of only one outstanding patient. Many studies demonstrated the importance of compliance with the foot abduction orthosis. However the failure to wear the orthosis reported to be as high as 41 percent.[5,10] The influential factors were inconvenience of the parents and the child refusing to wear the orthosis.[10] There was a high tendency to have recurrence in those who did not comply to the orthosis wearing. In Dobbs[10] study, recurrence occurred in 16 out of 21 cases who did not wear the orthosis.

In general, recasting and repeat percutaneous tendo achilles tenotomy or lengthening, or tibialis anterior transfer is recommended for correcting the recurrence.[4,11,12] But extensive soft tissue releases were unavoidable. Despite using orthosis after initial correction, extensive soft tissue releases were needed in 15 of 31 recurrence feet in the series of Changulani et al[12]. Nineteen feet in this study needed further treatment after initial correction. Seventeen of 19 feet in this study were successfully treated with these minor procedures which were recast or recast and redo tenotomy. The patient who had percutaneous tendo achilles lengthening was older than 1 year at the time of the surgery. Only 2 feet needed more extensive surgeries. The open achilles tendon lengthening combining posterior release and posteromedial release were done without complications such as skin necrosis or neurovascular injury.[13,14] The home stretching program not only reduced the recurrence rate, but also reduced the number of extensive soft tissue releases.

There was no patient who had recurrent deformity after they were able to walk in this study. Walking may act like a stretching force to the soft tissue of the foot and prevents recurrent deformity. There may be late recurrence in patients who is older than 7 years but the rate of recurrence is less and less over the years.[11,15] Longer follow up time will be needed to determine long term result of this manipulation technique. If such a deformity should occur, anterior tibial tendon transfer is recommended by Ponseti[16] to compensate for possible muscle imbalance.

In conclusion, the new home stretching program reduced the recurrence rate and rendered high compliance from the parents and caregivers. With this technique, extensive surgeries were not necessary in the vast majority of cases. No definitive criteria have been determined to differentiate the clubfoot that will have recurrence from the one that will not. No recurrence was found after these patients started walking.

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บทคัดย่อ **การดัดเท้าเพื่อการป้องกันการกลับเป็นซ้ำของโรคเท้าปุกแต่กำเนิดภายหลังรักษาด้วยวิธีของพอนเซติ**

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วารสารวิชาการสาธารณสุข **2551; 17:SVI1601-7.**

การรักษาเท้าปุกแต่กำเนิดโดยการใส่เฝือกด้วยเทคนิคของพอนเซติมีผลสำเร็จสูงมากเป็นที่น่าพอใจ แต่ปัญหาการกลับเป็นซ้ำก็เป็นสิ่งที่พบได้บ่อย ทำให้ต้องใส่เฝือกรักษาซ้ำ และอาจต้องผ่าตัดใหญ่ภายหลัง การใส่อุปกรณ์ดัดเท้าภายหลังการใส่เฝือกเป็นปัจจัยที่สำคัญต่อการป้องกันการเกิดเท้าปุกซ้ำ แต่อุปกรณ์ดังกล่าวมีราคาแพง และการจูงใจให้ผู้ป่วยร่วมมือใส่อย่างสม่ำเสมอนาน 3-4 ปีเป็นเรื่องที่ยากมาก คณะผู้ศึกษาจึงประยุกต์การดัดเท้าเด็กมาใช้ในการดัดเท้าของผู้ป่วยเท้าปุกแต่กำเนิด โดยศึกษาเท้าปุกแต่กำเนิด 49 เท้า ติดตามผลการรักษาเป็นเวลาอย่างน้อย 3 ปี ผู้ป่วยทุกรายได้รับการรักษาโรคเท้าปุกแต่กำเนิดโดยการใส่เฝือกอย่างเดียว หรือใส่เฝือกร่วมกับการเจาะตัดเอ็นร้อยหวาย จนกระทั่งเท้ามีลักษณะปกติ เมื่อถอดเฝือกออกในครั้งสุดท้าย จึงสอนผู้ปกครองให้ดัดเท้าผู้ป่วยทันที พบว่าได้รับความร่วมมือในการดัดเท้าอย่างถูกต้องสูงถึงร้อยละ 96 มีเพียง 19 เท้าที่กลับผิดรูปซ้ำ เมื่อพิจารณาเฉพาะกลุ่มที่กลับเป็นซ้ำร้อยละ 74 ของเท้าที่ผิดรูป กลับผิดรูปภายใน 4 เดือนหลังจากการถอดเฝือก อายุผู้ป่วยที่มากที่สุดที่เกิดการผิดรูปซ้ำคือ 14 เดือน ซึ่งผู้ป่วยทั้งหมดเดินได้แล้วในช่วงอายุดังกล่าว ในเท้าที่เกิดการผิดรูปซ้ำ ส่วนใหญ่รักษาการผิดรูปซ้ำโดยการใส่เฝือก หรือใส่เฝือกร่วมกับการเจาะตัดเอ็นร้อยหวายหรือเจาะยืดเอ็นร้อยหวายซ้ำ มีเพียง 1 รายที่ผ่าตัดยืดเอ็นร้อยหวายแบบเปิด และอีก 2 รายที่ได้รับการผ่าตัดใหญ่ การดัดเท้าแบบใหม่นี้ผู้ปกครองสนใจปฏิบัติถูกต้องได้มาก และหากเท้าผิดรูปซ้ำ ก็แก้ไขได้ง่าย จำเป็นต้องผ่าตัดใหญ่น้อยลง

คำสำคัญ: **เท้าปุก, เทคนิคของพอนเซติ, การดัดเท้าที่บ้าน, การเกิดซ้ำ**