Complications Associated with Ponseti Serial Casting and Surgical Correction via Soft Tissue Release in Congenital Idiopathic Clubfoot

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Background: *The current standard treatment used worldwide for management of congenital idiopathic clubfoot is serial casting by Ponseti method. Prior to 2006, standard treatment for congenital idiopathic clubfoot at Siriraj Hospital involved major soft tissue release by any of the following release techniques, modified posteromedial release, complete subtalar release, and posterior release.*

Objective: *To evaluate the complications and recurrence of deformity associated with treatment of congenital idiopathic clubfoot by Ponseti serial casting and major soft tissue release at Siriraj Hospital.*

Material and Method: *This retrospective review of medical charts and records was conducted in congenital idiopathic clubfoot patients who underwent primary treatment by either Ponseti serial casting or major surgical soft tissue release between 2000 and 2012 at Siriraj Hospital. Patient demographic, clinical, diagnostic, and surgical procedure-related data were reviewed. All associated complications were recorded and analyzed.*

Results: *One hundred sixty one patients were included, of which 46 had treatment by Ponseti method and 115 had treatment by major soft tissue release. In the Ponseti group, there were 26 males and 20 females (73 feet), with an average age at the beginning of treatment of 10.70 weeks (range 0.86 to 42.86). The complication rate was 17.8% (13 feet in 11 patients). The most common complications were cast loosening in four feet (5.48%) and cast-associated skin irritation in four feet (5.48%). In patients treated with Ponseti method, second surgery for recurrent deformity was performed in 26 feet (35.61%). In the soft tissue release surgical intervention group, there were 69 males and 46 females (171 feet), with an average age at the beginning of treatment at 52.05 weeks (range 9.86 to 248.71). The complication rate was 12.87% (22 feet in 18 patients). The most common complications were wound infection in nine feet (5.26%), followed by cast loosening in seven feet (4.09%). In soft tissue release patients, second surgery for recurrent deformity was performed in 26 feet (15.20%).*

Conclusion: *In this study, complication rates relating to clubfoot treatment by Ponseti serial casting and major soft tissue release were 17.8% and 12.87%, respectively. The two most common complications of Ponseti serial casting were cast loosening (5.48%) and cast-associated skin irritation (5.48%). The most common complication of major soft tissue release was wound infection (5.26%), followed by cast loosening (4.09%).*

Keywords: *Clubfoot, Congenital, Complications, Wound infection, Tendon transfer, Ponseti serial casting, Modified posteromedial release, Complete subtalar release, Posterior release*

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Congenital idiopathic clubfoot is a deformity that is characterized by equinus, hindfoot varus, forefoot and midfoot inversion, and adduction. When treated early and appropriately, considerable improvement can be anticipated. Incidence is one to six per 1,000 live births depending on race and region[1-4], and it is more common in males[5]. The etiology of this condition remains elusive, but genetic aberrations[6], fetal development, and histological abnormalities[5,7] have been proposed.

The goal of treatment is maintenance of flexible, plantigrade, and pain-free foot to the greatest achievable extent. Since the 1980's, the most common and widely accepted treatment for congenital idiopathic clubfoot has been surgery involving major soft tissue release. However, this treatment method has fallen out of favor due to an unacceptably high prevalence of pain, stiffness, and degenerative arthrosis in long-term follow-up[8,9].

Currently, the worldwide treatment of choice for management of congenital idiopathic clubfoot is the Ponseti method, which is a non-surgical technique

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Table 1. Demographic and clinical characteristics of patients who underwent Ponseti serial casting and major soft tissue release

	Ponseti serial casting	Major soft tissue release
Number of patients	46	115
Male	26 (55.3)	69 (60.0)
Female	20 (44.7)	46 (40.0)
Number of feet	73	171
Right	38 (52.1)	90 (52.6)
Left	35 (47.9)	81 (47.4)
Bilateral	27	56
Age at start of cast treatment (weeks)	10.70 (0.86-42.86)	-
Number of casts	5.58 (3-15)	-
Age at percutaneous tenotomy (weeks)	27.60 (6.71-62.43)	-
Age at major surgery (weeks)	-	52.05 (9.86-248.71)
Second surgery (feet)	26 (35.61)	26 (15.20)

Data presented as number (%) and mean (min-max)

that involves manipulation and serial casting. Ponseti casting was officially introduced at Siriraj Hospital in 2006. Syndromic clubfoot, neuromuscular clubfoot, and some neglected cases of clubfoot that present with very stiff deformity may require major surgery, such as modified posteromedial release or complete subtalar release. However, some authors have described some success in treating even these types of clubfoot with Ponseti serial casting[10-13].

The objective of this study was to evaluate the complications and recurrence of deformity associated with treatment of congenital idiopathic clubfoot by Ponseti serial casting and major soft tissue release at Siriraj Hospital.

Material and Method

This retrospective review of medical charts and records was conducted in congenital idiopathic clubfoot patients who underwent primary treatment by either Ponseti serial casting or major surgical soft tissue release between 2000 and 2012 at Department of Orthopaedic Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University. Patients treated with major soft tissue release underwent one or more of the following procedures: modified posteromedial release, complete subtalar release, and/or posterior release. All consecutive Ponseti serial casting cases were followed-up for at least two years. Exclusion criteria included non-congenital idiopathic clubfoot, such as arthrogryposis multiplex congenita, cerebral palsy, myelodysplasia, or other syndromic clubfoot; failed previous surgical treatment; recurrent clubfoot; and incomplete medical data. The protocol for this study was approved by the Siriraj Institutional Review Board (SIRB). Written informed consent was waived due to the retrospective nature of this study.

Table 2. Complications associated with Ponseti serial casting

Complication	Feet (%)
Cast loosening	4 (5.48)
Cast-associated skin irritation	4 (5.48)
Cast-associated pressure sore	3 (4.11)
Infection	2 (2.73)
Total	13 (17.80)

Results

Complications associated with both the Ponseti serial casting and major soft tissue release groups are shown as Table 1 and 2.

Seventy-three feet in 46 patients (26 males and 20 females) were treated with Ponseti serial casting. Complications were observed in 13 feet in 11 patients (17.8%). Two feet had superficial wound infection following percutaneous tenotomy. All complications were minor. Secondary surgery for recurrent deformity was performed in 26 feet (35.61%) in 17 patients. Fourteen feet (19.25%) underwent open Achilles lengthening. Six feet (8.21%) underwent modified posteromedial release. The other cases underwent secondary surgery, as described in Table 3. Average time interval from completion of initial treatment to secondary surgery was 2.24 years (range 1.53 to 4.34).

One hundred and seventy-one feet in 115 patients (69 males and 46 females) were treated with major soft tissue release. Sixty-one feet underwent

modified posteromedial release, 59 with complete subtalar release, and 51 with posterior release. Posteromedial incision was used for posteromedial release and Cincinnati incision was used for both complete subtalar release and posterior release (Table 4). Complications were observed in 22 feet (12.86%) from 18 patients (Table 4). The only major complication observed was wound bleeding in one patient who underwent complete subtalar release. The other minor complications were observed during follow-up in 21 feet from 17 patients. Secondary surgery for recurrent deformity was performed in 26 feet (15.20%) from 18 patients. Seven feet underwent second surgical treatment via posteromedial release. The secondary surgical procedures used in the other cases are shown in Table 5. The average time interval from completion of initial treatment to secondary surgery was 1.65 years (range 0.8 to 3.06).

Table 3. Procedures associated with second surgical treatment of Ponseti casting

Procedure	Feet (%)
TAL	14 (19.18)
MPMR	6 (8.21)
TAL and posterior tibialis recession	3 (4.11)
Posterior release	1 (1.36)
TAL and SPATT	1 (1.36)
Plantar fascia release and SPATT	1 (1.36)
Total	26 (35.61)

TAL = tendo-Achilles lengthening; MPMR = modified posteromedial release; SPATT = split anterior tibialis tendon transfer

Table 4. Complications associated with major soft tissue release

Complication	MPMR	CSR	PR	Feet (%); patients
Wound infection	2	4	3	9 (5.26); 7
Cast loosening	2	3	2	7 (4.09); 6
Cast breakage	0	0	3	3 (1.75); 2
Cast breakage and wound dehiscence	0	2	0	2 (1.19); 2
Wound bleeding	0	0	1	1 (0.58); 1
Total	4	9	9	22 (12.87); 18

MPMR = modified posteromedial release; CSR = complete subtalar release; PR = posteromedial release

Table 5. Procedures associated with primary surgery with major soft tissue release and secondary surgical treatment for recurrent deformity

Primary surgery (feet)	Secondary surgery (feet)
MPMR (6)	TAL (4) PR and SPATT (1) PR and midfoot osteotomy (1)
CSR (3)	TAL (3)
PR (17)	MPMR (7) PR (10)
Total (26)	Total (26)

MPMR = modified posteromedial release; CSR = complete subtalar release; PR = posterior release; TAL = tendo-Achilles lengthening; SPATT = split anterior tibialis tendon transfer

Discussion

The Ponseti serial casting method is now used worldwide to treat congenital idiopathic clubfoot[9,14,15]. Ponseti casting can also be used to treat syndromic or neurogenic clubfoot, but treatment outcomes are inferior to outcomes observed in congenital idiopathic clubfoot patients[10-13]. Prior to 2006, all congenital idiopathic clubfoot cases treated at our center were treated with modified posteromedial release, complete subtalar release, or posterior release at patient age of 9 to 12 months. It was common for surgery to be postponed until a more suitable time and/or the patient achieved an appropriate weight. Some patients were initially treated by serial casting until foot physiology and weight gain were sufficiently adequate for performing major surgery.

At our center, Ponseti method was adopted as the treatment of choice for this condition in 2006. In this study, more than 80% (11 in 13 feet) of Ponseti technique-related complications were cast-related. All of the Ponseti cases with complications were performed between 2006 and 2007. As such, it can be suggested that these complications were learning curve-related. Many studies have reported success rates using the Ponseti technique of up to 90%[16]. Some studies reported cast complication rates of 5 to 20%, which is comparable to the 17.8% we found in this study[17]. Most complications were superficial soft tissue damage from the cast, such as skin irritation and/or pressure sore. In 2008, two feet in two patients had superficial wound infection from percutaneous tenotomy performed at outpatient clinic. After these two infections developed, all subsequent percutaneous tenotomy procedures were performed in the operating room.

Even though some authors described persistent clubfoot coming from the accessory soleus muscle after percutaneous Achilles tenotomy[18-21], which did not find in this study. For Ponseti casting,

secondary surgery in this study was performed in 26 feet (35.6%), and 8.22% (6 in 73 feet) of second surgery feet underwent modified posteromedial release. The remaining feet underwent minor foot surgery. This result is comparable to other studies, such as the study by Halanski et al[27], which had 37.5% recurrence. We postulate that this high rate of secondary surgical procedure may be related to the limitation of available high-quality braces, such as modified Dennis Brown splint, Mitchell-Ponseti brace[22], Markell brace[23], Steenbeek brace[24], Dobb's dynamic clubfoot bar[25], and Kessler brace[26]. We also had many cases that used uncomfortable locally made braces, which may have increased rates of brace non-compliance. Many authors have described unexpectedly high recurrence rates that range from 30 to 45% that are thought to be due to a failure by the patient's family to comply with the protocol requirements of the brace program[22,25-28].

In the major soft tissue release group, complications were found in 22 feet (12.8%). The majority of complications (9 feet in 7 patients) were surgery-related from wound infection, all of which could be treated with wound dressing and oral antibiotics. Kaewpornsawan et al[29,30] reported 5.94% of patients had wound infection after modified posteromedial release and 4.68% of feet had wound infection after modified posteromedial release or complete subtalar release. Other complications observed in our study were minor cast complications after surgery for maintaining the position of the foot. The number of cast complications was found to be lower serial casting technique. This was probably due to the fact that there was no cast force, because the foot was already in the plantigrade position after surgery. Hussain et al[31] reported that more than a half (56%) of patients developed toe swelling after surgery and all required cast splitting with bandage augmentation following suspected wound infection in four patients (13.3%). Halanski et al[27] reported 65.51% of patients having cast complications after major soft tissue release.

This study did not find any toe swelling problems due to the fact that cast splitting was performed immediately after surgery. There were, however, some other cast-related complications, including cast loosening and cast breakage. Regarding secondary operation for recurrent deformity, Kaewpornsawan et al[29,30] reported a 2 to 6% rate of secondary surgical procedure at an average follow-up of 15 months. Halanski et al[27] reported secondary surgery rates of up to 30.43% in surgical soft tissue release at an average follow-up of 3.8 years. The present study found that 15.2% of feet required secondary procedure after soft tissue release, which is comparable to other studies.

This study has some mentionable limitations. First, due to the retrospective nature of this study, some patient data may have been missing or incomplete. Second, we were not able to compare complications and recurrence between the two treatment methods due to differences in time (year of procedure) and numbers of patients.

Conclusion

In this study, complication rates relating to clubfoot treatment by Ponseti serial casting and major soft tissue release were 17.8% and 12.87%, respectively. The two most common complications of Ponseti serial casting were cast loosening (5.48%) and cast-associated skin irritation (5.48%). The most common complication of major soft tissue release was wound infection (5.26%), followed by cast loosening (4.09%).

What is already known this topic?

The complication of clubfoot treatment either Ponseti serial casting or major soft tissue release could be found more than 10% of both.

What this study adds?

Then main complication of Ponseti serial casting was cast complication which was quite high comparing to other study due to be included in the beginning time of Ponseti treatment in first a few years. The main complication of treatment via major soft tissue release is surgical wound infection.

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Potential conflicts of interest

None.

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ภาวะแทรกซ้อนของการรักษาโรคเท้าปุกแต่กำเนิดแบบใส่เฝือกดัดโดยวิธีพอนเซติกับการผ่าตัดใหญ่แบบเลาะพังผืดและเนื้อเยื่อ

จตุพร โชติกวณิชย์, พีระจิตร เอี่ยมโสภณา, ธเนศ อริยะวัตรกุล, จาริกธรรม แซ่ลิ้ม, กมลพร แก้วพรสวรรค์

ภูมิหลัง: *ปัจจุบันการรักษาโรคเท้าปุกแต่กำเนิดโดยวิธีสากล คือ การใส่เฝือกดัดโดยวิธีพอนเซติ ในอดีตก่อน พ.ศ. 2549 โรงพยาบาลศิริราชได้ทำการรักษาโรคเท้าปุกด้วยวิธีการผ่าตัดใหญ่โดยวิธีการเลาะพังผืดและเนื้อเยื่อ*

วัตถุประสงค์: *ศึกษาภาวะแทรกซ้อนของการรักษาโรคเท้าปุกแต่กำเนิดด้วยวิธีการใส่เฝือกดัดโดยพอนเซติรวมถึงการผ่าตัดใหญ่โดยวิธีเลาะพังผืดและเนื้อเยื่อ สำหรับการรักษาครั้งแรก*

วัสดุและวิธีการ: *เป็นการศึกษาย้อนหลังจากเวชระเบียนของกลุ่มผู้ป่วยที่ได้รับการรักษาโรคเท้าปุกเป็นครั้งแรก ระหว่าง พ.ศ. 2543 ถึง พ.ศ. 2555 โดยจะเก็บข้อมูลการรักษา อายุ เพศ ภาวะแทรกซ้อนและการผ่าตัดซ้ำ*

ผลการศึกษา: *รายงาน 73 เท้า จากผู้ป่วย 46 ราย เป็น ชาย 26 ราย หญิง 20 ราย ได้รับการรักษาแบบใส่เฝือกดัดโดยวิธีพอนเซติ อายุเฉลี่ยที่เริ่มต้นการรักษาคือ 10.7 สัปดาห์ (range 0.86-42.86) พบภาวะแทรกซ้อน 13 เท้า (17.8%) ภาวะแทรกซ้อนที่พบมากที่สุด คือ เฝือกหลวม คิดเป็น 4 เท้า (5.48%) และมีการบาดเจ็บของผิวหนังส่วนตื้นจากเฝือกกดทับคิดเป็น 4 เท้า (5.48%) พบอัตราการผ่าตัดซ้ำครั้งที่ 2 ทำใน 26 เท้า (35.61%) รายงาน 171 เท้า จากผู้ป่วย 115 ราย เป็น ชาย 69 ราย หญิง 46 ราย ได้รับการรักษาแบบผ่าตัดใหญ่โดยวิธีเลาะพังผืดและเนื้อเยื่อ อายุเฉลี่ยของการรักษา 52.05 สัปดาห์ (range 9.86-248.71) พบภาวะแทรกซ้อน 22 เท้า (12.87%) ภาวะแทรกซ้อนที่พบมากที่สุด คือ แผลติดเชื้อ คิดเป็น 9 เท้า (5.26%) รองลงมา คือ เฝือกหลวม คิดเป็น 7 เท้า (4.09%) พบอัตราการผ่าตัดซ้ำครั้งที่ 2 ทำใน 26 เท้า (15.20%)*

สรุป: *ในการศึกษานี้พบภาวะแทรกซ้อนของการรักษาเท้าปุกแต่กำเนิดด้วยวิธีการใส่เฝือกดัดโดยพอนเซนติก 17.8% และที่พบบ่อยที่สุด คือ เฝือกหลวมและมีการบาดเจ็บของผิวหนังส่วนตื้นจากเฝือกกดทับ ส่วนภาวะแทรกซ้อนจากการผ่าตัดใหญ่โดยวิธีเลาะพังผืดและเนื้อเยื่อ พบได้ 12.87% โดยพบแผลผ่าตัดติดเชื้อมากที่สุด*