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## Comparison of ponseti method versus surgical treatment in congenital idiopathic clubfoot: A 5-year follow up study

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### Abstract

**Background:** Congenital idiopathic clubfoot is a complex congenital deformity. The goal of treatment is to achieve pain-free plantigrade feet with good mobility and without deformity. Prior treatment for congenital idiopathic clubfoot included manipulation, serial casting, and major soft tissue release surgically by any of the following techniques: modified posteromedial release, complete subtalar release and posterior release. The objective of this study was to compare the functional outcome between Ponseti method and major surgical treatment.

**Materials and Methods:** This prospective cohort study was conducted in congenital idiopathic clubfoot patients who underwent primary treatment by either Ponseti serial casting or major surgical soft tissue release between 2000 to 2012. Outcome measurements included the Functional Rating System of Laaveg and Ponseti, the talocalcaneal angle (TCA) in antero-posterior (AP) and lateral view radiographs.

**Results:** Nineteen children (28 feet) were treated with Ponseti method and 19 children (30 feet) were treated with major surgery. The minimum follow up was 5.07 years (mean  $5.94 \pm 1.01$  years in the Ponseti group and  $8.73 \pm 2.78$  years in the surgical treatment group). In the last follow up, there was statically significant difference of the mean Functional Rating score between the Ponseti group and major surgery group ( $95.35 \pm 2.31$  and  $89.76 \pm 4.97$ ,  $p < 0.001$ ). There was statically significant difference of the satisfaction score between the Ponseti group and major surgery group ( $20$  and  $18.27 \pm 2.01$ ,  $p < 0.001$ ). The passive motion score was statically significant better in Ponseti group ( $5.79 \pm 1.37$  and  $4.57 \pm 1.45$ ,  $p = 0.003$ ). The mean TCA in AP and lateral views were within normal range in both groups with statically significant better in Ponseti group ( $24.89 \pm 4.83$  and  $21.63 \pm 4.62$ ,  $p = 0.009$  and  $23.46 \pm 4.88$  and  $21.13 \pm 7.96$ ,  $p = 0.013$ ).

**Conclusion:** Ponseti method is effective and satisfactory treatment for congenital idiopathic clubfoot and should be considered as initial treatment for congenital idiopathic clubfoot. Major surgery should be reserved for deformity that cannot be completely corrected.

**Keywords:** Ponseti method, congenital idiopathic clubfoot, talocalcaneal angle

### Introduction

Congenital idiopathic clubfoot is a complex congenital deformity affecting the foot which characterized by equinus, hindfoot varus, midfoot cavus and forefoot adductus. The incidence is approximately 1- 6 cases per 1,000 live births <sup>[1-4]</sup>. It is three times more common in males. The goal of treatment is to achieve pain-free plantigrade feet with good mobility and without deformity <sup>[5, 6]</sup>.

Majority of the patients previously required surgical correction. During the last two decades, the Ponseti method seems to have become the standard treatment of congenital idiopathic clubfoot <sup>[6-11]</sup>.

Prior to 2006 the treatment for congenital idiopathic clubfoot was manipulation, serial casting, and major surgical soft tissue release including modified posteromedial release, completed subtalar release and posterior release. Ponseti method was officially introduced at author's institute hospital since 2006.

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The objective of this study was to compare the Ponseti method to the previous major surgical treatment including functional outcome, radiographic outcome, recurrence rate and complications.

### Materials and methods

This prospective cohort study was conducted in congenital idiopathic clubfoot patients who underwent primary treatment by either Ponseti serial casting or major soft tissue release between 2000 to 2012 at Department of Orthopaedic Surgery, in author's institute hospital.

Patients in the major soft tissue surgical treatment group were treated with manipulation, serial casting by Imhauser technique<sup>[12]</sup> then underwent one or more of the following procedures such as modified posteromedial release, complete subtalar release and posterior release. Patient in the Ponseti group was treated as regimen described by Ponseti. All patients of both groups were followed up for at least five years.

Exclusion criteria included non-congenital idiopathic clubfoot, such as postural clubfoot, neuropathic or another syndromic clubfoot, and incomplete medical data.

The outcome measures used to assess foot function was the Functional Rating System for clubfoot (FRS) of Laagveg and Ponseti<sup>[6]</sup>. This questionnaire consists of three questions regarding the patients' satisfaction (maximum 20 points), function (maximum 20 points) and pain (maximum 30 points). In addition, the examiner evaluates the foot based on the position of heel while standing (maximum 10 points), the flexibility of the foot in dorsiflexion of the ankle, varus-valgus motion of the subtalar joint, and inversion-eversion (maximum 10 points). Finally gait pattern is evaluated (maximum 10 points). The total maximum score is 100 points.

Radiographs of the feet were taken in standard anteroposterior and lateral weight bearing views when the patients were at least five years follow up examination. Anteroposterior and lateral talocalcaneal angle were measured.

The recurrence rate and complications after treatment were evaluated.

For both groups, descriptive statistics were calculated for the FRS total scores and all categories, radiographic parameters, recurrence rate, and complications. The comparison of the FRS total scores and its categories, radiographic parameters, and complications between the two groups was analyzed by nonparametric tests (Mann-Whitney U-tests).

### Results

Total of 58 feet in 38 patients (18 males and 20 females), Twenty-eight (19 patients) were in the Ponseti group and 30 feet (19 patients) were in the surgical treatment group. The minimum follow up time was 5.07 years (mean  $5.94 \pm 1.01$  years in the Ponseti group and  $8.73 \pm 2.78$  years in the surgical treatment group). The mean age at the start of the treatment was  $6.18 \pm 5.08$  weeks in the Ponseti group, and  $7.77 \pm 5.81$  weeks in the surgical treatment group (Table. 1).

When the foot function was evaluated at the age of at least 5 years, patients in the Ponseti group scored higher in the FRS total score ( $p < 0.001$ ) (Table. 2). The FRS category All feet had a plantigrade position when standing and had good function in both groups ( $p = 1.00$  and  $p = 0.14$  respectively). The FRS category for gait was comparable in both groups. For passive motion category of the FRS, passive maximal dorsiflexion, varus-valgus, and inversion-eversion mobility scores were higher in the Ponseti group ( $p = 0.003$ ). None of

the patients in the Ponseti group experienced foot pain. Eight feet (5 patients) in the surgical treatment group reported occasionally mild foot pain during strenuous activities ( $p = 0.004$ ).

For satisfaction category describing the level of caregiver contentment scores, in the Ponseti group were higher than the surgical treatment group ( $p < 0.001$ ). For gait category, all patients in both groups walked normally. However, patients in the Ponseti group can perform toe-walk and heel walk better than surgical treatment group ( $p < 0.001$ ).

For radiographic outcome, the mean AP talocalcaneal angles in both groups were in normal range but significant higher in the Ponseti group when compared to surgical treatment group ( $24.89 \pm 4.83$  and  $21.63 \pm 4.62$  degree respectively,  $p = 0.009$ ). The lateral talocalcaneal angle in both groups were slightly less than the normal range, but significant higher in the Ponseti group ( $23.46 \pm 4.88$  and  $21.13 \pm 7.96$  degree respectively,  $p = 0.013$ )<sup>[13]</sup> (Table. 3).

The recurrence rate in surgical treatment group was higher than the Ponseti group but no statistically significant ( $p = 0.64$ ).

Complications associated with both the Ponseti method and surgical treatment groups are shown in Table 4.

### Discussion

The Ponseti method is now used worldwide to treat congenital idiopathic clubfoot. 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<sup>[14-17]</sup>. Prior to 2006, all congenital idiopathic clubfoot cases treated at our institute 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<sup>[18]</sup>. Some patients were initially treated by serial casting until foot physiology and weight gain were sufficiently adequate for performing major surgery. At our institute, the Ponseti method was adopted as the treatment of choice for this condition in 2006<sup>[18]</sup>.

When evaluating foot function at 5 years after treatment, we observed differences in several categories of the FRS of Laagveg and Ponseti. The parent/patient reported outcome was significantly better after the Ponseti treatment. In their study, the average score was 87.5 compared to  $95.35 \pm 2.31$  points in our Ponseti group.

The category satisfaction describing the level of care giver contentment suggested parents of patients in the Ponseti group were very satisfied with the middle-term outcome, where as parents of patients in surgical treatment group were satisfied or very satisfied. Laagveg and Ponseti evaluated 104 clubfeet and reported 72% very satisfied patients, 19% satisfied, and 4% not satisfied with the long term outcome<sup>[6]</sup>. Because the FRS scores are described to correlate with age, the high score in our study must be interpreted with caution. However, the less invasive character of the Ponseti method without need for wound management and the shorter hospital stay seem to contribute parental satisfaction. The passive mobility category in the FRS revealed better mobility of the feet in dorsiflexion, varus-valgus, and inversion-eversion for the Ponseti group with scores similar to those reported by Laagveg and Ponseti<sup>[6, 11]</sup>. For gait category, all patients in both groups walked normally, but patients in the Ponseti group could perform toe-walk and heel walk better than surgical treatment group.

The AP and lateral talocalcaneal angles are the most widely

used parameters and reflected the anatomic relationship between the talus and the calcaneus. A higher AP talocalcaneal angle was associated with a better functional outcome. This was concurred with several previous studies [19, 20], although many authors have found strong correlation between the functional rating and lateral talocalcaneal angle [19, 21, 22]. In our study, the mean AP and lateral talocalcaneal angles in the Ponseti group were significantly higher than the surgical group.

The complications associated with the treatment were 17.9% in the Ponseti group and 33.3% in surgical treatment group. In the Ponseti group, all of the complications were cast loosening but in the surgical treatment group, the most common complications were cast loosening and cast associated pressure sore. Some studies reported cast

complication rates of 5-20%, which is comparable to the 17.9% in the Ponseti group in our study [18].

In surgical treatment group, the surgical related wound infection was found in 2 feet (6.7%). All of which were treated with wound dressing and oral antibiotics. Some studies reported the surgical related wound infection 5.94-12.8%, which is comparable to the 6.7% in our study [18]. Other complications observed in our study were minor casts complications during manipulation before surgery and after surgery for maintaining the position of the foot.

Regarding second operation for recurrent deformity, some studies reported secondary procedure 2-30.43% [7, 18, 23]. The present study found that 17.9% in the Ponseti group and 26.7% in surgical treatment group required secondary procedure after treatment, which is comparable to our study.

**Table 1:** Demographic data

|  | Ponseti (n=28)        | Major surgery (n=30)       | p-value |
|--|-----------------------|----------------------------|---------|
| Number of patients                     | 19                    | 19                         |         |
| Gender                                 |                       |                            |         |
| Male                                   | 9 (47%)               | 9 (47%)                    |         |
| Female                                 | 10 (53%)              | 10 (53%)                   |         |
| Number of feet                         | 28                    | 30                         |         |
| Side                                   |                       |                            |         |
| Right                                  | 11 (39.3%)            | 14 (46.7%)                 |         |
| Left                                   | 17 (60.7%)            | 16 (53.3%)                 |         |
| Bilateral                              | 9                     | 11                         |         |
| Type of surgery                        |                       |                            |         |
| PMR                                    | -                     | 22 (73.3%)                 |         |
| TAL + posterior release                |                       | 8 (26.7%)                  |         |
| Age at start of cast treatment (weeks) | 6.18±5.08 (1-24)      | 7.77±5.81 (1-20)           | 0.57    |
| Number of casts                        | 5.68±1.7 (2-12)       | 6.4±1.32 (4-9)             | 0.85    |
| Age at percutaneous tenotomy (weeks)   | 33.79±30.79 (11-142)  |                            |         |
| Age at major surgery (weeks)           |                       | 59.95±72.61 (15.57-307.14) |         |
| Follow up time                         | 5.94±1.01 (5.07-8.35) | 8.73±2.78 (5.07-13.95)     |         |

**Table 2:** Laaveg and Ponseti's Functional Rating System for clubfoot

| Category                               | Surgery group n = 30 feet (mean score) | Ponseti group n = 28 feet (mean score) | Mean difference (95% CI) | p-value |
|--|--|--|--------------------------|---------|
| <b>Parent/patient reported outcome</b> |  |  |                          |         |
| Satisfaction (max. 20 pts.)            | 18.27±2.01 (16-20)                     | 20                                     | 1.73 (0.97-2.49)         | <0.001  |
| Function (max. 20 pts.)                | 20                                     | 19.71±1.04 (16-20)                     | 0.28 (-0.66-0.98)        | 0.14    |
| Pain (max. 30 pts.)                    | 28.4±2.69 (24-30)                      | 30                                     | 1.6 (0.57-2.62)          | 0.004   |
| <b>Physical examination/evaluation</b> |  |  |                          |         |
| Heel position (max 10 pts.)            | 10                                     | 10                                     | 0                        | <0.999  |
| Passive motion (max. 10 pts.)          | 4.57±1.45 (2-7)                        | 5.79±1.37 (3-8)                        | 1.21 (0.47-1.96)         | 0.003   |
| Gait (max. 10 pts.)                    | 8.53±1.27 (6-10)                       | 9.86±0.52 (8-10)                       | 1.32 (0.8-1.84)          | <0.001  |
| Total score (max. 100 pts.)            | 89.76±4.97 (78-97)                     | 95.35±2.31 (89-98)                     | 5.59 (3.52-7.65)         | <0.001  |

**Table 3:** Radiographic outcome

|                             | Surgery group n = 30 feet (mean score) | Ponseti group n = 28 feet (mean score) | Mean difference (95% CI) | p-value |
|-----------------------------|--|--|--------------------------|---------|
| AP talocalcaneal angle      | 21.63±4.62                             | 24.89±4.83                             | 3.26 (0.75-5.76)         | 0.009   |
| Lateral talocalcaneal angle | 21.13±7.96                             | 23.46±4.88                             | 2.33 (-1.17-5.83)        | 0.013   |

**Table 4:** Complication associated with treatment

| Complication                  | Surgery group n = 30 feet (%) | Ponseti group n = 28 feet (%) | p-value |
|-------------------------------|-------------------------------|-------------------------------|---------|
| <b>Cast complication</b>      |                               |                               |         |
| Cast loosening                | 4 (13.3%)                     | 5 (17.9%)                     |         |
| Cast-associated pressure sore | 4 (13.3%)                     |                               |         |
| <b>Surgical complication</b>  |                               |                               |         |
| Infection                     | 2 (6.7%)                      |                               |         |
| Recurrence                    | 8 (26.7%)                     | 5 (17.9%)                     | 0.64    |

## Conclusion

Ponseti method is a safe, effective and satisfactory treatment for congenital idiopathic clubfoot and should be considered as initial treatment for congenital idiopathic clubfoot. Open surgery should be reserved for deformity that cannot be completely corrected.

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