

# Family factor, treatment options and evaluation of results in pes equinovarus disease

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**Abstract.** In this study, we analyzed the patients who had applied to Yüzüncü Yıl University Medical Faculty due to pes equinovarus between 2011 and 2013 and treated with the Ponseti method. Thus we evaluated 56 feet of 38 patients in the early-treatment period and the factors affecting the treatment.

All of the patients were systematically examined before and after the treatment. For the feet that had anomaly we used the scale that was used by Dimeglio et.al. Averagely 7.5 plaster casts were applied to the feet of the patients (range: 3-16). In patients with PEV, after the recovery of hindfoot varus and forefoot adduction in 48 feet in which equine deformity, achillotomy operation was applied under local anesthesia with mini open technique. After plastering, Steenbeek orthosis was applied to the feet. Average follow-up time was 14 months (range 5-28 months).

In patients with PEV, the most commonly recurred component was metatarsus adductus. While this rate was 36% in idiopathic PEVs, in complex PEVs it was 83%. The plantigrade walking ratio in patients with idiopathic PEV was 92%. In patients with idiopathic PEV, the compliance with orthosis was 81% whereas in patients with complex PEV it was 33%. In addition to this, except one patient, in all patients with complex PEV recurrence was observed and additional treatments were made for these patients. The final Dimeglio score of the patients with idiopathic PEV was very good in 16 feet, good in 6 feet. On the other hand, in patients with complex PEV, this score was very good in 4 feet, good in 3 feet, and bad in 1 foot.

The most important recurrence reason for PEV was non-compliance with orthosis. The reasons for non-compliance with foot abduction orthosis are as follows: long processing time the negative psychological effects of orthosis on families and considering orthosis as unnecessary since the correction in the feet was seen by the family. The education level of the family is an important risk factor for the development of recurrence. In this sense, it was determined that the recurrence risk was 10 times higher in the families whose education level was high school and below in comparison to the families with university degree.

We achieved success at a rate of 92% in manipulation and plastering treatment of PEV which was materialized by Ponseti method. The most important factor affecting the treatment was the continuity of the treatment and the compliance with orthosis.

Key words: PEV, ponseti method, aschillotomy, dimeglio score

## 1. Introduction

Pes equinovarus (PEV) is the most common pediatric congenital foot deformity which was known since Hippocrates. It requires intense orthopedic treatment starting from birth. There have been many studies on it and various treatment methods were applied to this disease (1, 2). There are three main components of PEV:

- Adduction of forefoot and midfoot (Varus-metatarsus adductus)
- Hindfoot varus
- Equine deformity (Achilles shortness)

Frequently, cavus deformity accompanies these three components; however, in some cases there are internal tibial torsion (2).

According to etiology, PEV is studied in four groups: congenital, teratological, a part of a syndrome and positional. Every year one hundred thousand children with PEV come into the world. Most of these cases are unfortunately seen in developing countries like our country and due to omissions a part of them becomes permanently disabled (3).

In all conservative and surgical methods applied in the treatment of PEV the aim is obtaining a foot which plantigrade walking and is painless. The conservative methods are manipulation by hand, bandaging, plastering, application of orthosis and physiotherapy methods which are known as French methods that include long term passive exercises (4). Surgical methods are soft tissue operations, bone

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Fig. 1. A patient to whom plaster cast was applied.



Fig. 2. Achillotomy with mini open technique.

operations, or combined operations that include both.

The idea that only slight deformities could be corrected conservatively had led orthopedists to surgical options. However, in time the complications of surgical treatments have been seen and thus the orientation for conservative treatments have increased (5, 6).

Many surgical and non-surgical methods in the treatment of PEV were published up to now (7, 8). There are still debates about these various methods regarding correcting the deformity; however, the method which had the best long term results has been reported by MD Ignacio Ponseti. In this study, we will look at patients who were treated with the Ponseti method and we will evaluate their characteristics, family factor and the factors that affect short-term treatment results.

## 2. Materials and Methods

In this study, we analyzed the patients who had applied to Van Yüzüncü Yıl University Medical Faculty due to pes equinovarus between 2011 and 2013 and treated with Ponseti method. Thus we evaluated 56 feet of 38 patients in the early-treatment period and the factors affecting the treatment.

All of the patients were systematically examined before and after the treatment. For the feet with PEV, PEV evaluation scale that was used by Dimeglio et.al was used. The patients who were treated somewhere else and whose diseases were recurred or patients with complex PEV (the ones who also have diseases like spina bifida or hydrocephalus) and primary PEV patients were included in the study. The type 1 patients whose deformities were mild were

excluded from the study. The plaster cast was applied to the patients by using the Ponseti method (Figure 1). The plastering was repeated every week ya da plaster casts were changed weekly.

After correcting foot adduction and hindfoot varus, in the feet that equine deformity achillotomy operation was applied with percutan mini incision in the operation room under local anesthesia (Figure 2).

The last casting was applied for three weeks. Than Steenbeek orthosis was applied after removal of the cast. The width of bar was arranged at the width of shoulder opening. The used shoes were peep toe and the suitability of the shoes was controlled before it was put on (Figure 3).



Fig. 3. A patient who we follow-up in Steenback orthoses.

The family was informed that the orthosis would be used day and night for three months and then it would be put on only nights for 3 years. Also the importance of the compliance with

orthosis was explained to all families. In this context, they were told that the most common reason for recurrence was orthosis non-compliance. After the application of plaster cast, the patients were invited for control at the 3<sup>rd</sup> week, 3<sup>rd</sup> month and then in every 6 months in order to see orthosis compliance and treatment evaluation. For the last evaluation the patients called a few times and then the last examinations were performed. The orthosis compliance was learned from the family by asking. In the examination, the patients' plantigrade walking and forefoot adduction were evaluated and the Dimeglio scoring was re-determined.

After evaluating the patients, statistics were made on the predetermined variables. The defining statistics in terms of stressed characteristics were expressed as percentage. The significance level was set at 5% and the calculations were made by the statistics package program, SPSS (version: 16). In addition to this, in order to determine whether the orthosis compliance changes according to the groups or not Chi-Square test was made.

### 3. Results

Of the 38 patients with PEV, 8 were female, 30 were male. Among them 29 had idiopathic and 9 had complex PEV. Average final examination duration was 16 months (range 5-42 months). Average follow-up time was 14 months (range 5-28 months). In 20 patients there was unilateral PEV and in 18 patients there was bilateral PEV.

PEV degree of our patients before the treatment according to the Dimeglio classification: 43 feet of 29 patients were Grade 3, 8 feet of 6 patients were Grade 4, and 5 feet of 3 patients were Grade 2 (Figure 4-5). Two of our patients died due to other reasons during the treatment.



Fig. 4. The appearance of the foot in a patient with PEV grade 3.

There was affinity in between parents of 16 patients (42%). There were PEV stories in 2 (5%) of our patients' siblings and in the second degree relatives of 14 patients (37%) there was PEV cases. The average sibling number was 3.2 (min. 1, max. 7). In all of the cases, the sick child was the last child.

The education level of the patients' parents was as follows: 24 (63%) mothers and 8 (20%) fathers have never gone to school and they were not even literate. 11 (29%) mothers and 26 (68%) fathers were graduated from primary education. 2 (5%) mothers and 2 (5%) fathers were graduated from high school and 1 (2%) mother and 2 (5%) fathers had a university degree. Except 1 (3%) mother (she was a nurse), all of the mothers (97%) were housewives. 4 (10.5%) of the fathers were state officials and 34 (89.5%) of them were self-employed. The mean age of mothers was 26.7 (range: 18-40) and the mean age of fathers was 30.8 (range 18-50).

In one patient, convulsion was seen as a complication depending on local anesthesia which was performed for percutaneous achillotomy.

The average plaster cast number performed in these patients was 7.5. Achillotomy was applied to 48 feet of 30 patients. 8 feet of 6 patients completely corrected without performing achillotomy. In one patient who had unilateral resistant deformity Turko operation was performed and the deformity was corrected. These patients were averagely followed up for 14 months (max.28; min.5). 9 of our patients received treatment in other places or had complex PEV which was seen along with the diseases like meningomyelocele. These patients were treated similar to the patients with idiopathic PEV by adhering to the Ponseti method. The average



Fig. 5. The appearance of the foot in a patient with PEV grade 4.

number of performed plaster casts was 10.8 in patients with complex PEV. In 5 of the patients with complex PEV, achilloplasty and posterior release operation was performed in patients with metatarsus adductus and equinus deformity. In one patient Turco operation was performed since there was resistance regarding correction and disagreement with the family about the treatment. These patients were averagely followed up for 16.6 months (max. 24, min 10 months). Among these patients three of them did not continue participating in the controls. Except one patient, various deformities recurred in other patients.

Our patients were classified into two groups considering their application reason (primer or recurrence) for the hospital. The patients who primarily applied to us and received treatment in our clinic were categorized as Group I. The patients who started their treatments in other medical centers, then discontinued their treatment and so applied to our clinic, and the ones who applied to us because of the reasons like meningomyelocele or arthrogryposis were categorized as Group II. There were 16 patients in Group I, and 6 patients in Group II. The final examinations of these patients were performed and deformities were searched according to the compatibility with orthosis. In Group I, 12 out of 16 patients, in Group II, 3 out of 6 patients were completely compatible with orthosis.

Only one patient (Group II) could not walk plantigrade and was walking by stepping on the lateral column of the foot. It was determined that the Dimeglio score of this patient before the treatment was 20 and the start-up age for the treatment was 4 months. Also it was seen that orthosis was non-compatible and the patient did not come to the controls. In the patient's last examination, the Dimeglio score was specified as 14.

In patients with primer idiopathic PEV, the number of patients who was compatible with the treatment was 23 (88.5%). In patients with complex PEV in which recurrence and additional diseases was seen, the number of patients who was compatible with the treatment was 3 (11.5). It was determined that the difference in the rate

of compatibility with the treatment was statistically significant among the groups (p=0.002).

The rate of incidence for metatarsus adductus which is the most common recurrent component was 36% in Group I and 83% in Group II (Table 1).

The last Dimeglio score of the patients with idiopathic PEV was very good in 16 feet and good in 6 feet. In patients with complex PEV this score was very good in 4 feet, good in 3 feet and bad in 1 foot.

While the average age of the patients with idiopathic PEV was 3.7 months, the average age of the patients with complex PEV was 12.7 months and it was statistically significant (p: 0.002). No significant difference was found between the patient's age at the time s/he applied for the treatment and the final Dimeglio score. Achillotomy was performed on 72% of the patients with idiopathic PEV, on 90% of the patients with complex PEV. 10.7% of the patients with idiopathic PEV was grade 2, 82.1% of them was grade 3, 7.1% of them was grade 4. 50% of the patients with complex PEV was grade 3, 50% of them was grade 4. This rate was statistically significant (p: 0.009). There was not compliance with the treatment in 41% of the patients with idiopathic PEV and in 58% of the patients with complex PEV. This rate was statistically significant (p: 0.002).

No statistically significant difference was found between the last Dimeglio score and the parental education level. However a statistically significant difference was found between the last Dimeglio score and compliance with the treatment (p: 0.02). The last Dimeglio score of 80% of the patients who were compliant with the treatment was excellent.

#### 4. Discussion

Ponseti method was developed in the 1940s. In 1980, Ponseti defined success rate that rose up to 89% basing on his follow-ups for 30 years and his method attracted attention. Nonetheless, this method has had repercussions with the publication of long term results by Cooper and

Table 1. The relationship of treatment compatibility and recurrence in patients with PEV, Group I and Group II

	Compatible with the Treatment		Non-compatible with the Treatment		Total	
	Group I	Group II	Group I	Group II	Group I	Group II
Number of Patients	12(75%)	3 (50%)	4 (25%)	3 (50%)	16 (73%)	6 (27%)
Non-recurrent	7 (58%)	1 (33%)	-	-	7 (9%58)	1 (33%)
Metatarsus adductus	5 (41%)	2 (33%)	4 (100%)	3 (100%)	9 (56%)	5 (83%)

Deitz in 1995 (9, 10). The failure of the surgical treatments increased the interest in the Ponseti method. Towards the end of the 1990s the method was started to be used commonly world-wide. In our country it was used by Dr. Bursalı for the first time in 1997 (11).

The initial correction speed was reported as 100% by Herzenberg et.al., as 98% by Morcuende et.al, as 98% by Tindall et.al. and as 95% by Colburn and Williams (12-14). In this study, our initial correction speed (100%) was in compliance with the data in the literature. In our study, the average casting number applied to the patients was found as 7.5. While the average number of casting in patients with idiopathic PEV was 6, this number was 10.8 in patients with complex PEV. When we look at the literature, we linked the high quantity in our casting number to the discordant attitudes of our patients at the initial stage. They did not regularly come to the controls and this caused an increase in the number of casting. Ponseti have reported that recurrence could be blocked in 50% of the patients by careful observation and families' compatibility with the treatment. He indicated that recurrence could be seen in the other 50% of the patients with an average of 2.5 years old (10 months-7 years old). While 28 of our patients had idiopathic PEV, 10 of them had complex PEV. The average age of the patients was 3.7 months in idiopathic PEV cases and 12.7 months in complex ones and they were found as statistically significant (p: 0. 002).

It has been reported that the recurrences mostly occurred in the hind foot, equine and varus deformities developed and usually no recurrence was seen in forefoot adduction and cavus deformity (17, 18). In our case, we saw that the recurrence mostly developed in forefoot and

midfoot. This was linked to the non-compatibility of the patients with orthosis.

In this study, in the last control of the patients with idiopathic PEV, in two recurred patients the recurrence of cavus deformity was seen along with the recurrence of all deformity. These patients were the ones who dropped out of the treatment and who were non-compatible with orthosis. In 56% of the patients with idiopathic PEV forefoot adduction was determined (Figure 6). In 6 patients (36%) out of 16 who were compatible with orthosis and in 6 patients (85%) out of 7 who were non-compatible with the orthosis we saw that there was forefoot adduction.

Varol et.al observed that in patients who were treated with the Ponseti method, the ones who were non-compatible with orthosis needed more additional treatment interventions in comparison to the ones who were compatible with orthosis (19). In our study, the difference between the rate of incidence for forefoot adduction in patients who were compatible with orthosis and who were non-compatible with orthosis was not statistically significant. We explained this situation by basing on our low patient quantity. We determined that in patients with idiopathic PEV, plantigrade walking was at a rate of 87% (Figure 7).

It was seen that in all patients with PEV, all deformity was corrected at the end of the first treatment; however, except one patient, we applied additional plaster treatment to all our patients due to recurrence. The recurrence was not very severe. Despite this, the emergence of recurrence caused a decrease in families' belief in the treatment. This loss of belief resulted in discontinuity in controls more than the others.

In 1963, Ponseti and Smoley have reported initial success at a rate of 83% and recurrence



Fig. 6. Forefoot adduction.



Fig. 7. The patients with plantigrade walking.

more than 50%. However they stated that between 1991 and 2001 the initial success rate of 157 patients (256 feet) was 98% and recurrence was at a rate of 11%. They explained the increase in their success rate with the hyperabduction which was obtained in the last casting and strict obedience to the principles of orthosis use (15, 20-23).

In all conducted studies related to PEV, the most important criteria were getting successful results with Ponseti method and the compliance with the foot abduction orthosis in order to prevent recurrence. There was not a consensus on the required time for the continuity of the reduction which was obtained after casting; however Ponseti have recommended the use for 3-4 years.

In our patients, the most important recurrence reason for PEV was non-compliance with orthosis. The reasons for the non-compliance with foot abduction orthosis were long application time, the negative psychological effect of orthosis on families and considering orthosis as unnecessary since the correction in the feet was seen by the family.

In a study conducted by Dobbs et.al, it has been reported that the education level of the family was an important risk factor for the development of recurrence. Also it has been determined that the recurrence risk was 10 times higher in the families whose education level was high school and below in comparison to the families with university degree (17). In our study these factors did not pose a statistically significant difference and we believe that this depends on the constraint in number of patients and regional socio-cultural structure.

We have reached success at a rate of 91% in 54 feet of 38 patients during the follow up for 14 months. PEV's etiology is multifactorial and similarly the success of its treatment is multifactorial. In our country and in the world, the Ponseti method is considered as the most common and successful treatment technique in correcting idiopathic PEV if all of its principles are applied.

In the Ponseti method, the most important shortage is the hardship of compliance with Steenbeek orthosis which is used after casting treatment. The factors that affect this compliance vary and change in relation to regional, cultural and economic characteristics. We confirmed that in our patients who were non-compatible with orthosis, the rate of recurrence was high. Mostly, the recurrences which emerged due to the non-compliance with orthosis were the deformities that could be corrected by surgical interventions.

Also, informing patients related to PEV and showing the results and photos of the PEV cases that were previously neglected have dramatically increased the compatibility with the treatment.

In line with the data obtained from this study, it has been seen that the Ponseti method was a quite influential treatment method in both patients with idiopathic and complex PEV even if its success depends on many factors.

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