



## Assessment of early Achilles tenotomy in the newborn idiopathic pes equinovarus

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We aimed to evaluate the clinical and radiological results of early Achilles tenotomy which was performed before Ponseti method in PEV deformities. 37 feet of 26 patients with Dimeglio type 3 and 4 deformities were included in the study. Unlike the classical Ponseti method, patients underwent a mini-open Achilles tenotomy before the first cast. 6-month follow-up of the foot deformities were assessed using Dimeglio classification clinically and lateral talocalcaneal and tibio-calcaneal angles radiologically. There were 20 male and 6 female patients with the median age of 14 days (4-37 days) and 11 bilateral and 15 unilateral deformities. The average follow-up period was 7 months (6-12 months). The mean Dimeglio scores before the Achilles tenotomy and Dimeglio score at the 6<sup>th</sup> month follow-up were 14 (11-16) and 4 (4-6) for the right feet, 13 (10-16) and 4 (4-6) for the left feet respectively. The mean number of casting was  $3.8 \pm 0.4$  for right feet and  $3.7 \pm 0.4$  for left feet. The mean talocalcaneal angle was  $24 \pm 8.2$  degrees for the right feet and  $27 \pm 8.2$  degrees for the left feet. The mean tibio-calcaneal angle was  $69 \pm 12$  for the right feet and  $72 \pm 14$  degrees for the left feet. Early Achilles tenotomy can decrease the total number of cast for deformity correction in Ponseti method and provide good clinical and radiological outcomes at 6<sup>th</sup> month follow-up in severe PEV deformities according to Dimeglio classification.

**Keywords:** pediatric foot deformities; clubfoot; pes equinovarus; Achilles tenotomy; Ponseti method.

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## INTRODUCTION

Since the Ponseti method revolutionized pes equinovarus (PEV) treatment and brought conservative treatment into the forefront, all orthopaedists agree that the first step of PEV treatment is manipulation with serial casting (1-4). Although Ponseti method avoids early surgery in majority of cases, which can result in excessive scarring and stiffness, resistance to serial casting and relapsing still remain as main problems today (5-7). In order to prevent these problems from occurring, Achilles tenotomy and bracing were combined with treatment regime (3,4,8-10).

Achilles tenotomy is usually performed before the last cast to improve equinus correction. However, it is not clearly indicated in the literature, how an earlier performed Achilles tenotomy affect the correction process of PEV. A preliminary report

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was presented by Ghanem et al. who obtained better correction results with early Achilles tenotomy (11). They compared the patients according to technical difficulty, the amount of bleeding contaminating the cast, and the early and late complications. They found better results of the cases undergoing early Achilles tenotomy than the classical Ponseti method (11).

Based on our literature review, instead of the preliminary report of Ghanem et al. (11), there are no studies evaluating the clinical results of early Achilles tenotomy technique in patients with PEV according to Dimeglio Classification preoperatively and postoperatively, indicating how many casts were made in these cases and reporting the radiological results of these cases.

The aim of this study is to investigate the effect of early (pre-cast) Achilles tenotomy on neonates with type III and type IV (idiopathic) PEV deformity treated with Ponseti method, and how it affects the clinical, radiological parameters and the number of casting needs the deformity to be corrected.

## MATERIALS AND METHODS

Ethics committee approval (16969557-1133) was obtained from our institution and written consent from the families of the cases. 43 feet of 30 patients with type III and type IV PEV deformity according to Dimeglio classification who were not treated before admission to our clinic were determined between the dates from 2017 to 2019 and reviewed retrospectively. Patients with absent radiographs and loss of follow-up were excluded from the study and 37 feet of 26 patients were included in the study. All body examinations were performed and secondary causes such as teratologic PEV were also not included in the study. Foot deformities were evaluated and recorded according to the examination form prepared with reference to the classification system defined by Dimeglio et al (12).

Unlike the classical Ponseti method, all of the patients underwent a mini-open Achilles tenotomy under local anesthesia before the first cast in the operating room. Subsequent castings were performed at 7-day intervals in accordance with the

mentioned Ponseti method. After the removal of the cast each week, the feet were evaluated according to the Dimeglio classification and noted. Final cast for complete correction was performed on patients with recovered cavus, adductus and heel varus and lasted for 3 weeks. Abduction splint was applied to the feet after removal of the final cast. Splints were applied to both feet at 70 degrees of abduction in patients with bilateral involvement and at 70 degrees of abduction on the involved side and 40 degrees of abduction and 15 degrees of dorsiflexion on the intact side in patients with unilateral involvement. The bar width of the abduction splint was adjusted at the shoulder opening distance. Patients were advised to use the splint continuously for 16 weeks (4 months) day and night (full time), and then continuously during bedtime and 4 hours (part time) during the day (13). Foot and general body examinations were repeated at each follow-up session. Lateral talocalcaneal and tibiocalcaneal angle measurements with maximum dorsiflexion were performed and recorded after lateral foot X-rays in children for whom the families who accepted and gave consent for X-ray at the 6<sup>th</sup> month. All measurements were performed by a trained pediatric orthopedic fellow. We were not able to obtain talocalcaneal angle from dorsoplantar weight bearing radiographs (Kite angle) as infants were not able to bear weight at 6 month of age. Talocalcaneal angle were defined as the angles between the lines drawn from the axis of talus and calcaneus and tibiocalcaneal angle between tibia and inferior border of calcaneus (14) (Figure 1).

## RESULTS

The mean age of the patients at the time of Achilles tenotomy was 14 days (4-37 days). 20 patients

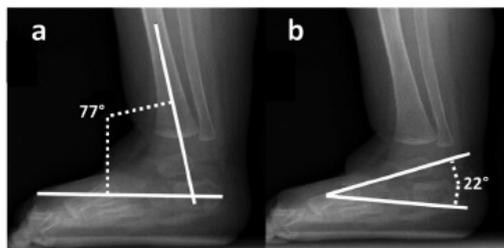


Figure 1. — Measurement of lateral tibiocalcaneal (a) and talocalcaneal (b) angles.

Table 1. — Data of all patients at the time of admission to our hospital

Patient No	Side	Starting Time of Treatment (day)	Preoperative Dimeglio Score (24)	Preoperative Dimeglio Score (Left)
1	Bilateral	18	14	16
2	Left	9		13
3	Bilateral	19	15	16
4	Left	23		12
5	Right	14	15	
6	Right	7	16	
7	Left	27		15
8	Bilateral	11	13	13
9	Left	10		13
10	Right	37	13	
11	Bilateral	4	15	15
12	Left	8		14
13	Bilateral	9	14	10
14	Bilateral	21	13	14
15	Bilateral	8	15	15
16	Right	4	16	
17	Bilateral	13	15	14
18	Left	9		15
19	Bilateral	14	15	15
20	Bilateral	11	15	15
21	Right	16	15	
22	Left	10		14
23	Right	14	15	
24	Left	4		15
25	Bilateral	24	11	11
26	Left	9		12

were male and 6 were female. Mean follow-up period was 7 months (6-12 months). 11 patients had bilateral deformity and 15 had unilateral deformity. Demographic data and preoperative Dimeglio scores were given at Table 1.

The mean Dimeglio score before the first casting and Achilles tenotomy was 14 (11-16) for the right

feet and 13 (10-16) for the left feet. Dimeglio scores before second, third and fourth castings were 6, 5, 4 and 4 for the right feet and 6, 4, 4 and 4 for the left feet, respectively (Figure 2). Dimeglio scores at 6<sup>th</sup> month were 4 (4-6) for the right feet and 4 (4-6) for the left feet. Summary of final scores according to Dimeglio classification were given at Table 2.



Figure 2. — Time dependent Dimeglio Scores of the patients.

Table 2. — 6<sup>th</sup> month clinical evaluation according to Dimeglio classification

	Number of feet
Excellent	35
Good	2
Inadequate	0
Poor	0

Table 3. — Tibiocalcaneal and talocalcaneal angle results of both side of the deformities at 6<sup>th</sup> month follow-up

	Tibiocalcaneal	Talocalcaneal
Right feet	69 ± 12	24 ± 8
Left feet	72 ± 14	27 ± 8

The mean number of castings was 3.8 (3-4) for the right feet and 3.7 (3-4) for the left feet. None of the deformities required more than four castings.

The mean 6<sup>th</sup> month talocalcaneal angle was 24.8 ± 8.7 degrees for the right feet and 27 ± 8.2 degrees for the left feet. Mean 6<sup>th</sup> month tibiocalcaneal angle was 69.1 ± 12.9 degrees for the right feet and 72 ± 14 degrees for the left feet (Table 3).

During the follow-up, we learned that one patient and its family had orthosis adaptation problems and did not use the orthosis. We found a deterioration in Dimeglio score in this patient after the last cast. One patient developed more venous bleeding than expected after Achilles tenotomy, and one patient developed a wound complication due to cast compression in the popliteal region.

Both complications healed without additional intervention.

## DISCUSSION

When Ponseti reported a success rate of nearly 90% in a 30-year follow-up study with his method, it replaced the routine surgical methods with higher complication and failure rates (6,15-17). Surgery is still in use in recurrence and failure of conservative treatment. Thus, increasing the success rates of Ponseti method is critical to avoid recurrence and surgery. Achilles tenotomy was recommended by Ponseti in resistant cases without wasting time if adequate improvement cannot be achieved (18). Ponseti and other authors did not specify any certain time for the Achilles tenotomy and the decision was left to the orthopaedic surgeon depending on how much improvement he or she observes. However, routine use of Achilles tenotomy is almost always performed after third or fourth cast and the minimum number of cast required for deformity correction is 5 or more (17,19-21). This the first study that publishes the results of early Achilles tenotomy in the literature with radiological and clinical scores.

In the present study, we did not apply more than four casts in any case. Generally, after the second or third casts, we achieved adequate improvement in cavus, adductus, and heel varus, and applied the three-week final correction casts to our patients. The average number of cast was 3.8 ± 0.4 for right feet and 3.7 ± 0.4 for left feet and we did not observe any loss of foot function in any of our patients during follow-up after Achilles tenotomy. These results showed that early Achilles tenotomy can decrease the average number of casting required to correct the deformity and ease the correction process via preventing the deforming effect of the Achilles tendon.

In a report including 140 patients, Ghanem et al. performed classical Ponseti method to half of the patients and casting after early achillotomy to the other half. They compared the cases according to technical difficulty, postoperative bleeding, long and short-term complications. They reported that the results of early achillotomy were more successful. However, they did not discuss the average number

of castings and radiological results and that report has not been published elsewhere in the literature (11).

The results of the present study included the data in the first six months of all patients. In type III and type IV patients according to the Dimeglio Classification, early Achilles tenotomy is easier to perform compared to our previous experiences since the Achilles tendon can technically be palpated more easily in the early period. We performed manipulations and castings easier after early Achilles tenotomy and the rapid improvement in Dimeglio scores even after the first cast corroborates our experience. Excellent results according to Dimeglio classification were obtained almost every feet at 6<sup>th</sup> month (Table 2). Radiological measurements of mean lateral tibio-calcaneal angle was also very close to normal range of infants with even normal feet at 6<sup>th</sup> month follow-up and lateral talocalcaneal angle were within normal ranges of infants with normal feet (22, 23).

We preferred the mini-open technique as it assures to cut the entire Achilles tendon without increasing complication rates. MacNeille et al. retrospectively examined 63 feet of 41 patients with PEV deformity who underwent mini-open Achilles tenotomy between 2008 and 2015. They stated that the average number of casts required for PEV correction was 5.2. They did not present the radiological data in the results of this study (24).

The main limitations of our study was its retrospective nature, the lack of a control group and low number of patients. Our study included only type III and type IV PEV patients according to Dimeglio classification and it is not clear whether early Achilles tenotomy is needed in mild patients. We also do not know whether early Achilles tenotomy provide better results in the long term follow-up.

## CONCLUSION

Early Achilles tenotomy at the beginning of Ponseti method decreased the total number of cast and provided good clinical and radiological outcomes at 6<sup>th</sup> month follow-up in severe deformities according to Dimeglio classification. We obtained lower complication rates, improved de-

formity correction and reduced the cost of the treatment in terms of cast and hospital admission. Randomized control studies are required for further evaluation of long term results.

## REFERENCES

1. Ponseti IV, Campos J. The Classic: Observations on Pathogenesis and Treatment of Congenital Clubfoot. *Clin Orthop Relat Res.* 2009;467(5):1124-32.
2. Jowett CR, Morcuende JA, Ramachandran M. Management of congenital talipes equinovarus using the Ponseti method: a systematic review. *J Bone and Joint Surg Brit* 2011;93(9):1160-4.
3. Ponseti IV, Smoley EN. The classic: congenital club foot: the results of treatment. 1963. *Clin Orthop Relat Res.* 2009;467(5):1133-45.
4. Ponseti IV, Smoley EN. Congenital Club Foot: The Results of Treatment. *JBJS.* 1963;45(2):261-344.
5. Dimeglio A, Canavese F. Management of resistant, relapsed, and neglected clubfoot. *Current Orthopaedic Practice.* 2013;24:34-42.
6. Laaveg SJ, Ponseti IV. Long-term results of treatment of congenital club foot. *The J Bone and Joint Surg Am.* 1980;62(1):23-31.
7. Morcuende J, Dolan L, Dietz F, Ponseti I. Radical Reduction in the Rate of Extensive Corrective Surgery for Clubfoot Using the Ponseti Method. *Pediatrics.* 2004;113:376-80.
8. Alves C. Bracing in clubfoot: do we know enough? *J Child Orthop.* 2019;13(3):258-64.
9. Morcuende JA, Abbasi D, Dolan LA, Ponseti IV. Results of an accelerated Ponseti protocol for clubfoot. *J Pediatr Orthop.* 2005;25(5):623-6.
10. Tuhanoğlu Ü, Oğur HU, Seyfettinoğlu F, Çiçek H, Tekbaş VT, Kapukaya A. Percutaneous achillotomy in the treatment of congenital clubfoot: should it be performed in the operating theater or the polyclinic? *J Orthop Surg Res.* 2018;13(1):155.
11. Ismat Ghanem ES, Ayman Assi. Serial Casting for Stiff Clubfoot According to Ponseti: The Timing of Achilles Tendon Tenotomy. *Journal of Children's Orthopaedics.* 2016;10: S9-S80:S73.
12. Diméglio A, Bensahel H, Souchet P, Mazeau P, Bonnet F. Classification of clubfoot. *J Pediatric Orthop.* 1995;4(2): 129-36.
13. Zions LE, Dietz FR. Bracing following correction of idiopathic clubfoot using the Ponseti method. *J Am Acad Orthop Surg.* 2010;18(8):486-93.
14. Radler C, Manner HM, Suda R, et al. Radiographic evaluation of idiopathic clubfeet undergoing Ponseti treatment. *J Bone and Joint Surg Am.* 2007;89(6):1177-83.
15. Cooper DM, Dietz FR. Treatment of idiopathic clubfoot. A thirty-year follow-up note. *J Bone and Joint Surg Am.* 1995;77(10):1477-89.

16. Sanghvi AV, Mittal VK. Conservative management of idiopathic clubfoot: Kite versus Ponseti method. *J Orthop Surg (Hong Kong)*. 2009;17(1):67-71.
17. Halanski MA, Davison JE, Huang JC, Walker CG, Walsh SJ, Crawford HA. Ponseti method compared with surgical treatment of clubfoot: a prospective comparison. *J Bone and Joint Surg Am*. 2010;92(2):270-8.
18. Ponseti IV. Common errors in the treatment of congenital clubfoot. *Int Orthop*. 1997;21(2):137-41.
19. Terrazas-Lafargue G, Morcuende JA. Effect of cast removal timing in the correction of idiopathic clubfoot by the Ponseti method. *Iowa Orthop J*. 2007;27:24-7.
20. Evans A, Chowdhury M, Rana S, Rahman S, Mahboob AH. 'Fast cast' and 'needle Tenotomy' protocols with the Ponseti method to improve clubfoot management in Bangladesh. *J Foot Ankle Res*. 2017;10(1):49.
21. Kampa R, Binks K, Dunkley M, Coates C. Multidisciplinary management of clubfeet using the Ponseti method in a district general hospital setting. *J Child Orthop*. 2008;2(6):463-7.
22. Noh H, Park S-S. Predictive factors for residual equinovarus deformity following Ponseti treatment and percutaneous Achilles tenotomy for idiopathic clubfoot. *Acta Orthop*. 2013;84.
23. Ippolito E, Fraracci L, Farsetti P, De Maio F. Validity of the anteroposterior talocalcaneal angle to assess congenital clubfoot correction. *AJR Am J Roentgenol*. 2004;182(5):1279-82.
24. MacNeille R, Hennrikus W, Stapinski B, Leonard G. A mini-open technique for Achilles tenotomy in infants with clubfoot. *J Child Orthop*. 2016;10(1):19-23.