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Achilles Tendon Release in Clubfoot: Radiological Comparison of Needle and Scalpel Techniques

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Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Background: Achilles tenotomy is the final and most critical step of the Ponseti method for correcting equinus deformity in idiopathic congenital talipes equinovarus (CTEV). The procedure can be performed using either a needle or a scalpel; however, it remains uncertain whether these 2 percutaneous techniques provide different levels of tendon relaxation and radiological correction.

Material/Methods: This retrospective study included 130 feet of 90 patients with CTEV treated by the Ponseti method between January 2022 and December 2024. Patients underwent percutaneous Achilles tenotomy either with a 16-gauge needle under topical anesthesia or with a No. 15 scalpel blade under general anesthesia. Only patients with at least 1 year of follow-up were included. Lateral foot radiographs obtained in maximum dorsiflexion at 1 year postoperatively were used to measure the tibiocalcaneal, talocalcaneal, and talo–first metatarsal angles. Maximum ankle dorsiflexion was measured with a goniometer. The results were compared between the 2 tenotomy groups and with the unaffected feet of the same patients.

Results: No significant differences were observed between the needle and scalpel groups in any radiological parameter or in maximum dorsiflexion ($P>0.05$). Compared with the unaffected feet, the tibiocalcaneal angle was significantly higher ($P<0.001$), while the talocalcaneal angle was significantly lower ($P<0.001$), in both tenotomy groups. The talo–first metatarsal angle showed no significant difference ($P=0.099$).

Conclusions: The 2 techniques – percutaneous Achilles tenotomy with a needle and with a scalpel – provided comparable radiological and functional outcomes. Although clinical correction is satisfactory, persistent differences in tibiocalcaneal and talocalcaneal angles suggest that mild structural deviations may remain despite successful treatment.

Keywords: Achilles Tendon • Clubfoot • Comparative Study • Orthopedics • Radiography • Tendon Release • Tenotomy

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Introduction

Idiopathic congenital talipes equinovarus (CTEV) is one of the most common congenital foot deformities, and if not treated in the early stages, it can lead to permanent functional or cosmetic problems. Today, the Ponseti method is regarded as the most effective and reliable approach for correcting this deformity [1,2]. However, only a few decades ago, the treatment of CTEV commonly involved extensive soft-tissue releases and comprehensive surgical procedures. Such operations often resulted in long-term complications, such as stiffness, pain, and recurrence [3,4]. With the introduction of the Ponseti method, the treatment approach has changed substantially. Through serial casting and, when necessary, minimally invasive Achilles tenotomy, it has become possible to achieve better physiological and functional outcomes [5,6]. Nevertheless, even today, resistance to serial casting and relapse remain challenging issues in some cases [7]. One of the main reasons for this is thought to be insufficient relaxation of the Achilles tendon [8]. The Achilles tenotomy, which constitutes the final step of the Ponseti protocol, is therefore important for achieving complete correction of the equinus deformity and sufficient dorsiflexion [9].

The Achilles tenotomy, which is the final step of the Ponseti treatment protocol, is one of the most critical stages in the correction of equinus deformity. Today, this procedure is performed using 2 main techniques: percutaneous tenotomy with a scalpel and percutaneous tenotomy using a needle. The primary goal of both methods is to achieve adequate relaxation of the Achilles tendon, thereby restoring full dorsiflexion of the foot. Needle-assisted tenotomy has become increasingly preferred in recent years, as it allows for a smaller skin incision, can be performed under local anesthesia, involves minimal bleeding, and has been associated with lower complication rates [10,11]. In contrast, percutaneous Achilles tenotomy with a scalpel is still preferred by some clinicians, as it provides direct visualization and greater control for the surgeon [12]. In the literature, the number of studies directly comparing the clinical and radiological outcomes of these 2 techniques is limited. However, studies evaluating procedures with similar surgical principles have reported that open (limited-open) and percutaneous approaches yield largely comparable clinical results, with differences mainly observed in parameters such as operative time, healing rate, and the extent of soft-tissue trauma [13,14].

Lateral foot radiographs play an important role in the objective assessment of deformity correction after treatment in patients with CTEV. In particular, the tibiocalcaneal, talocalcaneal, and talo–first metatarsal angles measured on radiographs taken in dorsiflexion provide valuable information regarding foot biomechanics and the quality of correction. In general, a tibiocalcaneal angle below 85° is considered normal, while a talocalcaneal angle ranging between 25° and 40° is regarded as the ideal range for anatomical alignment [14,15]. Improvements in these angles reflect the adequacy of the performed Achilles tenotomy and indicate successful correction of the equinus deformity. Several studies have suggested that measurements obtained in dorsiflexion, particularly changes in the tibiocalcaneal angle, best demonstrate the functional relaxation of the Achilles tendon. Therefore, radiographic measurements are considered an objective and reliable criterion not only for assessing the degree of deformity correction but also for evaluating the effectiveness of the tenotomy technique applied [16,17].

The choice of Achilles tenotomy technique can vary depending on the surgeon's experience, preferences, and patient characteristics. However, the current literature lacks sufficient data to determine whether Achilles tenotomies performed with a needle or a scalpel differ in terms of radiological or functional outcomes. This limitation has led to variations in the protocols adopted by different centers and has made it difficult to compare results across studies. Moreover, radiological parameters evaluating the effect of tenotomy on ankle dorsiflexion have been addressed only to a limited extent in previous research.

The primary aim of this study was to evaluate whether residual posterior soft-tissue tightness persists after percutaneous Achilles tenotomy in idiopathic CTEV by using the tibiocalcaneal angle as a dorsiflexion-sensitive radiographic parameter. Secondary aims were to compare other radiological measurements and maximum ankle dorsiflexion between needle and scalpel tenotomy techniques, and to assess differences between tenotomized feet and the unaffected contralateral feet.

Material and Methods

This retrospective study was conducted after obtaining approval from the Local Ethics Committee (decision No: AEŞH-BADEK1-2025-577). Patients who had been treated with the Ponseti method and underwent Achilles tenotomy for CTEV between January 1, 2022, and December 31, 2024, were evaluated for eligibility. Inclusion criteria were as follows: patients who underwent Achilles tenotomy using either a needle or a scalpel following serial casting with the Ponseti method, had adequate clinical and radiological data, and completed at least 12 months of follow-up. Exclusion criteria included the presence of neuromuscular disease or syndromic conditions, a history of previous surgical intervention for CTEV, incomplete radiological data, or a follow-up period shorter than 6 months. A total of 115 patients were initially assessed for eligibility. Of these, 25 patients were excluded due to neuromuscular clubfoot (n=6), syndromic clubfoot (n=5), recurrent clubfoot (n = 4), previous surgical intervention for CTEV (n=5), or incomplete data (n=5). After applying these criteria, a total of 130 feet from 90 patients were deemed eligible for analysis

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(**Figure 1**). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patients were divided into 2 groups according to the surgical technique used for Achilles tenotomy. Group 1 included cases in which the Achilles tendon was released percutaneously using a 16-gauge hypodermic needle, while group 2 comprised cases in which a No. 15 scalpel blade was used. Both groups were treated with serial casting in accordance with the Ponseti protocol. Needle-assisted tenotomies were performed under superficial local anesthesia using EMLA cream only, whereas percutaneous Achilles tenotomies with a scalpel were performed under general anesthesia in sterile conditions. Both techniques were performed by experienced orthopedic surgeons, with needle tenotomies and scalpel tenotomies performed by different surgeons. Because some patients had bilateral deformities, the total number of feet exceeded the number of patients, and each foot was evaluated as an independent unit. After comparing the 2 tenotomy techniques, the unaffected feet of patients with unilateral CTEV were also included in the analysis and served as internal controls for radiological and functional comparisons.

Lateral foot radiographs obtained at the end of a 1-year follow-up period after Achilles tenotomy were taken in maximum dorsiflexion. Measurements were performed independently by 2 orthopedic surgeons in a blinded manner, and the mean values were used for analysis. Interobserver reliability was evaluated using an intraclass correlation coefficient (ICC), showing excellent agreement between the evaluators (ICC=0.946, $P<0.001$). Radiological assessments were conducted using images archived in the hospital's digital Picture Archiving and Communication System (PACS).

All lateral ankle radiographs were obtained with patients in the supine position, the hip in neutral rotation, and the knee flexed to approximately 90°. The ankle was gently held in maximum passive dorsiflexion without forceful manipulation, and no sedation was used during image acquisition. Lateral views were obtained using a true lateral technique based on the analytical radiographic principles described by Simons, with the medial border of the foot positioned against the image receptor and the X-ray beam directed perpendicular to it. The source–image distance was standardized at approximately 110 cm. Angular measurements were performed digitally using the hospital PACS system with a minimum angular resolution of 0.1° [18]. The talo–first metatarsal angle was defined as the angle between the long axes of the talus and the first metatarsal; the tibiocalcaneal angle as the angle between the long axes of the tibia and the calcaneus; and the talocalcaneal angle as the angle between the long axes of the talus and the calcaneus. These measurements were used to evaluate the degree of deformity correction and the adequacy of Achilles tendon relaxation (**Figure 2**). For functional evaluation, the maximum ankle dorsiflexion angle of each patient was measured separately for both feet using a goniometer. The obtained dorsiflexion values were compared both between the 2 tenotomy techniques and between the tenotomized and unaffected feet.

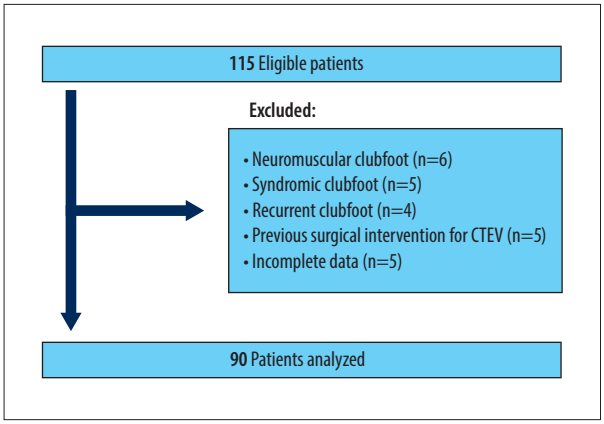

Figure 1. STROBE flow diagram of the study population. The flowchart illustrates patient eligibility assessment, exclusion criteria, and the final number of patients included in the analysis. Reasons for exclusion, including neuromuscular clubfoot, syndromic clubfoot, recurrent clubfoot, previous surgical intervention for congenital talipes equinovarus (CTEV), and incomplete data, are shown.

Statistical Analysis

Continuous variables are summarized using median and interquartile range (IQR; 25^{th}-75^{th} percentile) due to non-normal distribution, which was assessed using the Shapiro-Wilk test. Group comparisons were conducted using the Kruskal-Wallis test for overall differences among the 3 groups. When a significant result was found, pairwise Dunn post hoc tests with Bonferroni correction were applied. Categorical variables were summarized as frequency and percentages and compared using the Pearson chi-square test. A P value <0.05 was considered statistically significant. All statistical analyses were performed using R (version 4.5.0). Statistical analyses were primarily focused on the predefined primary outcome (tibiocalcaneal angle), while analyses of secondary outcomes were considered supportive.

Results

A total of 130 feet from 90 patients were included in the study. Of these, 74 feet underwent percutaneous Achilles tenotomy with a needle (group 1), and 56 with a scalpel (group 2).

Table 1 presents the demographic and baseline clinical characteristics of patients who underwent percutaneous tenotomy

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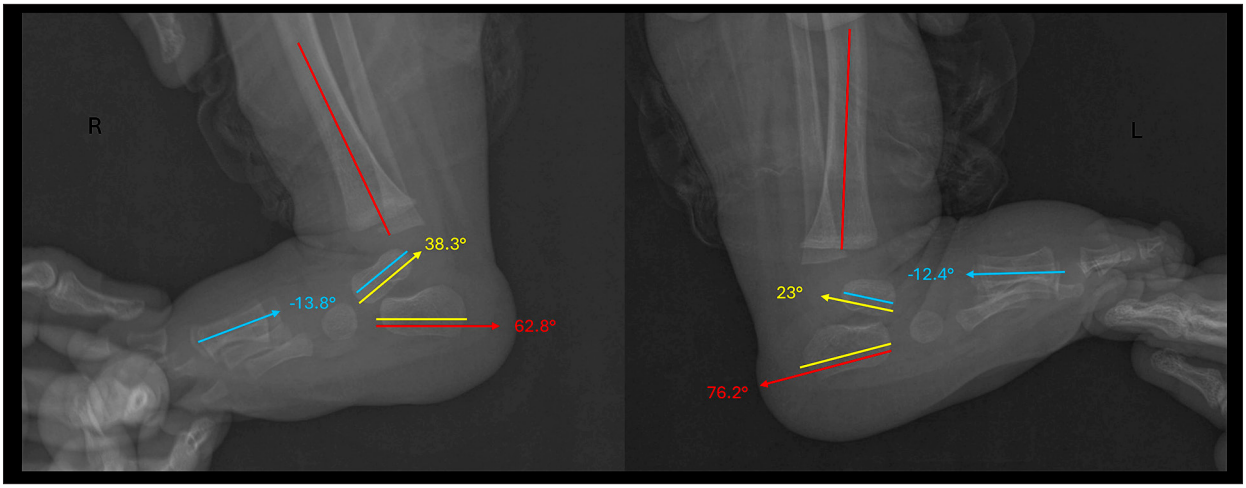

Figure 2. Radiographic assessment of angular measurements on lateral foot radiographs. Red arrows indicate the tibiocalcaneal angle, yellow arrows indicate the talocalcaneal angle, and blue arrows indicate the talo–first metatarsal angle. These measurements were performed on lateral radiographs obtained in maximum dorsiflexion to evaluate the degree of deformity correction and the adequacy of Achilles tendon relaxation.

Table 1. Demographic and baseline clinical characteristics of patients undergoing percutaneous Achilles tenotomy with a needle or a scalpel.

Variables	Needle (n=74)	Scalpel (n=56)	*P* value
Sex			
Male	51 (68.9%)	43 (76.8%)	0.321
Female	23 (31.1%)	13 (23.2%)	
Side			
Right	38 (51.4%)	33 (58.9%)	0.390
Left	36 (48.6%)	23 (41.1%)	
Laterality			
Bilateral	48 (64.9%)	32 (57.1%)	0.124
Right	13 (17.6%)	18 (32.1%)	
Left	13 (17.6%)	6 (10.7%)	
Pirani score	4 (3.5-5.0)	4.5 (3.5-5.0)	0.197
Dimeglio score	13 (11-14)	13.5 (12-15)	0.159
Age at initiation of casting (days)	15 (14-21)	8.5 (7-21)	0.174
Time elapsed since last cast (months)	13 (13-18)	15 (13-18)	0.654

with a needle or a scalpel. There were no statistically significant differences between the 2 groups in terms of sex distribution, laterality, or severity scores (Pirani and Dimeglio), as well as age at the beginning of casting or time elapsed since the last cast ($P>0.05$ for all comparisons).

The comparative analysis among the control, needle tenotomy, and scalpel tenotomy groups revealed significant differences in most angles, except for the talo–first metatarsal angle. The tibiocalcaneal angle was significantly smaller in the control group (median 65.4°, IQR: 58.2-72.0°) than in both the needle (median 77.8°, IQR: 73.4-78.8°) and scalpel (median 77.0°, IQR: 70.5-81.1°) groups ($P<0.001$).

Pairwise comparisons demonstrated that both the needle vs control ($P<0.001$) and scalpel vs control ($p<0.001$) differences were statistically significant, whereas there was no significant difference between the needle and scalpel groups ($P=1.000$).

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Table 2. Comparison of patients who underwent percutaneous Achilles tenotomy with a needle or a scalpel and the control group (n=number of feet).

Variables	Needle (n=74)	Scalpel (n=56)	Control (n=50)	P value
Talo–first metatarsal angle (°)	2.0 (-10.0 to 6.9)	-7.3 (-11.7 to 4.5)	-4.7 (-10.9 to 4.5)	0.099
Tibiocalcaneal angle (°)	77.8 (73.4-78.8)	77.0 (70.5-81.1)	65.4 (58.2-72.0)	**<0.001**
Talocalcaneal angle (°)	29.3 (26.7-33.8)	28.1 (25.6-33.7)	45.9 (40.8-49.4)	**<0.001**
Dorsiflexion angle (°)	15.0 (15.0-20.0)	15.0 (10.0-20.0)	20.0 (20.0-30.0)	**<0.001**

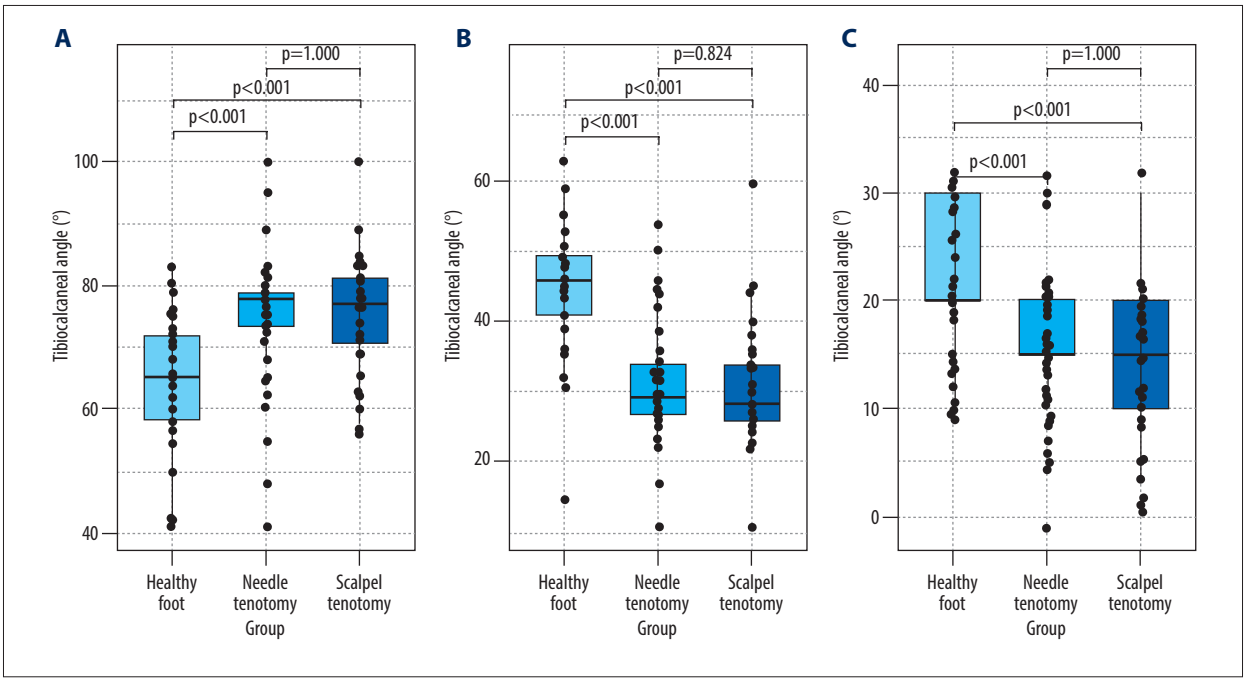

Figure 3. Pairwise comparison among the needle, scalpel, and control groups. Comparison of (**A**) tibiocalcaneal, (**B**) talocalcaneal, and (**C**) dorsiflexion angles across the 3 groups using box plots. *P* values were calculated using the Dunn post hoc test; dots represent individual data points.

The talocalcaneal angle was significantly smaller in the needle (median 29.3°, IQR: 26.7-33.8°) and scalpel (median 28.1°, IQR: 25.6-33.7°) groups than in the control group (median 45.9°, IQR: 40.8-49.4°) (*P*<0.001). Post hoc analyses revealed significant differences between both operated groups and the control group (*P*<0.001 for each), whereas no significant difference was found between the needle and scalpel groups (*P*=0.824).

The dorsiflexion angle was also significantly smaller in both operated groups (needle group: median 15.0°, IQR: 15.0-20.0°; scalpel group: median 15.0°, IQR: 10.0-20.0°) than in the control group (median 20.0°, IQR: 20.0-30.0°) (*P*<0.001).

Pairwise comparisons showed that both the needle vs control and scalpel vs control differences were statistically significant (*P*<0.001 for both), whereas the needle vs scalpel comparison was not (*P*=1.000). In contrast, there was no significant difference among the groups in terms of the talo–first metatarsal angle (*P*=0.099). The results are summarized in **Table 2** and illustrated in **Figure 3**.

Discussion

The main finding of this study is that percutaneous Achilles tenotomy performed with either a needle or a scalpel results in comparable functional and radiological outcomes. With respect to the predefined primary outcome, no significant difference was observed in the tibiocalcaneal angle between the 2 tenotomy techniques. However, when tenotomized feet were compared with the unaffected contralateral feet, significant differences in dorsiflexion-sensitive radiological parameters,

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particularly the tibiocalcaneal angle, were identified. Although clinical ankle dorsiflexion was similar between operated and unaffected feet, this finding did not consistently correspond to complete radiological normalization. This discrepancy suggests that clinical dorsiflexion alone may be an insensitive indicator of residual posterior soft-tissue tightness. Therefore, despite satisfactory clinical correction, subtle residual anatomical deviations can persist in treated CTEV feet, irrespective of the tenotomy technique used.

The Ponseti method is currently regarded as the gold standard casting protocol for the treatment of CTEV, and most cases require an Achilles tenotomy at the end of the casting phase. However, there is no clear consensus on whether the tenotomy should be performed through an open or percutaneous approach, and, if a percutaneous technique is preferred, whether it is more appropriate to use a scalpel or a needle. The available evidence on this topic remains limited [19]. From a historical perspective, although the Ponseti casting approach has largely replaced extensive surgical procedures, variations in tenotomy techniques persist. Previous long-term studies have reported that, despite achieving excellent clinical correction, radiographic parameters do not always return to normal values. For instance, Cooper and Dietz demonstrated that even after appropriate treatment, residual angular differences remained when compared with normal pediatric feet, while Church et al found persistent alterations in lateral talocalcaneal, tibiocalcaneal, and talo–first metatarsal angles in Ponseti-treated feet relative to normative data. These findings suggest that radiological normalization does not always parallel clinical recovery, and subtle anatomical differences can persist even after functionally successful outcomes [20,21].

More recently, studies aiming to objectify the indications for tenotomy have demonstrated radiographic improvement following tenotomy but emphasized that complete normalization compared with the unaffected foot is not always achieved. However, in all of these studies, the tenotomy was performed using the classical scalpel technique, and alternative approaches such as percutaneous needle-assisted tenotomy have not yet been systematically evaluated [22]. In this context, the present study provides a unique contribution to the literature by directly comparing 2 different tenotomy techniques within the same dataset. The findings demonstrate that both techniques yield comparable functional and radiological outcomes; however, in line with previous research, both groups continued to exhibit significant radiological differences when compared with the unaffected feet.

The final step of the Ponseti protocol, Achilles tenotomy, is critically important for achieving complete correction of the deformity and ensuring adequate dorsiflexion. In the literature, percutaneous tenotomies performed with a needle have been highlighted for their minimally invasive nature, feasibility under local anesthesia, and low complication rates. Studies by Richetta et al and Pigeolet et al reported that needle-assisted tenotomies achieved a high rate of complete correction, with very low risks of infection and bleeding, and demonstrated early functional recovery in patients [23,24]. In contrast, classical percutaneous tenotomies performed with a scalpel have been reported to offer greater procedural safety due to the surgeon's direct control and visualization, allowing for a more predictable complete tendon release and achieving comparable clinical correction rates [25].

In line with these findings, our study also found no significant functional or radiological differences between the groups that underwent tenotomy using a scalpel and those treated with a needle. Although previous studies have suggested that achieving a complete cut during needle tenotomy can be technically challenging and could carry a risk of incomplete tendon release, the marked tightness of the Achilles tendon in patients with CTEV allows the surgeon to easily verify intraoperatively whether the tendon has been completely severed, ensuring adequate release in most cases [23]. Therefore, the achievement of adequate tendon release in the cases treated with needle tenotomy in our study is considered the most likely explanation for the comparable functional and radiological outcomes observed between the 2 techniques.

In our study, lateral foot radiographs were analyzed to objectively assess the degree of deformity correction, focusing on the tibiocalcaneal, talocalcaneal, and talo–first metatarsal angles. These parameters are among the most reliable radiological indicators, reflecting both the extent of Achilles tendon release and the degree of biomechanical restoration of the ankle and hindfoot [21,22]. However, in CTEV cases, these radiographic angles, although appearing clinically corrected after treatment, rarely reach the same values as those of normal, unaffected feet [20,21]. The main reason for this discrepancy is that the deformity in CTEV arises not only from soft-tissue contractures but also from abnormalities in the shape and alignment of the tarsal bones. In particular, the anterior and plantar rotation of the talus, although clinically corrected through treatment, often fails to fully realign with normal anatomical axes, which can cause the talocalcaneal and tibiocalcaneal angles to remain outside normal limits. Furthermore, during correction with the Ponseti protocol, soft-tissue adaptation tends to occur more rapidly than bony remodeling, resulting in a foot that appears functionally well-corrected but radiographically remains short of complete normalization. In the existing literature, it has been demonstrated that even when functional correction is fully achieved after treatment with the Ponseti method, residual radiographic deviations often persist [21,26]. This finding is largely consistent with the results of our study. Thus, the persistence of radiological differences despite full functional correction in treated CTEV

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cases can be interpreted as a consequence of the structural and morphological origin of the deformity.

This study has several limitations. Due to its retrospective design, observer bias could not be completely eliminated, despite blinded radiographic measurements. In addition, needle and scalpel tenotomies were performed by different surgeons and under different anesthesia modalities, which can be potential confounding factors. Adverse events were not systematically recorded; therefore, a comprehensive complication analysis could not be performed. Finally, as the study included only idiopathic CTEV cases, the findings may not be generalizable to non-idiopathic forms of clubfoot.

Conclusions

In patients with CTEV treated using the Ponseti method, percutaneous Achilles tenotomy performed with either a needle or a scalpel provides comparable radiological and functional outcomes. Although both techniques achieve satisfactory correction, radiological differences persist, compared with the unaffected feet, indicating that mild structural deviations can remain despite clinical normalization. Therefore, radiological recovery should not be interpreted as complete anatomical correction.

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Statement

In this study, AI-supported technologies, chatbots, or image generators were not used.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

References:

1. Dobbs MB, Rudzki JR, Purcell DB, et al. Factors predictive of outcome after use of the Ponseti method for the treatment of idiopathic clubfeet. J Bone Joint Surg Am. 2004;86(1):22-27
2. Bitew A, Melesse DY, Admass BA. A 5-years results of the Ponseti method in the treatment of congenital clubfoot: A retrospective study. Eur J Orthop Surg Traumatol. 2023;33(5):1781-87
3. Radler C. The Ponseti method for the treatment of congenital club foot: Review of the current literature and treatment recommendations. Int Orthop. 2013;37(9):1747-53
4. Morcuende JA, Dolan LA, Dietz FR, Ponseti IV. Radical reduction in the rate of extensive corrective surgery for clubfoot using the Ponseti method. Pediatrics. 2004;113(2):376-80
5. Alves C. Bracing in clubfoot: Do we know enough? J Child Orthop. 2019;13(3):258-64
6. Chandirasegaran S, Gunalan R, Aik S, Kaur S. A comparison study on hindfoot correction, Achilles tendon length and thickness between clubfoot Patients treated with percutaneous Achilles tendon tenotomy versus casting alone using Ponseti method. J Orthop Surg (Hong Kong). 2019;27(2):2309499019839126
7. van Praag VM, Lysenko M, Harvey B, et al. Casting is effective for recurrence following Ponseti treatment of clubfoot. J Bone Joint Surg Am. 2018;100(12):1001-8
8. Cohen E, Katz T, Rozen U, et al. The influence of Achilles tenotomy and compliance with foot abduction orthosis on the relapse rate of ponseti treatment for idiopathic clubfoot: A regional study. J Foot Ankle Surg. 2020;59(4):784-87
9. López-Carrero E, Castillo-López JM, Medina-Alcantara M, et al. Effectiveness of the Ponseti method in the treatment of clubfoot: a systematic review. Int J Environ Res Public Health. 2023;20(4):3714
10. Alkan H, Tuncel CY, Üner Ç, et al. Ultrasonographic and elastographic comparison of needle versus scalpel Achilles tenotomy in clubfoot: A clinical and morphological study. Foot Ankle Surg. 2025 [Online ahead of print]
11. Sharma R, Kumar A, Sinha S, et al. Effectiveness of needle tenotomy for correction of equinus in clubfoot. Cureus. 2022;14(11):e32080
12. 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
13. Dogan A, Uzumcugil O, Sarisozen B, et al. A comparison of percutaneous and mini-open techniques of Achilles tenotomy: An experimental study in rats. J Child Orthop. 2009;3(6):485-91
14. Subaşı İÖ, Çepni Ş, Tanoğlu O, et al. A clinical comparison of two different surgical techniques in the treatment of acute Achilles tendon ruptures: Limited-open approach vs. percutaneous approach. Ulus Travma Acil Cerrahi Derg. 2023;29(8):935-43
15. Flores DV, Mejía Gómez C, Fernández Hernando M, et al. Adult acquired flatfoot deformity: Anatomy, biomechanics, staging, and imaging findings. Radiographics. 2019;39(5):1437-60
16. Kang S, Park SS. Lateral Tibiocalcaneal Angle as a determinant for percutaneous Achilles tenotomy for idiopathic clubfeet. J Bone Joint Surg Am. 2015;97(15):1246-54
17. Moerman S, Zijlstra-Koenrades N, Reijman M, et al. The predictive value of radiographs and the Pirani score for later additional surgery in Ponseti-treated idiopathic clubfeet, an observational cohort study. Children. 2022;9(6):865
18. Simons GW. Analytical radiography of club feet. J Bone Joint Surg Br. 1977;59-B(4):485-89
19. Rangasamy K, Baburaj V, Gopinathan NR, Sudesh P. Techniques, anaesthesia preferences, and outcomes of Achilles tenotomy during Ponseti method of idiopathic clubfoot correction: A systematic review. Foot (Edinb). 2022;52:101922
20. Cooper DM, Dietz FR. Treatment of idiopathic clubfoot. A thirty-year follow-up note. J Bone Joint Surg Am. 1995;77(10):1477-89
21. Church C, Coplan JA, Poljak D, et al. A comprehensive outcome comparison of surgical and Ponseti clubfoot treatments with reference to pediatric norms. J Child Orthop. 2012;6(1):51-59
22. Yalçın MB, Dogan A, Uzumcugil O, Zorer G. Radiographic impact on the clinical decision making of Achilles tenotomy in clubfoot: In search of an objective cut-off value. J Clin Med. 2024;13(3):714
23. Richetta S, Andreacchio A, Monforte S. Percutaneous Achilles tenotomy using a 18 gauge needle in the treatment of clubfoot with Ponseti method. Pediatr Med Chir. 2022;44(s1):295
24. Pigeolet M, Ghufran Syed J, Ahmed S, et al. Percutaneous Achilles tendon tenotomy in clubfoot with a blade or a needle: A single-centre randomized controlled noninferiority trial. Bone Joint J. 2024;106-B(8):871-78
25. Dhingra M, Bak YC, Edokpayi F, et al. A systematic review and single center experience with percutaneous needle tenotomy in congenital talipes equinovarus (CTEV). Cureus. 2022;14(12):e32812
26. Rastogi A, Agarwal A. Long-term outcomes of the Ponseti method for treatment of clubfoot: A systematic review. Int Orthop. 2021;45(10): 2599-608

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