Araştırma Makalesi
Research Article

# A New Trend in Orthopedics: Radiofrequency Ablation for the Treatment of Intractable Plantar Fasciitis

## RADYOFREKANS ABLASYONUN PLANTAR FASİİTE ETKİSİ

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**ABSTRACT**

**Aim:** One of the most common causes of pain in the plantar region of the foot is plantar fasciitis (PF), for which there are numerous treatment options. Several invasive and non-invasive treatment modalities have been developed for this condition. One of these options for patients who do not respond to conservative treatment is radiofrequency ablation (RFA). Due to its early functional benefits and minimally invasive nature, RFA is believed to achieve successful clinical outcomes in patients with persistent early-stage PF. This study aims to evaluate the efficacy and clinical outcomes of RFA in the treatment of PF.

**Methods:** A total of 35 patients (46 feet), aged 31-50 years, who were treated with RFA from December 2018 to December 2019 were included in the study. AOFAS (American Orthopaedic Foot & Ankle Society) and Visual Analog Scale (VAS) of patients who received conservative treatment for 3 months or longer and whose complaints persisted were pre-treatment (PrT) of RFA. These scores were re-evaluated after 3 months.

**Results:** Among the patients in the study, 10 (28.57%) were male and 25 (71.43%) were female. The mean age of the patients was 40.43±5.37 years. The PrT and post-treatment (PsT) VAS scores were 8.97±1.36 and 5.89±3.66, respectively. The PrT and PsT AOFAS scores were 48.51±10.67 and 65.86±22.74, respectively. Statistical analyses showed that the clinical outcomes of RFA were significantly improved after treatment for both scores ($p<0.05$).

**Conclusion:** RFA, which is rapidly and long-term effective without disrupting the plantar fascia anatomy, is an important minimally invasive treatment option that can be preferred in patients with chronic PF.

**Keywords:** Radiofrequency ablation method, VAS, calcaneal spur, plantar fasciitis.

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**ÖZ**

**Amaç:** Ayağın plantar bölgesindeki ağrının en yaygın nedenlerinden biri olan plantar fasiit (PF) için çok sayıda tedavi seçeneği bulunmaktadır. Bu durum için çeşitli invaziv ve non-invaziv tedavi yöntemleri geliştirilmiştir. Konservatif tedaviye yanıt vermeyen hastalar için bu seçeneklerden biri radyofrekans ablasyondur (RFA). Erken fonksiyonel faydaları ve minimal invaziv doğası nedeniyle, RFA'nın inatçı erken evre PF'li hastalarda başarılı klinik sonuçlar elde ettiğine inanılmaktadır. Bu çalışma, RFA'nın PF tedavisindeki etkinliğini ve klinik sonuçlarını değerlendirmeyi amaçlamaktadır.

**Gereç ve Yöntem:** Çalışmaya Aralık 2018'den Aralık 2019'a kadar RFA ile tedavi edilen 31-50 yaş arası toplam 35 hasta (46 ayak) dahil edildi. RFA öncesi (PrT) 3 ay veya daha uzun süre konservatif tedavi alan ve şikayetleri devam eden hastaların AOFAS (American Orthopaedic Foot & Ankle Society) ve Görsel Analog Skalası (VAS) değerlendirildi. Bu skorlar RFA sonrası (PsT) 3 ay sonra tekrar değerlendirildi.

**Bulgular:** Çalışmaya katılan hastaların 10'u (%28,57) erkek, 25'i (%71,43) kadındı. Hastaların yaş ortalaması 40.43± 5.37 yıl idi. Tedavi öncesi ve sonrası VAS skorları sırasıyla 8,97±1,36 ve 5,89±3,66 idi. PrT ve PsT AOFAS skorları sırasıyla 48,51±10,67 ve 65,86±22,74 idi. İstatistiksel analizler RFA'nın klinik sonuçlarının her iki skor için de tedavi sonrasında anlamlı olarak iyileştiğini gösterdi ($p<0,05$).

**Sonuç:** Plantar fasya anatomisini bozmadan hızlı ve uzun süreli etkili olan RFA, kronik PF'li hastalarda tercih edilebilecek önemli bir minimal invaziv tedavi seçeneğidir.

**Anahtar Kelimeler:** Radyofrekans ablasyon metodu, VAS, topuk dikeni, plantar fasiit

Plantar fasciitis (PF) is a significant health problem that causes severe foot pain during movement. It accounts for 11% to 15% of all foot diseases requiring intervention and is a major cause of heel pain in adults (1). PF occurs when the plantar fascia, a hard tissue on the foot, becomes inflamed. Heel pain is the most common symptom. Although the etiology and pathogenesis of heel pain are still controversial (2-3), many factors are implicated, including increased participation in sports and physical activity, and incorrect shoe selection (4). According to Nery et al., heel pain is believed to result from aseptic inflammation caused by micro-tears in the plantar fascia, which are caused by repetitive microtrauma (3).

The location, duration, and relationship of the pain with movement are significant factors to consider. Initially, although there may be pain across the entire sole and some wandering pain, it eventually localizes to the medial calcaneal tubercle in patients with PF. A key symptom of this is morning foot pain that reduces as one begins to walk (1).

For patients diagnosed with PF and without a widely accepted treatment algorithm, both conservative and surgical methods of treatment are utilized, with conservative treatments being the preferred initial option (5-8). Analgesia, rest, foot orthotics and support, physiotherapy, and extracorporeal shockwave therapy (ESWT) can be given as examples of conservative treatments (9-11). For patients who do not respond to conservative treatment, minimally invasive treatments such as steroid injections, botulinum toxin injections, platelet-rich plasma (PRP) injections and radiofrequency ablation (RFA) [1], and more invasive surgical procedures such as open or endoscopic plantar fascia debridement and gastrosoleus complex surgery may be used (12-15).

This study presents the clinical and functional outcomes of patients with resistant PF who did not respond

to conservative treatment and were treated with RFA as a minimally invasive method without the need for surgery.

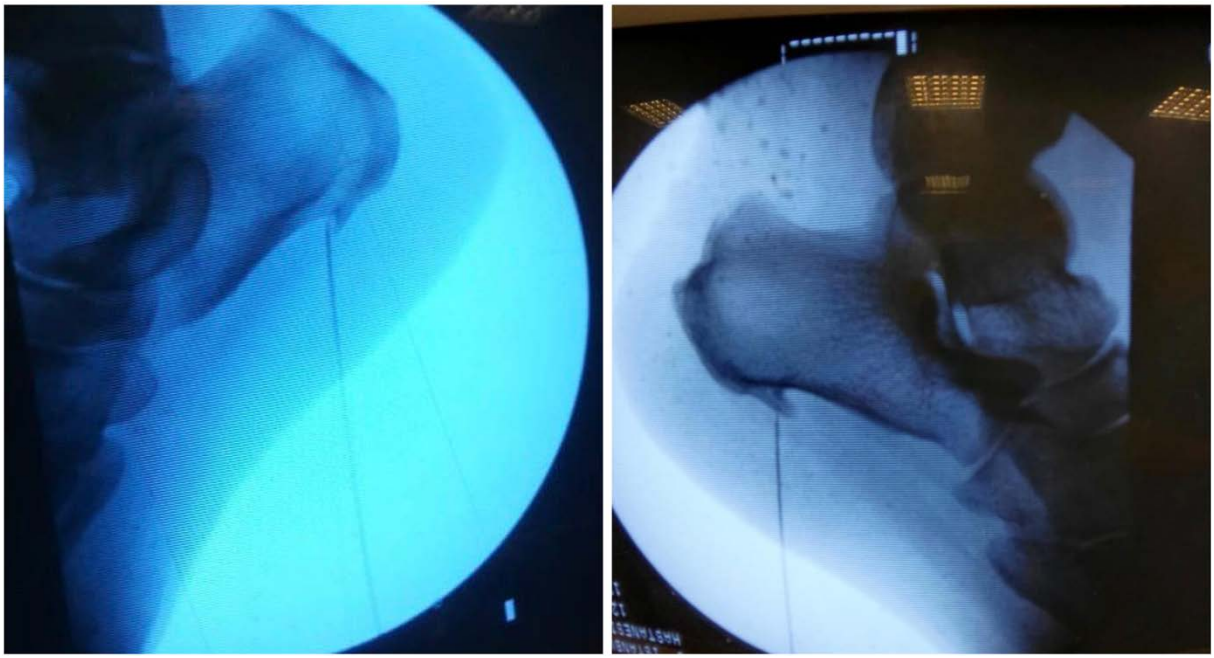
## METHODS

In this study, we prospectively evaluated patients with PF who were diagnosed with calcaneal spur on lateral ankle radiographs and treated with RFA between December 2018 and 2019. Patients who had been treated for 3 months or more, had no response to treatment, had heel pain only, and had tenderness to palpation of the medial calcaneal tubercle on physical examination were included in the study. Patients who had undergone foot and ankle surgery; had an open wound, infection, or history of fracture of any bone in the ankle region; had peripheral ischemic vasculopathy, peripheral neuropathy, or radiculopathy on electromyography; had a tumor lesion around the foot and ankle; or were pregnant were excluded from the study. Thirty-five patients between the ages of 31 and 50 who met these criteria were evaluated. American Orthopaedic Foot & Ankle Society (AOFAS) and Visual Analog Scale (VAS) scores were evalvated before treatment (PrT) and 3 months after RFA treatment (PsT). The percentage of these parameters was calculated according to the PrT and PsT scores, and the clinical and functional improvement was statistically evaluated. The study was conducted in accordance with the ethical standards set forth by the relevant ethics committee.

### RFA application procedure

Patients were placed in the prone position. The painful area was marked with a marker pen, and 10 mL of 2% lidocaine was injected subcutaneously at the site of the procedure. The RF electrode was advanced under fluoroscopy to the area of the medial calcaneal tubercle (Fig.1).

**Figure 1:** Administration of radiofrequency ablation therapy by fluoroscopy



To prevent iatrogenic motor nerve ablation during electrode placement, RFA was performed in the area where there was no fasciculation or involuntary contractions in the toes, assuming that the area where the voltage was set to a maximum of 2.5 V from 0 V and the stimulation frequency was set to 2 Hz in the stimulation mode before RFA. An RFA procedure was performed on the sensory part of the medial plantar nerve using the thermal RF mode

of the BNS® Radiofrequency Lesion Generator (Beijing Neo Science Co., Ltd., China) RFE 2 series device for 120 seconds at 60 °C and 60 seconds at 40 °C in a single session.

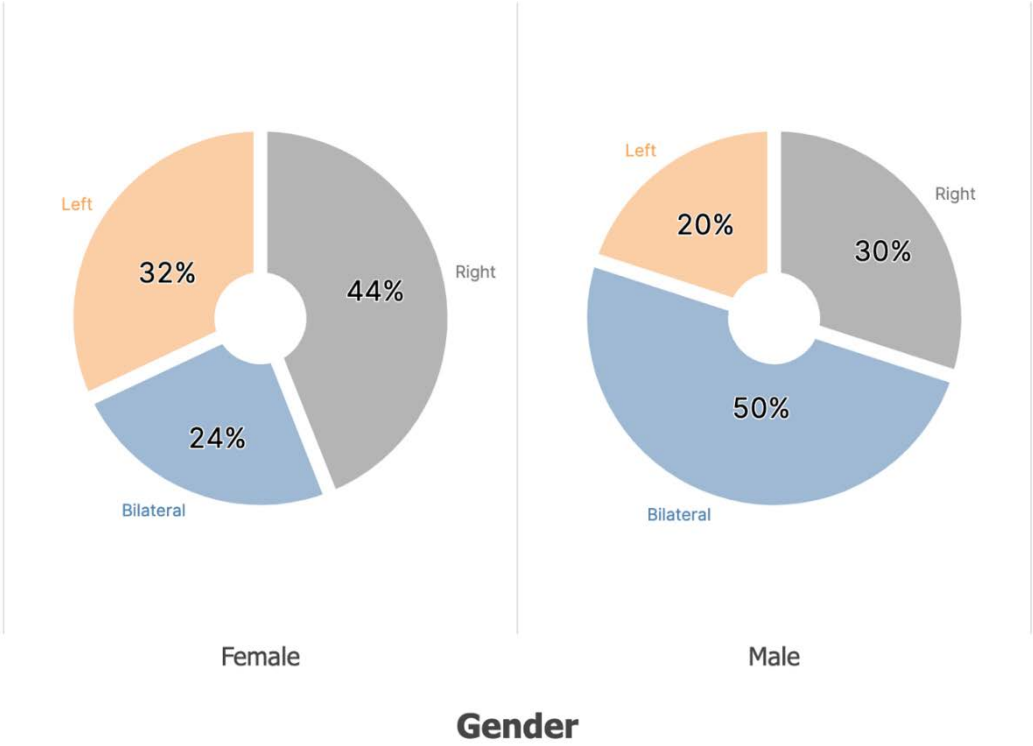
### Statistical analysis

The normal SPSS (Statistical Package for the Social Sciences) programme version 21.0 (IBM, Armonk, NY, USA) was used for the statistical analysis of the data in our study. Descriptive statistics were expressed as mean ± standard deviation or median (minimum-maximum) for discrete and continuous numerical variables, and as number of cases and (%) for categorical variables. Cross-tabulation statistics (chi-square, Fisher) were used to compare categorical variables. Normally distributed parametric data were compared using Student's t-test and ANOVA, and non-parametric data that were not normally distributed were compared using Mann-Whitney U and Kruskal-Wallis tests. $p<0.05$ statistical significance.

## RESULTS

In this prospective study of 35 patients, the mean age at diagnosis was 40.43±5.37 years, with 25 females (71.43%) and 10 males (28.57%). The mean age of the male patients was 41.60±5.14 years and the mean age of the female patients was 39.96±5.49 years. PF was located on the right side in 40% of cases (n=14), bilateral in 31.4% (n=11) and on the left side in 28.6% (n=10). The side of PF involvement did not show a statistically significant difference between the genders (p=0.339). 5 of the males had bilateral PF (50%), 2 had left PF (20%) and 3 had right PF (30%). 6 of the females had bilateral PF (24%), 8 had left PF (32%) and 11 had right PF (44%) (Fig. 2).

**Figure 2:** Distribution of PF involvement sides according to gender.

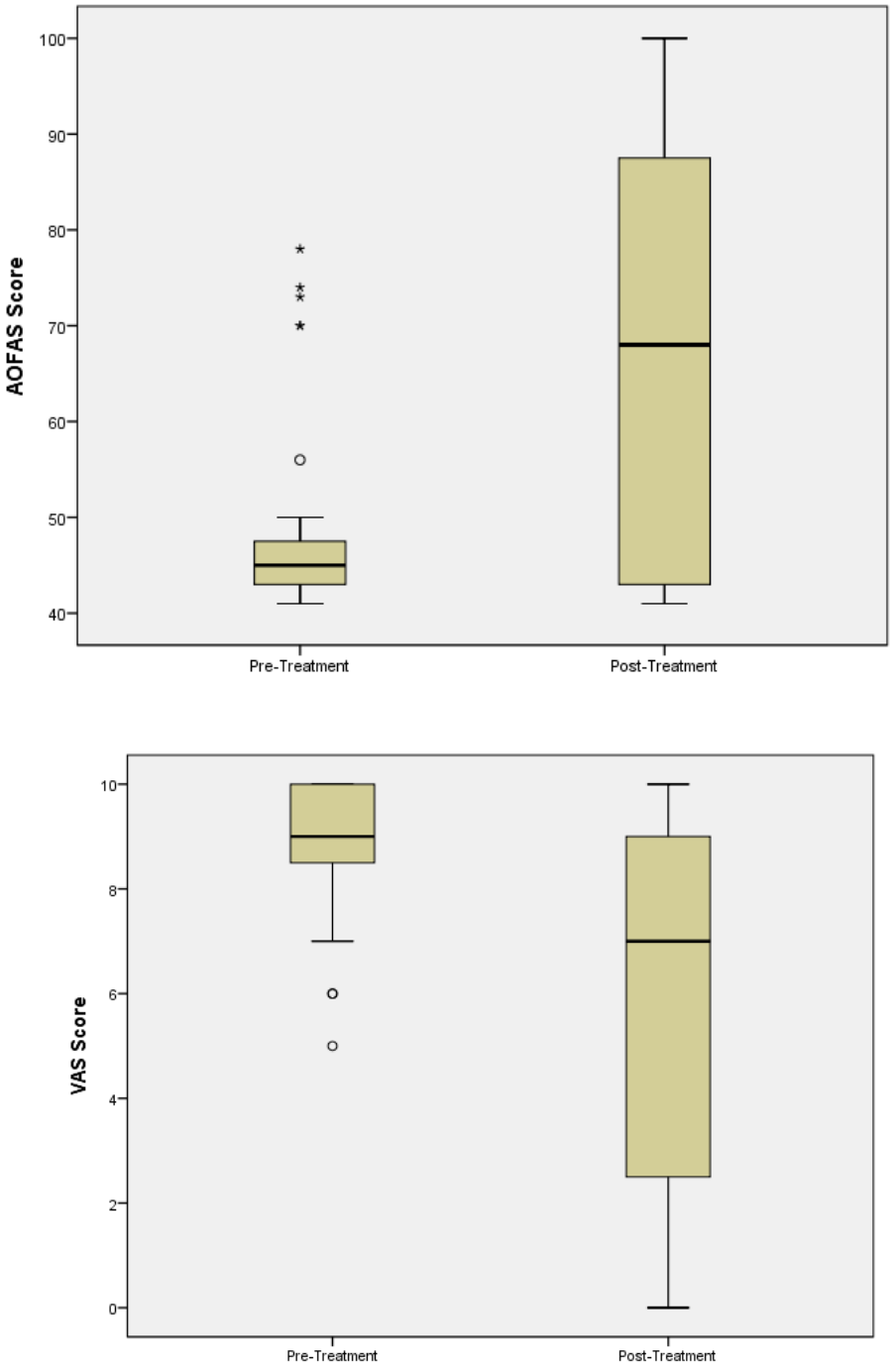


The comparative table of mean AOFAS and VAS scores at baseline PrT and follow-up PsT in our study is shown in Table 1. According to this table, the mean AOFAS score at PsT (65.86±22.74) was significantly higher than that at PrT (48.51±10.67) ($p<0.005$). The mean VAS score at PsT (5.89±3.66) was also significantly lower than at PrT (8.97±1.36) ($p<0.005$) (Table 1), (Fig. 3) .

**Table 1:** Comparison of mean AOFAS and VAS scores before and after treatment.

| | **Pre-Treatment (**Mean±SD**)** | **Post-Treatment (** Mean±SD**)** | **p-değeri** |
|---|---|---|---|
| **AOFAS** | 48.51±10.67 | 65.86±22.74 | **0.001*** |
| **VAS** | 8.97±1.36 | 5.89±3.66 | **0.000*** |

**Figure 3:** Comparison of mean AOFAS and VAS scores before and after treatment




The mean AOFAS change between PrT and PsT was 17.34±24.35, while the VAS change was 3.09±3.88. There was no statistically significant difference in mean AOFAS and VAS change between PrT and PsT according to age, gender, or side of PF involvement ($p>0.05$) (Table 2).

| Clinical Variables | AOFAS ( Mean±SD) | p-value | VAS ( Mean±SD) | p-value |
|---|---|---|---|---|
| **Age** | | | | |
| < 45 (n=24) | 17.63±24.42 | 0.775 | 3.17±4.01 | 0.957 |
| > 45 (n=11) | 16.73±25.37 | | 2.91±3.75 | |
| **Gender** | | | | |
| Male | 20.30±24.40 | 0.389 | 3.50±4.03 | 0.631 |
| Female | 16.16±24.73 | | 2.92±3.89 | |
| **Side** | | | | |
| Right | 23.86±24.49 | 0.325 | 4,07±3,60 | 0.305 |
| Bilateral | 13.18±23.13 | | 2.27±3.71 | |
| Left | 12.80±25.86 | | 2.60±4.50 | |

## DISCUSSION

RFA is a minimally invasive treatment method that destroys tissues by applying high heat to the diseased area. This procedure is based on the principle of delivering heat energy using appropriate catheters and electrodes. It is known to be an effective treatment method for a variety of diseases, including cancer, cardiac arrhythmias, and headache (16-18). In PF, the main purpose of using RFA is to block the sensory nerve by applying heat to the medial plantar nerve, which is a mixed-type branch of the posterior tibial nerve that causes heel pain. RFA treatment has many advantages. It does not require a large surgical incision. Therefore, it is also cosmetically advantageous. It is a short procedure, and the person can return to their daily life after the application. It is not a procedure that causes severe pain or discomfort in the patient.

Patients with PF often complain about morning pain triggered at the center of their heels after prolonged immobilization following first weight-bearing steps or upon waking up in the morning (19). PF accounts for approximately 11-15% of chronic heel pain (1), and studies show that standard conservative methods are effective in treating 95-99% of cases that require intervention (8). Non-invasive treatments include weight loss, stretching exercises for the plantar fascia and Achilles tendon, physical therapy modalities, activity, and footwear modifications, as well as orally administered analgesics (11-20).

Non-invasive treatment methods, like ESWT, are commonly used for PF. The release of certain biomolecules in the sensory nerve is purported to cause the effect of ESWT (21). Nevertheless, this claim lacks clear demonstration (22). Despite being a non-invasive procedure, ESWT's effectiveness in patients with PF is low in a single session.

One treatment approach for PF patients is administering local steroid injections. However, this method has limited effectiveness and often causes plantar fat pad atrophy and plantar fascia rupture, among other complications (23). Another minimally invasive technique for PF treatment is PRP injections (24). It is administered in multiple sessions like ESWT, but the necessity of obtaining blood samples from patients during each application can be viewed as a drawback when compared to RFA. Various treatments are available for the surgical management of PF. The benefits that RFA provides over surgery include earlier mobilization, bilateral operability, and a shorter hospital stay.

Most surgeons use a variety of methods during the procedure to place the RFA electrode in the correct location. These methods include palpating the painful area after applying low voltage to the electrode, referring to the medial tubercle of the calcaneus on the heel, and performing the procedure with ultrasound or fluoroscopy (25-26). In our study, we performed RFA both with fluoroscopy and with low voltage in the area where there

was no motor activation. The reason we selected only patients with calcaneal spurs in our study is that the spur is clearly visible under fluoroscopy. Therefore, we only selected patients with calcaneal spur PF because this structure is easily visible under fluoroscopy, and we did not want to evaluate this controversial etiological cause. The relationship between calcaneal spurs and the etiology of PF is controversial (27) and the presence of a calcaneal spur is not a diagnostic criterion for PF. However, in our study, we selected patients with PF who had a calcaneal spur.

The study investigated the effect of RFA over a period of three months and followed a conventional RFA protocol for nerve ablation by applying 60 °C for 120 seconds and 40 °C for 60 seconds. Our treatment's efficacy was 34.33%, while Kurtoğlu et al. reported 93% at 24 months and Yürük et al. reported 50.89% at 3 months (28-29). Our study's efficacy was consistent with Yürük et al.'s findings.

No significant association was found between age and gender in the treatment efficacy of the study, which is in line with existing literature (28- 29). This result shows that PF is not affected by etiological factors such as age and gender.

Our study has certain limitations. One of the key limitations is that it includes only PF patients with calcaneal spurs, which is not a definitive diagnostic criterion for PF. This selection criterion may have influenced the generalizability of our findings. Additionally, the short follow-up period and lack of examination of patient demographic structures, such as standing time in daily life, are also limitations.

The benefits of RFA treatment are numerous, including its extended and swift effects, its non-invasive nature which keeps the plantar fascia intact, its positive influence on the national economy by enabling patients to return to work earlier, and the consequential cost savings it can bring that may have a profound impact on global healthcare policies. Nevertheless, careful research is still necessary to thoroughly evaluate its economic implications. It should be acknowledged that RFA treatment also entails some drawbacks. Neuroma formation is a potential outcome of treatment in the affected region, whereas iatrogenic motor nerve ablation can conceivably impact the abductor hallucis muscle, thereby resulting in the development of bunion and hallux valgus deformities.

## CONCLUSION

In our study, it is our belief that RFA is effective in treating PF with calcaneal spur in the short term. However, the reduced treatment efficacy of our study compared to similar studies may be attributed to the limitations of our RFA methodology and the absence of evaluation of patient compliance with the provided recommendations during the 3 months after RFA. Moreover, the absence of fluoroscopy in outpatient clinics in many centers may cause orthopedic physicians to prefer more ergonomic techniques for RFA. If RFA is to be carried out in outpatient clinics, ultrasound-guided or indirect methods that do not require motor nerve stimulation would be more appropriate. As detailed demographic data are a significant etiological factor in PF, this study has the potential to serve as a guide for future research.

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