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ORIGINAL ARTICLE

Percutaneous radiofrequency nerve ablation in patients with chronic heel pain

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Abstract

Background: Heel pain, known as fasciitis, runner's heel, tennis heel, or police heel, can sometimes become challenging to manage. Many conservative methods, including stretching or orthosis, steroid injection, and extracorporeal shock wave therapy, are used in treating heel pain. This study investigated the therapeutic effect of percutaneous radiofrequency nerve ablation (RFNA) in treating patients with chronic heel pain.

Methods: In this retrospective study, 78 (84 feet) patients with severe and chronic heel pain were included. Patients with heel pain related to calcaneal spur were resistant to conservative methods. Therefore, RFNA was performed on patients who met the criteria. Patients were assessed with a questionnaire and the visual analog scale (VAS) before and after the procedure.

Results: The mean VAS results were 9.3 ± 0.8 before and 3.4 ± 2.6 six months after the procedure, with statistically significant change observed. ($p<0.05$) Furthermore, 79.2% of participants found RFNA favorable.

Conclusions: According to the findings, we may say that RFNA successfully relieves chronic heel pain.

Keywords: Chronic Plantar Fasciitis, Radiofrequency Nerve Ablation, Calcaneal Spur.

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INTRODUCTION

Heel pain describes pain and discomfort around the plantar side of the rear foot. Plantar fasciitis, plantar fasciopathy, runner's heel, tennis heel, and police heel; are various eponyms of heel pain. The prevalence of plantar heel pain is around 9.6% among the population, and in athletes, it is about 5-18%(1).

Chronic heel pain, one of the most common foot conditions affecting the foot, accounts for 15% of all adult foot complaints requiring professional care. Heel pain is primarily common in active people over the age of forty. This increased prevalence may result from decreased plantar fascia elasticity and slowing the healing process with age. In addition, the physical condition affects heel pain; for example, obesity can cause heel pain because excess pounds stress the heels(2,3). Co-morbidities such as obesity or a sedentary lifestyle are related to a higher risk of the presence of heel pain(4).

Chronic heel pain's aetiology is multifactorial; other than plantar fasciitis, calcaneal nerve entrapments, calcaneal bursitis, broken bone spurs, and stress fractures of the calcaneus could cause heel pain. The biomechanical aetiology of plantar fasciitis is increased tension and fascia thickness of the plantar fascia(5). The formation of a calcaneal spur is a sign of prolonged plantar fasciopathy. The reason is plantar fasciitis if the pain starts at the first step and decreases with walking. The pain increases with walking after sitting and resting; passive stretching of the plantar fascia exacerbates the pain. Moreover, neurogenic heel pain is originated from irritation or entrapment of the nerves that innervate the heel region. The related nerves are the first branch of the lateral calcaneal nerve and medial calcaneal nerve. In addition, the medial calcaneal branch and the anterior and posterior portions of the inferior calcaneal branch of the posterior tibial nerve provide sensory feedback to the heel(6). Entrapment of the lateral branch of the calcaneal nerve (LBCN) occurs between the deep fascia of the abductor hallucis muscle and the quadratus plantar muscle's medial head. The entrapment rate of LBCN is about %15 in chronic heel pain(7) .

Heel pain is managed with conservative methods such as; rest, stretching, anti-inflammatory drugs, injections, and supportive orthosis(8).

According to a guideline by Thomas JL et al.; treatment modalities could be stratified into three steps(9). First-step consists of non-steroidal medication and stretching regimens, activity modifications, foot padding, and cortisone injections. Second-step; prefabricated and custom orthotic devices, repeated cortisone injections, and physical therapy. Third-step surgical treatment inventions are extracorporeal shock wave therapy (ESWT), and radiofrequency. By this guideline, we could treat most patients with conservative measures. 10-20% of patients with heel pain would need a third management step. This patient population has been suffering from heel pain for a long time, and this pain gets unbearable and restricts a person's daily life. Surgical treatments have successful outcomes, but complications of these interventions are not innoxious; persistent heel pain (5.6%), paraesthesia or numbness (4.3%), soft tissue healing problems (1.7%), and superficial infection (0.4%) could have been seen (10). Therefore, surgeons are very circumspect in their decision to operate the patients because of heel pain. Also, patients want to try all the methods before surgery. For these reasons, ESWT and nerve ablation are the preferred methods for patients and surgeons.

Radiofrequency lesioning or nerve ablation is not a new intervention for the medical community. Peripheral nerve ablation has been performed for patients stricken with chronic pain by algologists with RFNA devices for years. Nowadays, it has become a popular method because its fewer complication risks. This study hypothesizes that chronic heel pain can be treated with the RFNA method with a low risk of complications compared to the surgery. In this present study, we evaluate the effectiveness of RFNA in reducing chronic heel pain.

MATERIALS AND METHODS

In this retrospective study conducted with the local ethics committee's permission, 78 patients treated in an Orthopedics and Traumatology Department of Training and Research Hospital in 2018-2019 were reached. All patients had heel pain present for at least six months and were resistant to many conservative treatment methods. Inclusion criteria are; older than 18 years old, mid-term heel pain (at least six months), conservative treatment failure, including; stretching, physical therapy, steroid injection, oral anti-inflammatories, and arch-supporting orthosis. Exclusion criteria are; prior foot surgery

or calcaneal fracture of the affected side, peripheral neuropathy, tarsal tunnel entrapment, ischemic limb disease, allergy to local anesthetics, and open wounds on the foot. Patients meeting these criteria were asked to complete a questionnaire at the sixth-month follow-up after the procedure. The study was conducted following the principles of the Declaration of Helsinki and with the permission of the local ethic committee.

All patients' medical histories and visual analog scale (VAS) values for pain assessment before and after the procedure were noted from the medical records. We asked patients to fill out a questionnaire which we prepared to analyze the procedure's effectiveness. In the questionnaire; age, weight, height, occupation, localization of heel pain, duration of pain, treatments for heel pain, VAS scores before and after the procedure, how much percent of the patients' pain was resolved after the procedure, opinions about the success rate of the procedure and whether the patient would recommend this treatment to another relative with heel pain were asked. Pain levels and changes in pain levels were collected with a 10-cm VAS score sheet. Adverse events were asked about in the questionnaire. Patients filled the questionnaire alone, and a medical doctor helped if any patient did not understand the questions.

Under the supervision of a senior surgeon, various clinic surgeons with the RFNA device (COOLIEF ® Cooled Radiofrequency; Belgium) performed the procedures in the intervention room. Materials for nerve ablation are a grounding pad, needle (cannula) with stylet, electrode probe (with 5 mm long destructive tip), povidone-iodine, sterile gauze, and sterile cover. The first step is to get informed consent from the patient and check the pain area in the heel. The second is placing the RF grounding pad on the patient's ipsilateral calf. Skin antisepsis was performed with povidone iodine. After skin preparation, local anaesthesia was obtained with 2 ml 1% lidocaine hydrochloride injection to the heel's medial aspect where the pain is located. After checking the numbness, a sterile needle was inserted through the calcaneus' anteromedial aspect to target the calcaneus' anteromedial aspect, where sensory nerve branches of the heel were located. The medial calcaneal branch and the anterior and posterior portions of the inferior calcaneal branch of the posterior tibial nerve are targeted. These three nerves provide sensory feedback to the anterior medial tubercle of the calcaneus and medial and posterior portions of the calcaneus(6). Next, an RF electrode was inserted through the cannula. For checking the electrode placement, sensory stimulation was performed by increasing the voltage at 50 Hz from 0, until the patient began to feel a tingling sensation. After that, the procedure is continued according to the patient's feedback. The procedure is stopped if any adverse event (allergic reaction, severe pain) happens. The procedure starts when the patient feels the stimulus distinctly. For example, if the stimulus could not be felt distinctly by a patient at 1.0 volt, the surgeon's needle's position would be checked and replaced if necessary. Ideally, the sensation should occur with a stimulus of fewer than 0.5 volts at 50 Hz. This step aims to determine whether the probe is on the motor or sensory nerve. If the probe is on the motor nerve, involuntary muscle contraction and foot movements will be seen when up to 2 volts stimulus is given. Fasciculations such as contractions in the foot muscles indicate that the motor neuron is targeted. The probe is repositioned whenever there is doubt that the probe is on the motor neuron. Another distinctive feature is that the electrical signal required for motor neurons' stimulation occurs at a lower frequency, while sensory neurons can be stimulated at faster frequencies. For example, it is possible to stimulate the sensory neuron with a 50 Hz electrical signal, while the 2 Hz frequency of the electrical signal is sufficient to stimulate motor neurons. Therefore, after finding the calcaneal nerve (LBCN) sensory branch, 1 mm 0.5% bupivacaine was injected through the cannula to obtain painless nerve ablation. Subsequently, ablation begins with a maximum temperature of 90° C. Ablation lasts 90 seconds; this time and temperature settings are selected according to previous studies(6,11). It was the last step of the procedure; subsequently, the cannula was withdrawn, a sterile bandage was applied, and the patient was allowed to tolerate all normal activities, such as ambulation on the operated foot. In addition, anti-inflammatory drugs were prescribed for diminishing pain or ice compresses to the heel.

Statistical analysis

Data were analyzed using the SPSS ver. 20.0 (IBM Co., Armonk, NY). The variables were investigated using visuals (histograms and probability plots) and a Kolmogorov–Smirnov test to determine whether they were normally distributed. In reporting descriptive

statistics, the data were expressed as mean ± standard deviation and median (minimum-maximum) for continuous variables and as frequency and percentage (%) for nominal and categorical variables. In addition, a one-way analysis of variance tests was used to compare the patients' VAS scores.

RESULTS

In this retrospective study, we analyzed 78 patients (84 feet), 13 patients were male (17%), and 65 were female (83%). The mean age was age 52,3±10,7, and the mean BMI was 32±4,8. Twenty-one patients had bilateral heel pain, 21 had a right heel, and 36 had left heel pain. More than half of the patients, primarily women, were housewives, 61%. More than half of patients with hypertension (65%) and diabetes mellitus (44%) and coronary heart disease were seen in 20% of patients with heel pain. 97.4% of the patients felt pain under the heel, and 30% felt pain in the medial side. Forty-four patients (57%) were stricken to heel pain for more than one year, and the rest were more than six months. 81% of the patients used arc-supporting orthosis, and 62% did stretching exercises. (Table 1). Of the 84 feet, 10 (14.3%) received ESWT, 18 (25.7%) received steroid injections, and 57 (%81.4) patients used arch-support orthosis, 44 (62.9%) underwent a stretching regimen. All 84 feet were unresponsive to these previous treatments.

Ablation was performed on six patients, both heels, 30 patients' right heels, and 42 patients' left heels. The mean VAS score for all patients before the ablation procedure was 9.1±1.4, and six months after the procedure was 3.5 ±2.7 ($p<0.001$). According to patients' opinions, twenty-five of the patients think the procedure was successful, 37 think it was very successful, and 16 found it was unsuccessful (Figure-1).

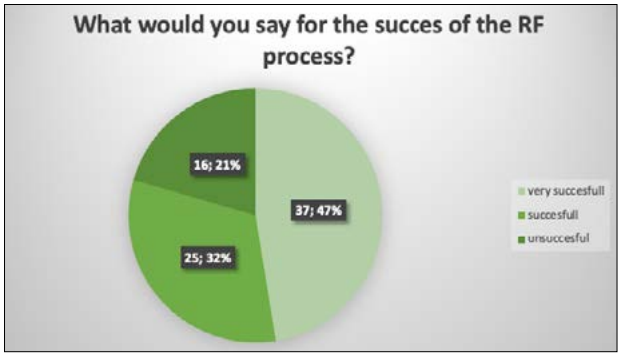

Figure 1. Success of RF therapy from the patients' eyes

According to the patient's report, 44.2% of patients said they almost had a painless heel after the procedure, and 27.3% said more than half of the pain was resolved. Also, 13% of the patients said less than 50% of the pain had a reduction, while 15% said there was less than a 10% reduction (Figure 2).80% of patients stated that they could recommend this procedure to relatives suffering from the same problem. After the procedure, one adverse event was stiffness in the medial heel region, resolved by ice compression and rest. Of the 78 patients, 6 (7.7%) had received RFNA to both heels. All 62 patients rated the treatment as either very successful or successful, of the 16 (20.5%) patients who had placed the treatment as either fair or poor.

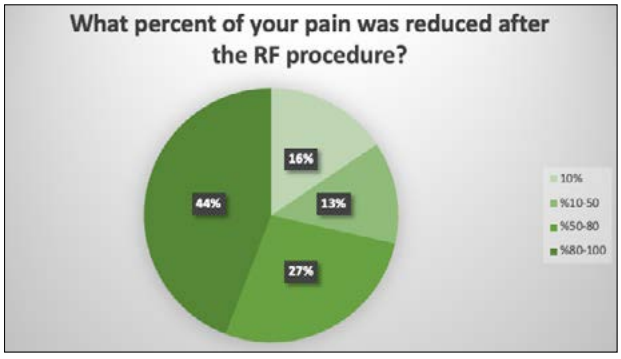

Figure 2. Pain reduction rate of RF procedure according to patients' report

DISCUSSION

We found that radiofrequency nerve ablation is a successful, non-surgical treatment option for chronic heel pain. Chronic heel pain is a disease that makes daily life unbearable and restricts the person from standing all day long. Although there are various conservative treatment methods for heel pain, surgical methods come into play when conservative methods are insufficient. The successful results of RFNA, an alternative to surgical procedures, are seen in this article.

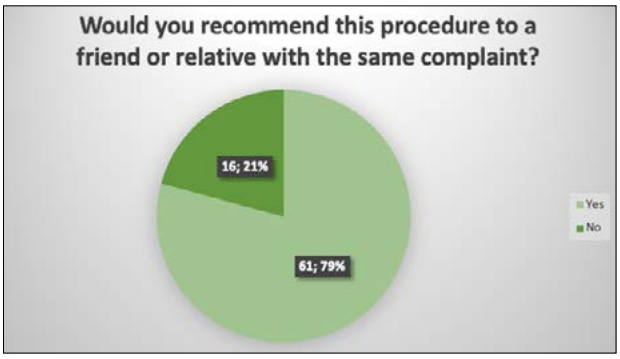

Figure 3. Patients were asked whether they would recommend the RFNA procedure to their relatives

Plantar heel pain is a common, disabling symptom among adults aged 40 years and over; in our study, the mean age was 52, and 84% of patients were female, as mentioned in the literature. Obesity and pronated foot posture are associated with heel pain and may be risk factors for developing chronic heel pain(3,4,12). Our study population's average body mass index was 32±4, supporting the current data. Diabetic patients are particularly at risk due to common risks and co-morbidities such as obesity or a sedentary lifestyle. Similarly, in the present study, 44% of patients with diabetes mellitus and 66% have hypertension, which may show us a sedentary lifestyle related to plantar heel pain. High physical activity was negatively associated with posterior heel pain in either heel; similarly to this information, more than half of the patients in this study were housewives(12).

Plantar fasciitis-related heel pain could be treated in three steps: first, non-steroidal medication, stretching regimens, and activity modifications. Also, calcaneal spur and nerve entrapment (FBLPN) are treated in the same conservative manner(13). If the first step of treatment fails, the second step of treatment consists of corticosteroid injection, orthotics, and physical therapy usually has 85% to 90% success rate in treatment within 2 to 3 months (14). All our patients failed these treatment modalities and were treated for at least six months. Consequently, pre-treatment VAS scores were high. A statistically significant difference between the VAS scores before RFNA and six months after treatment was observed in the present study, as Liden et al. Of the patients, 20-30 % with heel pain need the third step of treatment, consisting of extracorporeal shock wave therapy (ESWT) and nerve ablation or surgical release interventions, a solution for chronic heel pain(6). Plantar fasciopathies could be treated with the endoscopic or open release of the plantar fascia with successful outcomes. Still, in some cases, persistent heel pain (5.6%), paresthesias or numbness (4.3%), soft tissue healing problems (1.7%), and superficial infection (0.4%) could have been seen(10). Surgical decompression and neuroma excision should be considered if conservative treatments are ineffective; radiofrequency nerve ablating is a desirable method instead of surgical treatment or an option to the surgical procedure. These cases, which are resistant to the conservative manner, could benefit from RFNA.

There was one adverse event that happened and was cured with ice compression and elevation of the extremity. That shows us that RFNA is a safe, repeatable procedure. ESWT is another safe and effective method of reducing pain in chronic plantar fasciitis. It is unclear which mechanism in ESWT relieves heel pain, but one of the theories is that ESWT causes injury to the calcaneal nerves. ESWT's success rate improved overall VAS pain by 60% (15). Also, ESWT is an operator-dependent technique, and outcomes are still controversial. In the current study, we ablated the sensory nerve that innervates the heel area to ease the heel pain, as done before by Liden et al. and Arslan et al. (6,11). RFNA is also an operator-dependent method, but voltage tests to ensure the needle is on the sensory nerve make RFNA's specificity superior to ESWT. Patients' feedback guides proper cannula placement, which is the most crucial step of the procedure. The possible complications include periosteal burns, skin burns, fat pad atrophy, and entire plantar surface denervation. For practitioners, placement of the needle is becoming proper through repetitive procedures. Also, we can say it is not an easy method to learn. The possible complications include periosteal burns, skin burns, fat pad atrophy, and entire plantar surface denervation, hematoma, skin burns, and fat pad atrophy were not observed. In this study, only one patient reported stiffness in the medial heel region.

In the present study, we have seen that patients suffering from heel pain resistant to conservative treatment methods benefit from RFNA therapy. The RFNA method, which is a hope for these patients with chronic heel pain, has given us the capability to deal with this situation with another non-surgical procedure. In this study, more than one surgeon performed the RFNA procedure under the supervision of

a senior surgeon. Although each surgeon used the same method, we observed a few unsuccessful attempts during the learning phase of the method. Nevertheless, we found that 80% of the patients were content with RFNA, and the pain resolution rate was 70.5%, different from Sollitto et al. and Liden et al (6,16). In another study, Cione et al. retrospectively analyzed 75 patients with calcaneal neuritis treated with fluoroscopically guided RFNA and reported a clinical success rate of 93.3% (17). Erken et al. reported 39 feet that had received RFNA to the FBLPN sensory branches, with a success rate of 85.7% at the 2-year follow-up period(18) . We think that having more than one practitioner in the study increased the number of unsuccessful attempts at the learning stage, which caused us to obtain less successful results than other researchers.

The present study has several limitations: a small number of patients, a single-center study, the follow-up schedule was six months, and close follow-up could better understand the short-term VAS score results. Nevertheless, most of the data were taken from the patient's records from the outpatient clinics and confirmed by personal conversation.

CONCLUSION

This study demonstrates that RFNA may ease heel pain resistance to prior conservative measures but is not an absolute or definitive treatment method. We can say that RFNA can be recommended as a non-surgical treatment, such as ESWT. This study shows us that RFNA is a safe option for resistant heel pain patients.

Declarations

The authors received no financial support for the research and/or authorship of this article. There is no conflict of interest.

This study was approved by the clinical research Ethics Committee of the University of Health Sciences Diskapi Yildirim Beyazit Training and Research Hospital (Date: 19.10.2020, Number: 68/06).

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