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Evaluating Extracorporeal Shockwave Therapy (ESWT) in Pain Relief for Plantar Fasciitis Patients: Insights from King Fahad Armed Forces Hospital, Jeddah, Saudi Arabia

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Abstract— Plantar fasciitis (PF) is a common foot condition that results in heel and arch pain, affecting mobility and quality of life. Despite its prevalence, there exists a significant lack of complete knowledge and awareness about PF among the general population in Saudi Arabia. Current study aims to evaluate the efficacy of Extracorporeal Shockwave Therapy (ESWT) in reducing pain in individuals with PF. A quasi-experimental methodology was used to assess the effects of ESWT of pain reduction. The research was carried out at King Fahad Armed Forces Hospital in Jeddah, Saudi Arabia, with the participants of 35 adults' patients meeting specific inclusion criteria. Baseline evaluation and measurements were performed throughout the 2nd and 4th weeks using validated outcome measure, Visual Analog Scale (VAS). The ESWT treatments were given twice a week over four weeks utilizing the ENDOPULS 811 device. The finding shows that there were significant decreases in pain intensity, as shown by mean of VAS ratings dropping from 7.29 ± 1.29 by the 4th week with p value less than 0.05. These results highlight the efficacy of ESWT in reducing pain in individuals with PF.

Index Terms—*Plantar Fasciitis, Extracorporeal Shockwave Therapy (ESWT), Pain Relief, Visual Analog Scale (VAS)*

I. INTRODUCTION

Plantar fasciitis is a prevalent cause of heel pain, affecting about 10% of the general population [1cooper], and approximately 27% of patients may have this condition without experiencing any symptoms [2]. Despite the term "plantar fasciitis" implying an inflammatory condition, recent research suggests that this foot disorder involving the plantar fascia, is more closely related with degenerative changes, leading to be classified as "fasciosis" or "fasciopathy" [3]. This condition is characterized by pain in the medial calcaneus tubercle when weight is put on it [4]. Individuals suffering with plantar fasciitis often endure intense pain in the heel, especially while taking their first steps in the morning or after periods of rest [5].

Conservative measures are usually the primary treatment for plantar fasciitis; however, 10% of patients do not respond to these interventions [6]. Although surgical surgery is unsuccessful in 2% to 35% of patients, it may be indicated in circumstances when conservative treatment fails. Both conservative and surgical procedures show minimal evidence of short-term pain relief with local corticosteroid therapy [7].

Extracorporeal shockwave therapy (ESWT) has grown in popularity as an alternate therapy for plantar fasciitis due to safe and effective in treating various musculoskeletal disorder [8] and has emerged as an option for cases of plantar fasciitis

that do not respond to conventional treatment [9]. It has been shown to relieve pain and enhance function in a significant percentage of cases [10]. The specific mechanisms by which ESWT treats musculoskeletal pain are not entirely known; nevertheless, studies have shown that ESWT may alter sensory nerve fibers, induce neovascularization, and stimulate collagen formation in the

affected tissues. This therapy technique has shown potential in delivering relief and improving outcomes for those with plantar fasciitis [11]

II. METHODOLOGY

Current study applied a quasi-experimental methodology to evaluate the efficacy of ESWT in the treatment of plantar fasciitis. Adult patients diagnosed with plantar fasciitis were recruited from the out-patient clinic after diagnosis by a medical officer. Prior to participating, all patients provided informed consent.

Inclusion criteria were: participants must experience plantar fasciitis for at least 1 month, with a normal body mass index (BMI), and strictly demonstrate adherence to the treatment plan for valid study findings.

Exclusion criteria were: individuals unable to comprehend English or Arabic are excluded. Those with contraindications for ESWT, such as bleeding or nerve disorder are excluded. Current use of pain medication, myositis ossificans, fractures, prior steroidal treatment, active infection, or existing wounds also lead to exclusion.

Thirty five participants were assessed before receiving treatment by blinded observer who was unaware of the details of the study. Extracorporeal shockwave therapy (ESWT) used is an electrohydraulic shockwave with a mean of 20.6 kV and 2,506 pulses, administered using the ENDOPULS 811 model by Enraf Nonius and the treatment were conducted by experienced physiotherapists which have been handling electrotherapy modalities for more than five years.

The treatment parameters consisted of a continuous wave type, with 10 Hz of frequency, 2.5 bar of pressure level, and
2000 shocks applied around the most painful point initially. The energy level was increased up to 3.5 bar based on the patient's response, with the final 400 shocks delivered at a frequency of 15 Hz. The therapy lasted for a length of four weeks, with session scheduled twice weekly. Each session had a duration of roughly 30 minutes. The pain level is measured by using the Visual Analog Scale (VAS) and the data recorded at baseline, the 2nd week, and the 4th week. Data analysis involved descriptive and inferential statistics using SPSS version 24. A result considered to be statistically significant if the *p*-value was <0.05.

III. RESULT AND DISCUSSION

Table 1 shows the mean scores of the pain in the 1st week reported an average pain score of 7.29 ± 0.57, decreased during the 2nd week of treatment, falling to 3.63 ± 2.24, and further decreases occurred in the 3rd week (2.49 ± 1.85). In the 4th week, the pain mean score reach at 1.77 ± 1.26 which showing the pain has been decreased. These values reflect a clear downward trend in pain intensity as patients advanced through the treatment weeks, as shown in Figure 1.

Table 1 Pain scores of the treatment between weeks for VAS (n = 35)

Treatment Weeks	Mean ± SD
1st Week	7.29 ± 0.57
2nd Week	3.63 ± 2.24
3rd Week	2.49 ± 1.85
4th Week	1.77 ± 1.26

*SD: standard deviation

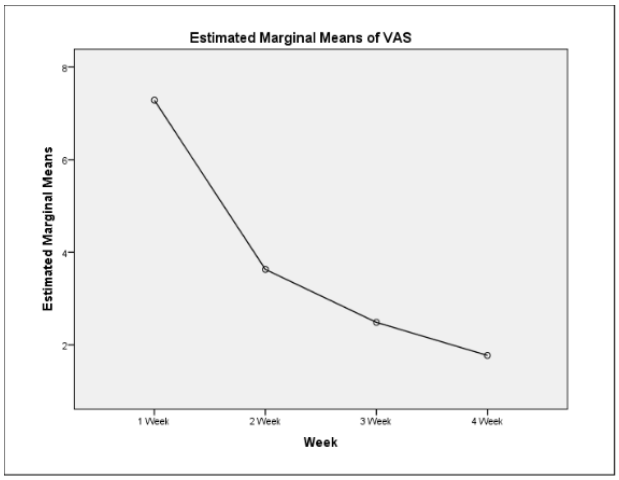

Figure 1 Mean Visual Analog Scale (VAS) versus Week

Table 2 shows the comparison of treatment between weeks for the pain scores level calculated by VAS. In the initial week, the mean pain was recorded at 7.29 ± 0.57. As the treatment advanced to the 2nd week, there was a significant reduction in level, with the mean pain score decreasing significantly to 3.66 ± 0.39 (p<0.05). In week 3, the mean pain score decreased to 2.49 ± 1.85 (p<0.05), followed by a considerable decrease in week 4 to 1.77 ± 1.29 (p<0.05). Upon comparing the mean pain scores between different weeks, it becomes apparent that the reduction in pain remained consistently significant throughout the course of treatment. The observe pattern is supported by the *p*-values, which were all determined to be less than 0.05.

Moreover, interesting insights emerge when pain levels between certain weeks are compared. The mean pain score decreased by 3.66 ± 0.39 units between week 1 and week 2, which was statistically significant. Similarly, there was a significant drop in the mean pain score of 1.14 ± 0.39 (p = 0.02) from week 2 to week 3. Between weeks three and four, there was another significant pattern of continuous pain relief, with a modest decrease in mean pain score of 0.71 ± 0.39 (p = 0.25); however, the statistical significance was not as pronounced in this case.

Table 2 Comparison of the treatment between weeks for VAS (n = 35)

Weeks		Mean ± SE	*p*-value
(I)	(J)	(I-J)	

Week 1 (7.29 ± 0.57)	Week 2 (3.63 ± 2.24)	3.66* ± 0.39	0.00
	Week 3 (2.49 ± 1.85)	4.80* ± 0.39	0.00
	Week 4 (1.77 ± 1.29)	5.51* ± 0.39	0.00
Week 2 (3.63 ± 2.24)	Week 3 (2.49 ± 1.85)	1.14* ± 0.39	0.02
	Week 4 (1.77 ± 1.29)	1.86* ± 0.39	0.00
Week 3 (2.49 ± 1.85)	Week 4 (1.77 ± 1.29)	0.71 ± 0.39	0.25

*Level of significance is at *p*-value of less than 0.05; One-Way MANOVA was used followed by Post Hoc Test: Tukey HSD.

This implies that after reaching the 3rd week, there might not be much further reduction in pain achieved, at least within the parameters of the current study or intervention. However, from a broader perspective, as the week progressed, there was a decrease in the mean of the VAS scores, indicating a reduction in pain. The study's findings align with prior research by Krishnan et al., demonstrated the efficacy of ESWT in treating PF by reporting a mean VAS decreased from 9.2 to 3.4 four weeks after treatment (12). Supported by a meta-analysis study conducted by Sun et al. found that ESWT is effective in the management of chronic PF, with success rates ranging from 80% to 88% in significantly reducing heel pain (13).

According to Yao et al., the therapeutic effect of ESWT often begin around two weeks following the treatment and may provide benefits on pain and activity levels for an extended period (14). Aqil et al. 2013 state that ESWT is a safe and effective treatment option for persistent plantar fasciitis that resists non-operative approaches. Pain scores improved at the 12-week point after treatment, and there are signs that this improvement persists for a duration of up to 12 months. Suggestion to employ ESWT for individuals experiencing considerable heel pain, even after a minimum of 3 months of non-operative therapy. The current study revealed a pain reduction through 4 weeks of treatment, revealing that the effectiveness of ESWT can be seen in a short time. An equivalent finding from another study discusses the effectiveness of ESWT Al-Siyabi et al. in 2020, shows ESWT being potentially more effective in reducing pain levels compared to the UST (15).

The therapeutic benefits of ESWT are well documented in the literature. When shockwaves pass through human tissues, they are considered to trigger four different phases of physiological changes (16). The first phase comprises a direct mechanical contact of the shockwave, causing extracellular cavitation and ionization of molecules, consequently enhancing membrane permeability. Subsequently, the physical-chemical phase involves interactions between diffusible radicals and biomolecules, which can impact cellular components such as lysosomes and mitochondria, hence exerting an influence on metabolism. The third phase follows, characterized by molecular changes and intracellular reactions, which are often accompanied by elevated temperatures caused by cavitation-induced radicals. The final biological phase includes physiological reactions that result from persistent changes in the preceding stages (17).

Although the exact analgesic mechanisms of shockwave treatment remain unclear, it is proven to reduce pain. Some suggest shockwaves may damage nerve endings; however, according to Sun et al., the gate control theory suggests that ESWT could minimize pain by enhancing nerve signals transmission via nociceptor nerves (13). Moreover, Wu et al. suggested that ESWT could boost local blood flow (hyperemia) to speed up inflammatory breakdown, reducing nerve-ending discomfort and pain. It was believed that the ESWT induces mild nerve tissue damage and speeds up recovery (18).

Further research performed afterward by Guo et al. in 2022 also mentioned that ESWT promotes nerve growth and healing. Believe that ESWT changes things in molecules and cells, hence facilitating the healing process of injured nerve tissues in the brain and spinal cord. It is also possible for ESWT to cause small damage to soft tissues, which help the body heal by releasing growth factors and bringing in stem cells that can help (19).

IV. CONCLUSION

The results of the current study revealed a statistically significant reduction in pain levels among the participants over the course of the treatment, as evidenced by the consistent and substantial decrease in VAS scores seen throughout the four-week treatment period. Current study emphasizes ESWT's effectiveness in pain reduction for PF, recommending the application in physiotherapy practice. Future suggestions should focus on broadening the patient group to include a diverse population, extending long-term follow-up to evaluate long-lasting benefits, investigating occupational that could influence on PF, in order to enhance understanding and tailoring the management of PF with ESWT.

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