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EFFECTIVENESS OF EXTRACORPOREAL SHOCK WAVE THERAPY IN COMPARISON WITH OTHER METHODS OF TREATMENT OF PATIENTS WITH PLANTAR FASCIITIS: LITERATURE REVIEW

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Цитування: *Медичні перспективи. 2024. Т. 29, № 3. С. 20-26*

Cited: *Medicini perspektivi. 2024;29(3):20-26*

Key words: *plantar fasciitis, extracorporeal shock wave therapy, comparison, conservative treatment, physiotherapy*
Ключові слова: *плантарний фасциїт, ударно-хвильова терапія, порівняння, консервативне лікування, фізіотерапія*

Abstract. *Effectiveness of extracorporeal shock wave therapy in comparison with other methods of treatment of patients with plantar fasciitis: literature review. Ovchynnikov O.M., Bludova M.O., Merkulova T.V. Plantar fasciitis (PF) is one of the most common causes of pain in the heel area, which is associated with the presence of inflammation in the plantar fascia and is most often localized in the medial part of the heel area. Extracorporeal shock wave therapy (ESWT) is a method of hardware treatment that has been used in orthopedics and traumatology for the past decades. One of the main diseases successfully treated with this method is plantar fasciitis. The aim of the work was to determine the effectiveness of extracorporeal shock wave therapy in the treatment of plantar fasciitis compared to other methods of conservative treatment based on the literature review. Research literary sources from scientific electronic databases PubMed, Medline and other sources of scientific and medical information were analyzed. A literature search was performed using search queries specifying the method under study and plantar fasciitis, namely: «Extracorporeal Shockwave Therapy», «Plantar Fasciitis», «Conservative Treatment», «Physiotherapy». During the search, 473 scientific articles devoted to the treatment of plantar fasciitis were selected. Given the large number of articles and the desire to present up-to-date data, the query was limited to the last 9 years (from 2015 to 2023) and 417 articles were selected. Articles devoted to other methods of treatment of PF (conservative and surgical) and articles devoted to the use of ESWT in orthopedic and traumatological diseases of other localizations were excluded from the search results. At the second stage of the search, articles devoted exclusively to the treatment of PF by the ESWT method were excluded, and sources comparing the effectiveness of ESWT treatment with other methods of conservative treatment were selected (31 articles). The main results – it was determined that extracorporeal shock wave therapy continues to remain one of the main methods of conservative treatment of PF, which has been used for the last decades. It has proven its high efficiency and safety in the treatment of PF. Compared with other methods of conservative treatment of PF, extracorporeal shock wave therapy remains one of the most effective, it is successfully used in the treatment of PF.*

Реферат. *Ефективність екстракорпоральної ударно-хвильової терапії порівняно з іншими методами консервативного лікування пацієнтів з плантарним фасциїтом: огляд літератури. Овчинніков О.М., Блудова М.О., Меркулова Т.В. Плантарний фасциїт (ПФ) є однією з найчастіших причин болю в п'ятковій ділянці, який пов'язаний з наявністю запалення в плантарній фасції та найчастіше локалізується в медіальному відділі п'яткової ділянки. Екстракорпоральна ударно-хвильова терапія (ЕУХТ) – метод апаратного лікування, що використовують в ортопедії та травматології останні десятиріччя. Одним з основних захворювань, які успішно лікують за допомогою методу, є плантарний фасциїт. Метою роботи було визначити ефективність екстракорпоральної ударно-хвильової терапії при лікуванні плантарного фасциїту порівняно з іншими методами консервативного лікування за даними літературного огляду. Проаналізовано літературні джерела з наукометричних електронних баз даних PubMed, Medline та інших джерел науково-медичної інформації. Пошук*

літератури виконано з використанням пошукових запитів із вказанням методу, який досліджується, та плантарного фасціїту, а саме: «Extracorporeal Shockwave Therapy», «Plantar Fasciitis», «Conservative Treatment», «Physiotherapy». При проведенні пошуку відібрано 473 наукові статті, які присвячені лікуванню плантарного фасціїту. Ураховуючи велику кількість статей та бажання представити сучасні дані, запит було обмежено останніми 9 роками (з 2015 до 2023 року) та відібрано 417 статей. З результатів пошуку було виключено статті, які присвячені іншим методам лікування ПФ (консервативного та хірургічного), та статті, присвячені використанню ЕУХТ при ортопедо-травматологічних захворюваннях інших локалізацій. На другому етапі пошуку виключено статті, присвячені виключно лікуванню ПФ методом ЕУХТ, і відібрано джерела порівняння ефективності лікування ЕУХТ з іншими методами консервативного лікування (31 стаття). Основні результати: визначено, що екстракорпоральна ударно-хвильова терапія продовжує бути одним з основних методів консервативного лікування ПФ, який використовують протягом останніх десятиліть. Він довів свою високу ефективність та безпечність при лікуванні ПФ. Порівняно з іншими методами консервативного лікування ПФ екстракорпоральна ударно-хвильова терапія залишається однією з найефективніших, її успішно використовують у лікуванні ПФ.

Plantar fasciitis (PF) is one of the most common causes of heel pain, which is associated with inflammation in the plantar fascia and is most often localized in the medial part of the heel area [1, 2, 3]. Pain from PF typically worsens after overloading the foot, periods of rest, after sleep, and gradually decreases with the onset of walking. It is also noted that approximately 90% of patients begin treatment with conservative methods [2, 4, 5].

Conservative treatment methods include rest, unloading, orthotics, exercise, physiotherapy, the use of nonsteroidal anti-inflammatory drugs (NSAIDs), and local corticosteroid injections [1, 2, 4].

Recently, extracorporeal shock wave therapy (ESWT) has become a popular method for treating PF. ESWT is based on the impact of a sound wave characterized by short duration, high pressure amplitude, and a relatively low tensile wave component. The mechanism of ESWT's effect on human tissues is not yet fully understood, although there are many studies in the literature on the impact of ESWT on human and animal tissues [3, 6, 7].

In the conducted review, we attempted to evaluate the effectiveness of ESWT in treating PF compared to other conservative methods based on data of scientific literature sources.

The aim of this study was to determine the effectiveness of extracorporeal shock wave therapy in treating PF compared to other conservative treatment methods based on a literature review.

MATERIALS AND METHODS OF RESEARCH

Publications from scientific metric electronic databases such as PubMed, Medline, and other relevant sources of scientific and medical information were analyzed.

The literature search was conducted using search queries specifying the method being studied and plantar fasciitis, namely: "Extracorporeal Shockwave Therapy," "Plantar Fasciitis," "Conservative Treatment," and "Physiotherapy." Bibliographic and

analytical research methods were used for searching and analyzing information.

A total of 473 scientific articles were found using the above search queries. Given the large number of articles and the desire to present up-to-date data, the query was limited to the last 9 years (from 2015 to 2023), resulting in 417 articles. Sources focused on diseases of other localizations, other conservative and surgical treatments for PF, and studies involving MRI (magnetic resonance imaging) and ultrasound investigations were excluded from the search results. After this selection process, 74 articles remained, from which articles dedicated exclusively to the ESWT method (without comparison to other PF treatment methods) were excluded. In total, 31 articles were selected for detailed analysis by the authors. Of the sources used, 23 (72 %) are in open access.

RESULTS AND DISCUSSION

Comparison with Several Conservative Treatment Methods for PF

In a meta-analysis (41 studies with 2,889 cases), 8 treatment options for PF were compared: ESWT, treatment with nonsteroidal anti-inflammatory drugs (NSAIDs), autologous blood injection, platelet-rich plasma (PRP), botulinum toxin A, glucocorticoid injections (GCIs), acupuncture, and ultrasound therapy. The authors concluded that ESWT might be the optimal treatment for PF, while botulinum toxin A and PRP were considered less optimal [10].

In a prospective randomized controlled study (44 female patients divided into 3 groups), pain, fatigue, and walking distance were evaluated with ESWT combined with therapeutic exercises, ultrasound therapy (UT) combined with therapeutic exercises, and a group receiving only therapeutic exercises. The study results showed that ESWT, UT, and therapeutic exercises are effective in treating PF [11].

Sun K. et al. conducted a meta-analysis to compare the effectiveness of ESWT with other conservative treatment methods (CTM) for PF. The analysis included

13 studies involving 1,185 patients (637 received ESWT, and 548 received other conservative treatments). The authors found that patients treated with ESWT had better outcomes, fewer complications, and a clear difference in effectiveness compared to other PF therapies [12].

In a retrospective study (217 patients divided into 3 roughly equal groups), Erden T. et al. compared ESWT (3 sessions with varying intensity), local glucocorticoid injections and radiofrequency thermal treatment (RTT) using ultrasound. They found that all procedures were approximately effective after one month of follow-up. However, after 3 and 6 months, ESWT proved to be less effective compared to the other treatments. No complications were observed following sessions of GCIs, ESWT, or RTT [13].

A similar study was conducted by Yapici F. et al. [14], who retrospectively compared GCIs, ESWT, and RTT in 229 patients divided into 3 groups. They found all procedures to be equally effective. In the initial treatment phase, GCIs or ESWT can be used. RTT should be considered for patients who do not respond to these treatments.

Physical therapy methods for treatment

In a prospective randomized controlled trial (34 patients), pain levels and foot function were assessed using the assessed pain reduction (VAS) and Foot Function Index (FFI) scores with ESWT and low-intensity laser therapy. Both groups achieved good treatment outcomes [15].

In a prospective randomized controlled trial (54 patients with PF), participants were divided into 3 groups: ESWT (3 sessions), ultrasound therapy (7 sessions), and a control group. All groups received additional PF-specific exercises. The results showed a decrease in FFI values in all groups, with a more pronounced reduction in the ultrasound therapy group compared to the others. Proprioceptive sense in the ankle joint increased only in the ESWT group [16].

Koz G. et al. conducted a prospective randomized controlled trial (40 patients), comparing low-dose laser therapy (LDT) and ESWT. They found significant improvements in pain, functional status, and daily activities with either treatment method. Additionally, LDT was shown to be significantly more effective for pain relief than ESWT in treating PF [17].

Timurtaş E. et al. conducted a prospective randomized controlled trial (47 patients) comparing these two methods. Over 3 weeks, each patient received either 1 session per week of ESWT or 3 sessions per week of LDT. LDT showed better results than ESWT in short-term treatment [18].

Al-Siyabi Z. et al. compared ESWT and ultrasound therapy in 7 studies involving 369 patients. They found that ESWT was significantly more

effective in improving activity levels, reducing pain intensity, primary effectiveness, and limiting activity compared to UT [19].

Glucocorticoid injections

Today, glucocorticoid injections are one of the most common methods for treating plantar fasciitis. In the studies listed below, the authors compared the effectiveness of two methods (ESWT and GCIs).

In a meta-analysis [20] (9 RCTs including 658 cases), the authors compared the effectiveness of low-energy and high-energy ESWT and GCIs for PF. The study found that, after 3 months of treatment, high-energy ESWT was the most effective, while low-energy ESWT and GCIs were approximately equally effective.

In a prospective randomized controlled trial, the authors compared the effectiveness of ESWT (49 patients) and GCIs (47 patients) for treating PF. Both groups showed equal effectiveness in the short term, but after 3 months, the ESWT group was found to be more effective [21].

Mishra B.N. et al. conducted a prospective randomized controlled trial (60 patients) comparing the effectiveness of local methylprednisolone injections and ESWT. According to the evaluation results at 1.5, 6, and 12 months, ESWT was found to be more effective than injections [22].

Eslamian F. et al. compared 40 patients divided into 2 groups (5 sessions of ESWT and local GCIs). Both groups showed a reduction in pain and improvement in functional ability 2 months after treatment. Although the intergroup differences were not significant, the FFI improved more with ESWT, and patients in this group reported higher satisfaction [23].

Mardani-Kivi M. et al. in their study (68 patients) also compared the effectiveness of GCIs and ESWT (3 sessions), assessing the effect 3 months after treatment. Pain intensity significantly decreased in all patients in both groups [24].

In contrast to the previous study, Lai T.W. et al. in a prospective randomized controlled trial (2 groups of 97 patients) assessed pain reduction and plantar fascia thickness (using ultrasound) 3 months after treatment. They found that the ESWT group showed a more significant reduction in pain and a decrease in fascia thickness on ultrasound [25].

In the meta-analysis [26] (6 studies, 454 patients), the authors did not find a significant difference between the two treatment groups. However, there was a statistically more pronounced reduction in pain in the ESWT group.

Orthotic insoles and footwear

Two studies were dedicated to comparing the effectiveness of orthotic insoles and footwear with ESWT.

In a prospective randomized controlled trial, the authors compared the effectiveness of ESWT (40 patients) with custom orthotic insoles (43 patients). Both groups achieved significant improvement in our assessment parameters (morning and evening pain) at weeks 4, 12, and 24 compared to their baseline values [27].

Eun S.S. et al. in a prospective randomized controlled trial (40 patients) compared the effectiveness of 4 sessions of ESWT with a weekly interval and the use of double-air-cushion footwear for PF. Both methods were approximately equally effective [28].

Kinesiotaping

Bahar-Ozdemir Y. et al. conducted a prospective randomized controlled trial (45 patients) comparing the effectiveness of ESWT in three groups: 1 – ESWT combined with kinesiotaping (KT); 2 – ESWT combined with sham taping; 3 – ESWT alone. No differences were found between the groups regarding VAS scores. Although KT combined with ESWT was more effective for improving foot function compared to sham taping and ESWT alone, it did not provide significant benefits regarding pain and heel sensitivity in PF [29].

An interesting comparison of ESWT and kinesiotaping for PF was conducted in a prospective randomized controlled trial by Ordahan B. et al. (80 patients divided into 2 groups). The authors found both methods to be equally effective in treating PF [30].

Tezel N. et al. in a short-term follow-up (6 weeks) conducted a prospective randomized controlled trial (40 patients in each of 2 groups) comparing the effectiveness of kinesiotaping and ESWT for treating PF. Both methods were equally effective in reducing pain, but the KT group showed better functional results according to the FFI index [31].

Platelet-rich plasma

Pandey S. et al. conducted a study (72 patients) on the effects of platelet-rich plasma (PRP) and ESWT for treating PF. Each patient underwent one procedure. The effect was evaluated on the 15th, 30th, and 90th days after the intervention. On the 15th and 30th days, both procedures were equally effective, but by the 90th day, better results were observed in the PRP group [32].

Haddad S. et al. in a randomized controlled trial (110 patients divided into 2 groups) also investigated the effectiveness of PRP and ESWT (3 sessions with weekly intervals). After one month, pain reduction, as measured by the VAS scale, was approximately equal in both groups. However, after 2 and 3 months, the PRP group showed more pronounced levels of pain reduction [33].

Other methods of treating plantar fasciitis

In a prospective randomized controlled trial (72 patients), the authors compared the effectiveness

of ESWT and botulinum toxin type A. The study found that the ESWT group experienced a more pronounced reduction in pain [34].

Kesikburun S. et al. in their study (29 patients) compared the effectiveness of prolotherapy using dextrose under ultrasound control and ESWT, evaluating pain dynamics and foot function. Each procedure was performed three times with a 2-week interval. The results showed that both procedures were equally effective [35].

Asheghan M. et al. in a prospective randomized controlled trial (59 patients) also compared prolotherapy with ESWT. Outcome measures were assessed before, and at 6 and 12 weeks after treatment. Dextrose prolotherapy showed comparable effectiveness to ESWT in reducing pain, functional limitations in daily life, and plantar fascia thickness in patients with PF [36].

In the study by Pisirici P. et al., 69 patients were divided into 3 groups: 1 – low-intensity ESWT with stretching exercises; 2 – plantar fascia mobilization using Graston tools and stretching exercises; 3 – patients performing only stretching exercises. Groups 1 and 2 had similar effects on initial pain reduction after 8 weeks of observation. However, Group 2 was found to be the most effective for improving functional status after 6 months in the treatment of PF [37].

Ozan F. et al. retrospectively evaluated the effectiveness of ESWT (4 sessions) and radiofrequency thermal treatment with 40 patients in the ESWT group and 16 in the RTT group. No side effects were noted in either group. The results indicated that both RTT and ESWT are safe and effective methods for treating patients with PF [38].

Tas NP. et al. [39] conducted a similar retrospective study with 159 patients divided into 2 groups. Both procedures (RFT and ESWT) were found to be equally effective. ESWT was more effective for pain relief, while RTT had a more pronounced impact on reducing work capability and activity limitations [39].

Wheeler P.C. et al. in a retrospective study (102 patients) compared the effectiveness of ESWT (3 sessions) and autologous blood injection using ultrasound navigation. The study showed statistically significant improvements in pain and local foot function after both procedures at 6 weeks, 3 months, and 6 months, but no statistically significant differences were observed between the groups at any of the studied time points [40].

In the literature review conducted, conservative treatment methods for plantar fasciitis were identified and compared with extracorporeal shockwave therapy. These included both invasive procedures such as botulinum toxin type A injections, corticosteroid injections, autologous blood injections, and

prolotherapy and non-invasive treatments such as nonsteroidal anti-inflammatory drugs, ultrasound therapy, low-level laser therapy, platelet-rich plasma, kinesiotaping, specialized footwear, orthotic insoles, and therapeutic exercises.

In most studies [11, 14, 15, 27, 28, 29, 30, 31, 32, 35, 36, 37, 38, 39, 40], the effectiveness of extracorporeal shockwave therapy (ESWT) was found to be similar to that of other conservative treatment methods for plantar fasciitis (PF), with statistically insignificant differences in some indicators. This includes comparisons with prolotherapy, RTT, PRP [25] (where both treatments were equally effective up to 90 days, with PRP being more effective afterward), KT, specialized footwear, orthotic insoles, UT, low-level laser therapy, therapeutic exercises, and acupuncture.

The ESWT procedure was found to be more effective in 9 studies [10, 18, 19, 21, 22, 23, 24, 26, 34].

When compared with one of the most common treatments for plantar fasciitis – steroid injections, ESWT was found to be superior according to data from [14, 15 (using 1 ESWT session), 16, 18, 19]. In one study, high-energy ESWT was found to be the most effective after 3 months of treatment, with low-energy ESWT and GCIs being approximately equal in effectiveness [13]. However, only in one study [17] was GCIs determined to be the superior method.

In five studies [13, 16, 17, 24, 33], the effect of ESWT was found to be less significant compared to other treatments such as low-dose laser therapy, platelet-rich plasma, radiofrequency thermal treatment, and steroid injections.

CONCLUSIONS

1. Analysis of the literature confirms that there are many conservative treatment methods available for plantar fasciitis.

2. Extracorporeal shockwave therapy is one of the most effective and safe procedures for treating plantar fasciitis, and it has been used for many years.

3. In most cases, ESWT (even with a small number of sessions) was comparable to or more effective than other treatment methods for plantar fasciitis.

4. The literature review highlighted conservative treatment methods for plantar fasciitis compared to ESWT, including invasive procedures such as botulinum toxin injections, corticosteroid injections, autologous blood injections, and RTT, as well as non-invasive methods like non-steroidal anti-inflammatory drugs, ultrasound therapy, low-level laser therapy, platelet-rich plasma, kinesiology taping, special footwear, orthotic insoles, and therapeutic exercises.

5. ESWT is non-invasive, making it a viable alternative for treating plantar fasciitis in patients with contraindications to invasive methods (e.g., allergic reactions).

6. ESWT remains one of the primary, most widespread, and effective methods for treating plantar fasciitis.

7. Further research is needed on the results in short-term and long-term follow-up periods for patients. Additionally, studies that combine ESWT with other conservative treatment methods to achieve better results in the treatment of plantar fasciitis would be promising. Research is also needed to assess the effectiveness of ESWT with an increased number of sessions.

Contributors:

Ovchynnikov O.M. – conceptualization, methodology, investigation, writing – original draft;

Bludova M.O. – investigation, formal analysis, data curation;

Merkulova T.V. – visualization, writing – review & editing.

Funding. This research received no external funding.

Conflict of interests. The authors declare no conflict of interest.

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Стаття надійшла до редакції 26.04.2024;
затверджена до публікації 16.07.2024

