

Effect of shock wave therapy on pain and daily functioning in patients with heel spurs

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Original article

Abstract

Introduction: One of the more common foot dysfunctions is a heel spur, which is a bony growth on the base of the heel bone. It is accompanied by pain. Extracorporeal shock wave therapy becomes an increasingly common, effective and non-invasive method of the heel spur treatment. The objective of this study is to assess the effect of shock wave therapy on pain and daily functioning in patients with the heel spurs.

Material and method: The study group consisted of 73 people with diagnosed the heel spurs and suffering from pain associated with this condition. Each participant underwent a series of 5 shock wave treatments with 7-day intervals. The treatments were conducted using an apparatus: BTL-5000 SWT POWER + HIGH INTENSITY LASER 12. This author's questionnaire and a Numeric Rating Scale (NRS) for pain were also used in this research.

Results: After applying the therapy, it was observed that there is a statistically significant decrease in the intensity of pain experienced by patients during the day (from 5.28 ± 1.46 to 1.1 ± 1.03) and at night (from 1.65 ± 1.84 to 0.17 ± 0.58). The statistical analysis also showed a significant decrease in the frequency of pain during the day and at night after applying shock wave. Before the therapy, the majority of patients indicated, that pain affected their professional activity rarely, often or very often. However, after the therapy, the majority of participants felt that pain does not affect their work. Similar results were obtained in relation to the question regarding the influence of pain on the performance of daily activities.

Conclusions: Shock wave treatments had the effect of reducing both the frequency and severity of pain. The treatments also reduced the negative impact of pain on professional and daily activities in the participants.

Keywords

- shock wave
- pain
- heel spur

Contribution

- A – the preparation of the research project
- B – the assembly of data for the research undertaken
- C – the conducting of statistical analysis
- D – interpretation of results
- E – manuscript preparation
- F – literature review

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Introduction

Human feet, being a supporting surface with a relatively small area of contact with the ground, are highly susceptible to the adverse effects of external factors, including microtrauma and overload. The conditions under which the feet function and their function predispose to the formation of various pathologies within them, affecting both bones and all soft tissues.^{1,2} One of the more common foot dysfunctions is a heel spur, which is a bony growth on the base of the heel bone. It is accompanied by pain. The main factors predisposing to the formation of the heel spur are the following: standing for a long period of time, intensive running, obesity, and flat feet.^{3,4} The pain that occurs in the course of the heel spur is located around the heel and increases with walking. Pain caused by this condition is often reflected in the functional status of the patient. Pain often causes a reduction in daily activities in terms of both work and leisure time.⁵

In addition to pharmacotherapy and anti-inflammatory physiotherapy treatments, an increasingly common method of treating the heel spur is Extracorporeal Shock Wave Therapy (ESWT). It is effective and non-invasive. What is more, it is currently one of the most modern methods of fighting pain and its causes.^{6,7} The therapeutic effect of the shock wave results from its physical properties, which translate into biological effects, including: increase in blood flow, influence on cell metabolism, stimulation of tissue regeneration or breaking the abnormal relationship between pain and muscle tension.⁷⁻⁹ Thanks to the shock wave, it is possible to reduce muscle tension, disperse substance P (inflammatory mediators), increase collagen production, accelerate metabolism and improve microcirculation, dissolve calcified fibroblasts or defragment and disintegrate calcareous deposits.¹⁰ The objective of this study is to assess the effect of shock wave therapy on pain and daily functioning in patients with the heel spurs.

Material and methods

The study group consisted of 73 people, including 36 women (49%) and 37 men (51%). The anthropometric characteristics of the participants are presented in Table 1. All participants underwent a series of 5 shock wave treatments. In order to be qualified for the examination, an orthopedist's diagnosis of the heel spur and pain associated with this disease were necessary. People who used other physiotherapeutic treatments for less than 3 months or who were injected with corticosteroids were excluded from the study. The research

was conducted in accordance with the ethical standards of the Declaration of Helsinki, and its participants signed an informed consent form.

Table 1. Anthropometric characteristics of the participants

Characteristics	Women			
	\bar{x}	SD	Min	Max
Age (years)	49.8	10.29	31	66
Body weight (kg)	66.4	9.22	47	87
Body height (cm)	167	5.85	156	176
BMI (kg/m ²)	23.9	2.74	18.8	29.6
Men				
Age (years)	48.1	9.69	32	71
Body weight (kg)	76.8	10.04	65	103
Body height (cm)	177	5.79	169	190
BMI (kg/m ²)	24.4	2.40	20.7	30.8
Whole group				
Age (years)	48.9	9.96	31	71
Body weight (kg)	71.7	10.93	47	103
Body height (cm)	172	7.87	156	190
BMI (kg/m ²)	24.1	2.57	18.8	30.8

The sitting position was the most frequently adopted body position by the participants during their work, with 29 people (39.73%) adopting it. Slightly less, i.e., 26 people (35.62%), assumed the sitting position and the standing position, while 18 people (24.66%) assumed the standing position.

In the study group, the period from the appearance of the first pain symptoms was varied and amounted to an average of 8 months \pm 7.41, and most of the participants reporting for shock wave therapy experienced pain between 4 and 12 months.

Most of the participants (43 people, 58%) used pharmacotherapy to ease their pain, while 30 people (41.10%) decided not to use such means. Among the people who used pharmacotherapy, 22 patients (51.16%) used only one method of pain relief, 14 patients (32.56%) used the combination of two types of pharmacological agents, and 7 patients (16.28%) received treatment in the form of three types of painkillers. Agents used included

analgesic / anti-inflammatory ointments, oral analgesic / anti-inflammatory agents, and corticosteroid injections.

The following were used to assess the treatment results:

1. Proprietary questionnaire – the questionnaire contained 20 questions, including 4 open-ended questions, 12 single choice questions and 4 closed multiple choice questions. The questionnaire was divided into two parts, the first part contained questions about medical records and information about previous treatment. In the second part, the patients answered questions about their health condition, the frequency of pain symptoms during the day and night, and the impact of pain on their work. To assess these indicators, a five-point Likert scale was used, where individual numbers were assigned the following answers: 1 – never; 2 – very rarely, 3 – rarely; 4 – often; 5 – very often. Additionally, the participants assessed the level of the impact of pain on daily activities.
2. NRS scale – to assess the severity of pain experienced by patients in two questions, the Numeric Rating Scale (NRS) was used, in which 0 indicated „no pain” and 10 indicated the most intense pain imaginable.

To perform the shock wave treatments, an apparatus generating a shock wave in a pneumatic manner was used, i.e., BTL-5000 SWT POWER + HIGH INTENSITY LASER 12 – to perform the shock wave treatments, an apparatus generating a shock wave in a pneumatic manner was used. Before starting the procedure, each patient was informed about the principles of the shock wave action and the possibility of side effects. Each of the project participants underwent a series of 5 treatments at 7-day intervals. The applied shock wave was continuous, its frequency was 10 HZ, the number of shocks was 2500, and the pressure changed depending on the treatment: the first and second treatments – 2.5 bar, the third treatment – 3 bars, the fourth and fifth treatments – 3.5 bara. During the procedure, the patient was asked to lie face down on the table, and for additional relaxation in the area of the ankle joints, a half roller was placed. According to the manufacturer's recommendations, apart from the most painful area in the palpation examination, the surrounding tissues were also exposed to the wave. A coupling medium in the form of an ultrasound gel was used for the procedure.

Statistical methods

Microsoft Office Excel and Statistica 10.0 were used to calculate the results. Descriptive statistics (mean, standard deviation, minimum and maximum) were used to prepare the data, whereas the dependent sample *t*-test and the chi-square test of independence were used to calculate the dependencies. A significance level of $p < 0.05$ was adopted in all the tests performed.

Results

The first indicator that underwent assessment was the level of pain intensity experienced during the day. Before the therapy, it was on average 5.22 ± 1.47 , while after the therapy, the average pain was assessed by the patients to be at 1.05 ± 1.05 . There was a statistically significant reduction in the pain intensity experienced by the patients during the day after the application of shock waves (Table 2).

The surveyed patients also assessed the level of pain intensity at night. Before the therapy, it was on average 1.66 ± 1.85 , while after the treatment, the patients rated pain on average at 0.15 ± 0.57 . As in the case of pain experienced during the day, pain experienced at night decreased statistically significantly after the application of shock wave therapy (Table 2).

Table 2. The level of intensity of pain experienced before and after the therapy

	N	\bar{x}	Me	Min	Max	SD
Before therapy, during the day	73	5.22	5.00	2.00	8.00	1.47
After therapy, during the day	73	1.05	1.00	0.00	4.00	1.05
Before therapy, at night	73	1.66	1.00	0.00	6.00	1.85
After therapy, at night	73	0.15	0.00	0.00	4.00	0.57

The participants also determined the frequency of pain during the day. Before the therapy, the majority of respondents stated that pain occurred very often, and after the therapy, more than half of the respondents indicated that pain occurred very rarely. The statistical analysis showed a significant decrease in the frequency of pain after applying shock wave (Table 3).

Another indicator assessed was the frequency of pain at night. Both before and after the therapy, the participants most often chose the answer „never”, however, after the use of shock wave treatments, the number of people choosing such a response increased significantly in statistical terms (Table 3).

Table 3. The frequency of pain during the day before and after therapy

Frequency of pain	During the day			P
	N	%		
Before therapy	never	0	0.00	< 0.001
	very rarely	5	6.85	
	rarely	7	9.59	
	often	37	50.68	
	very often	24	32.88	
After therapy	never	20	27.40	
	very rarely	44	60.28	
	rarely	9	12.32	
	often	0	0.00	
	very often	0	0.00	
At night				
Before therapy	never	33	45.20	< 0.001
	very rarely	12	16.44	
	rarely	8	10.96	
	often	16	21.92	
	very often	4	5.48	
After therapy	never	61	83.56	
	very rarely	9	12.33	
	rarely	2	2.74	
	often	1	1.37	
	very often	0	0.00	

The shock wave treatments also had a statistically significant influence on reducing the impact of pain on the professional work of the respondents. Before the therapy, the majority of patients indicated, that pain

affected their professional activity rarely, often or very often. However, after the therapy, the majority of participants felt that pain does not affect their work (Table 4).

Table 4. The level of the impact of pain on the professional work of the participants

Impact of pain on work	N	%	p	
Before therapy	never	3	4.11	< 0.001
	very rarely	11	15.07	
	rarely	26	35.62	
	often	16	21.92	
	very often	17	23.28	
After therapy	never	41	56.16	
	very rarely	23	31.51	
	rarely	8	10.96	
	often	1	1.37	
	very often	0	0.00	

The level of influence of pain on the performance of everyday activities was also assessed in the participants. As in the case of professional work, a significant impact of the shock wave on the level of pain, and thus indirectly on the performance of daily activities, was also observed here. After the therapy, the number of people who indicated that pain had an adverse effect on the performance of daily activities decreased significantly (Table 5).

Table 5. The level of the impact of pain on the performance of daily activities in the participants

Impact of pain on daily activities	N	%	p	
Before therapy	need to shorten the time needed to perform activities	27	36.99	< 0.001
	worse well-being	57	78.08	
	limitation of the type of activities performed	47	57.53	

Impact of pain on daily activities		N	%	<i>p</i>
Before therapy	occurrence of difficulties in performing an activity	50	68.49	< 0.001
	need to shorten the time needed to perform activities	2	2.74	
After therapy	worse well-being	10	13.70	
	limitation of the type of activities performed	5	6.85	
	occurrence of difficulties in performing an activity	10	13.70	

Table 6. Health assessment before and after therapy

Health status		N	%	<i>p</i>
Before therapy	excellent	1	1.37	< 0.001
	very good	4	5.48	
	good	21	28.77	
	satisfactory	16	21.92	
	unsatisfactory	31	42.47	
After therapy	excellent	14	19.18	
	very good	37	50.68	
	good	15	20.55	
	satisfactory	5	6.85	
	unsatisfactory	2	2.74	

The last assessed indicator was the health condition of the participants according to their own assessment. Before the therapy, the majority of people assessed their health as unsatisfactory, and after the therapy, the majority of patients assessed it as very good. The statistical analysis showed a significant improvement in

the assessment of the health condition of the patients participating in the study after the application of the shock wave therapy (Table 6).

Discussion

Nowadays, an increasing part of the population reports to orthopedist's and physiotherapist's offices with problems of the musculoskeletal system that cause pain. On the list of many diseases that patients have to face, the heel spur appears increasingly often. The pain that accompanies these pathological lesions frequently causes a reduction in the patients' quality and comfort of life, which translates into the patients' functional status both in terms of daily and leisure activities.

In order to eliminate pain during the treatment of the heel spur, pharmacotherapy and physical treatments (e.g., ultrasound, magnetotherapy, laser, electrotherapy, local cryotherapy) as well as, in a few cases, surgical removal are applied. However, as civilisation progresses and science develops, newer and newer methods of dealing with pain appear. Undoubtedly, such a method is the Extracorporeal Shock Wave Therapy (ESWT). The treatments in which it is used are not only applicable to the heel spurs, but also to many other diseases of the musculoskeletal system in which traditional methods did not bring the expected results.¹¹⁻¹³

Compared to traditional physical treatments, the shock wave therapy is a much less demanding method for the patient, as a single treatment is quite short and is performed at 7-day intervals, which does not require daily visits to the office. The short duration of therapy sessions is an additional advantage of the ESWT method, but the most important thing is its effectiveness. As shown through the survey performed with the use of the questionnaire containing, inter alia, the NRS for pain, the improvement is clear. In this authors' own research, both during the day and at night, patients experienced a decrease in pain intensity. The fact is that the NRS shows only the subjective feelings of patients, but taking into account the patients' functional status and comfort of life, it is this scale that provides the best answer to the question regarding the effectiveness of the procedure.

The extracorporeal shock wave therapy is nowadays one of the best methods of fighting pain caused by the heel spur. Agatowski,¹² Rompe,¹⁴ Przedborska et al.¹⁵ and many other specialists in the field of physiotherapy who use shock wave treatments in

their practice have come to similar conclusions in their work. This authors' own research has shown that the therapy consisting of 5 treatments is more effective compared to traditional physical treatments. Nearly half of the participants used other physical treatments before the shock wave treatments. Among these respondents, 54.3% felt a temporary improvement in their health, and 45.7%, unfortunately, did not feel any effects. A completely different situation can be observed after the shock wave treatments. When asked about the health condition before the therapy, as many as 31 people (42.47%) answered that it was unsatisfactory. After 5 treatment sessions, only 2 people (2.74%) did not feel any significant improvement, still assessing their health condition as unsatisfactory.

The period of time from the onset of the first pain in the study group was quite varied and it was on average 8 months ± 7.41 . For this reason, the time from the appearance of the first pain was divided into 3 periods, i.e., 1-3 months (34.20%), 4-12 months (50.70%) and > 12 months (15.10%). However, the statistical analysis did not show any relationship between the symptomatic period of the heel spur and the treatment effects. In each of the given time intervals from the onset of the first pain, positive effects were obtained in terms of reducing the intensity of pain, as well as everyday functioning and general well-being. In the research of Frank et al.¹⁶ the mean period of time from the onset of pain was 13.3 months. The authors noticed that the shock wave therapy has a positive effect on the reduction of discomfort related to the heel spur, even over such a long period of time. The mean assessment of pain intensity according to the VAS decreased. Before the therapy, the patients assessed their pain at an average of 8.8 degrees, and after the therapy - 6.7 degrees. In the authors' own research, the assessment of pain in relation to the NRS also improved, as discussed above.

The relationship between excess body weight and the presence of a heel spur may seem to be quite justified, taking into account the etiopathogenesis of the disease. Excessive body weight generates greater stress on the foot, thus exerting greater force on the plantar fascia. Lokrowski et al.¹⁷ proved in their research that 90% of women with obesity have plantar fasciitis. In this study, people with abnormal BMI accounted for 31.51% of the study group. Of those participants 28.77% were overweight, and only 2.74% were obese. While body weight may affect the appearance of the heel spur, as a result of this authors'

own analyses, no significant statistical correlation between the body weight of the studied subjects and the effectiveness of the therapy was found. The research carried out by Król et al.¹⁸ also shows the positive effect of the shock wave therapy in the symptomatic treatment of the heel spur. In their research, 30% of the group were people with excess body weight, and yet there was no significant difference between body weight and the effectiveness of the treatments.

Professional work takes more than half of the average person's day, so it is important to take care of the proper biomechanics of the musculoskeletal system during its performance. It should be remembered that the factors predisposing to the formation of the heel spur, and thus the pain associated with it, are incorrect stress on the lower limbs or maintaining one position for a long time. All this contributes to the formation of microtraumas that cause inflammation, which in turn stimulates the multiplication of osteophytes and the formation of the heel spur. Therefore, it can be assumed that people who work in a standing position are more prone to overload and the occurrence of this disease. On the other hand, a sedentary lifestyle may also contribute to the formation of the heel spur indirectly, i.e., the dominant flexion pattern disrupts the biomechanics of the lower limbs and also causes incorrect foot loading, which increases the risk of the heel spurs.^{19,20} Nevertheless, in this study, in order to analyse the results, the participants were divided into 3 groups, i.e., people performing their work while standing, sitting and mixing the two. After analysing the variables in each group, it was found that the body position most often taken by the participants during work does not affect the effectiveness of the therapy. Similar health improvement results were obtained in each group.

Many authors, such as Patel,²⁰ Rompe et al.,²¹ Czyrny,²² in their research suggest enthesopathy of the plantar fascia attachment as the cause of heel spurs. In each of the research articles mentioned, similar results of pain reduction after the ESWT treatment were obtained.²³ There are many research articles evaluating the effectiveness of the shock wave therapy in various respects. Taking into account the fact that the heel spur usually produces symptoms when there is inflammation of the plantar fascia to the calcaneal tuber, it is reasonable to use anti-inflammatory pharmacological agents or various types of physical treatments. However, the main purpose of the shock wave therapy is not only to relieve pain, but also to prevent its recurrence. The physical properties of the

shock wave allow for the defragmentation of the calcareous deposit, which is the heel spur. It is this bone growth that often irritates the place of attachment of the plantar fascia to the bone, thus stimulating the development of inflammation.^{8,9,23} People applying for the shock wave treatments have, on more than one occasion, sought the help of other specialists to ease their pain. Unfortunately, the treatment so far did not bring the expected results, or only effective for a short period of time. In this paper, and in the works of other authors,^{12,14-16} it was shown that the shock wave therapy significantly reduces the frequency and intensity of pain associated with the heel spur. It was observed that there is a noticeable impact of the therapy in terms of improved health, and thus increased quality of life. An analysis was performed that focused on various factors that could affect the effectiveness of the treatments, such as body weight, the period from the onset of pain, and body position during work. The statistical results showed that in each of the above-mentioned cases, the improvement in health and its subjective assessment are at a similarly high level. In conclusion it may be stated that the shock wave therapy is a modern, non-invasive and above all effective method of treatment of the heel spur, which largely improves the patients' quality of life.

Conclusions

The shock wave therapy had a statistically significant effect on reducing both the frequency and intensity of pain both during the day and at night in the patients with the heel spur who participated in the study.

The shock wave therapy significantly reduced in statistical terms the negative impact of pain on both professional work and the performance of daily activities in the participants.

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