

Momot-Kuryło Magdalena, Grzegorzczuk Michal. Effectiveness of using the shock wave in selected dysfunctions of the musculoskeletal system. *Journal of Education, Health and Sport*. 2022;12(1):292-311. eISSN 2391-8306. DOI <http://dx.doi.org/10.12775/JEHS.2022.12.01.25> <https://apcz.umk.pl/JEHS/article/view/JEHS.2022.12.01.025> <https://zenodo.org/record/5913275>

The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of December 21, 2021. No. 32343. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical Culture Sciences (Field of Medical sciences and health sciences); Health Sciences (Field of Medical Sciences and Health Sciences).

Punkty Ministerialne z 2019 - aktualny rok 40 punktów. Załącznik do komunikatu Ministra Edukacji i Nauki z dnia 21 grudnia 2021 r. Lp. 32343. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).

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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 02.01.2022. Revised: 17.01.2022. Accepted: 28.01.2022.

Effectiveness of using the shock wave in selected dysfunctions of the musculoskeletal system

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Introduction

In medicine, the shockwave was first used in the 1980s for lithotripsy [1]. Over time, new reports appeared about its positive impact on the human body, including on the musculoskeletal system. Nowadays it is successfully used in many fields of medicine.

Objective of the work

The aim of the study was to evaluate the effectiveness of the shock wave application in patients with patellar ligament enthesopathy, lateral epicondylitis of the humerus and heel spur.

Material and methods

The research was carried out in CM Luxmed, ul. Zwycięska 6a and CM MEDISPORT at ul. Łąbędzia in Lublin in the period from 01/12/2020. until December 10, 2021 75 patients took part in them. 25 of them were diagnosed with patellar ligament enthesopathy, another 25 with lateral epicondylitis of the humerus. The remaining 25 people received shock wave treatments for the heel spur. Each respondent underwent 5 shock wave treatments. Before starting the research, the respondents were informed about the purpose of the research. Moreover, they were guaranteed anonymity.

Results:

Among the surveyed people, in general, 50.7% (n = 38) of all respondents were women, and 49.3% (n = 37) - men. 36% (n = 9) women and 64% (n = 16) men were among the respondents treated for lateral epicondylitis of the humerus. In the case of the jumper's knee, the study group consisted of 60% (n = 15) women and 40% (n = 10) men, while in the group of patients with the heel spur, women constituted 56% (n = 14), and men 44% (n = 11).

Conclusions:

Based on the research carried out, the following conclusions can be drawn:

1. The application of the shock wave reduces pain among the respondents.
2. The application of the shock wave reduces swelling in the treatment area.
3. The application of the shock wave improves the mobility of the diseased joint.
4. Shock wave treatments improve the functioning of patients in everyday life.
5. Shock wave treatments improve the quality of professional work.

Key words: Shockwave, jumper's knee, calcaneal spur, tennis elbow.

Introduction

In medicine, the shockwave was first used in the 1980s for lithotripsy [1]. Over time, new reports appeared about its positive impact on the human body, including on the musculoskeletal system. Nowadays it is successfully used in many fields of medicine. Shockwave is a relatively new method used in physiotherapy. More and more often it is used to treat musculoskeletal dysfunctions, incl. Patellar ligament enthesopathy, lateral epicondylitis of the humerus or heel spur. The studies conducted so far prove its high efficiency and low invasiveness [2,3]. From the point of view of physics, it is a mechanical wave characterized by a large change in pressure in a short time and a low frequency [4].

Objective of the work

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Material and methods

The research was carried out in CM Luxmed, ul. Zwycięska 6a and CM MEDISPORT at ul. Łabędzia in Lublin in the period from 01/12/2020. until December 10, 2021 75 patients took part in them. 25 of them were diagnosed with patellar ligament enthesopathy, another 25 with lateral epicondylitis of the humerus. The remaining 25 people received shock wave treatments for the heel spur. Each respondent underwent 5 shock wave treatments. Before starting the research, the respondents were informed about the purpose of the research. Moreover, they were guaranteed anonymity.

In order to evaluate the effectiveness of the shock wave treatments, the following research tools were used:

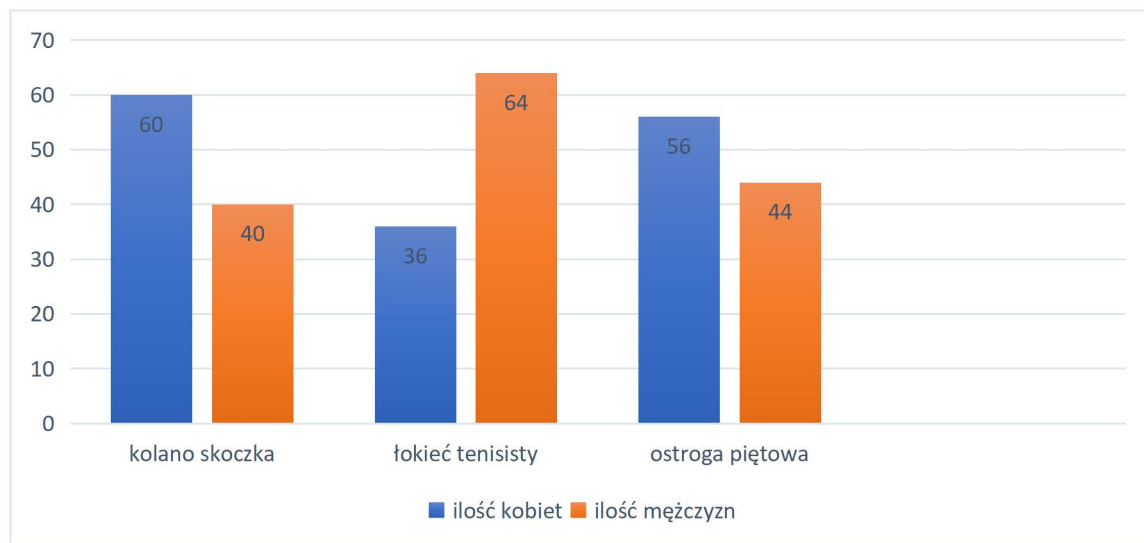
- Self-written questionnaire. The questions included in the questionnaire concerned socio-demographic data (age, sex, place of residence), disease entity, pain conditions (conditions of occurrence, frequency, severity, taking pharmacotherapy). The respondents also indicated when the pain first appeared. The questionnaire also included questions about the severity of swelling and the mobility of the affected joint. Moreover, the questionnaire asked about a possible limitation of physical activity. All these parameters were assessed before the therapy and after the end of the therapy.

- VAS scale (Visual Analogue Scale) - an analog scale that allows to determine the intensity of pain; 0 means no pain, 10 pain is hard to bear [6].
- The OKS (The Oxford Knee Score) questionnaire allowed for the assessment of the functioning of patients with a jumper's knee. It consists of 12 questions about knee function and pain, each with 5 possible answers. The questions are scored from 0 to 4, where 0 is a result of very severe pain and a marked impairment of function, and 4 - no pain and normal functioning. The overall score is the sum of all points and can range from 0 to 48. 48 points means no pain and normal functioning, 0- severe pain and severely impaired functioning [7].

Findings

Overall, 50.7% (n = 38) of all respondents were women, and 49.3% (n = 37) were men. 36% (n = 9) women and 64% (n = 16) men were the respondents treated for lateral epicondylitis of the humerus. In the case of the jumper's knee, the study group consisted of 60% (n = 15) women and 40% (n = 10) men, while in the group of patients with the heel spur, women constituted 56% (n = 14), and men 44% (n = 11). The breakdown of the respondents from each group by gender is presented in the chart below.

Diagram 1. Percentage gender structure of the studied group of patients with movement dysfunctions



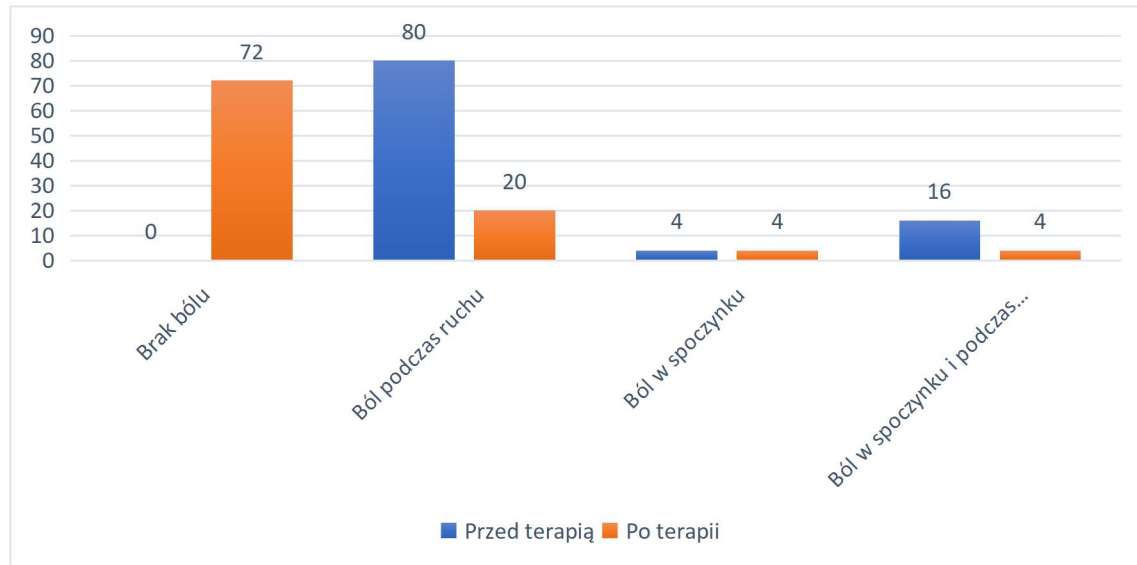
Source: Own study

1. Patellar ligament enthesopathy

After each subsequent shock wave treatment, the functioning of the patients improved and the pain ailments decreased. After the end of treatment, the results were as follows. As presented in Figure 2, before the therapy, 96% (n = 24) of the respondents with the jumper's knee felt pain while moving, and 16% of the respondents (n = 4) were also at rest. Before the therapy, one person among the respondents, constituting 4% of the research sample, had pain only at rest.

After the therapy, 20% (n = 5) of the respondents felt pain only during movement, 4% (n = 1) only at rest, and another 4% (n = 1) at rest and during movement. The largest percentage in the study group were people who did not feel pain, constituting 72% of the respondents (n = 18).

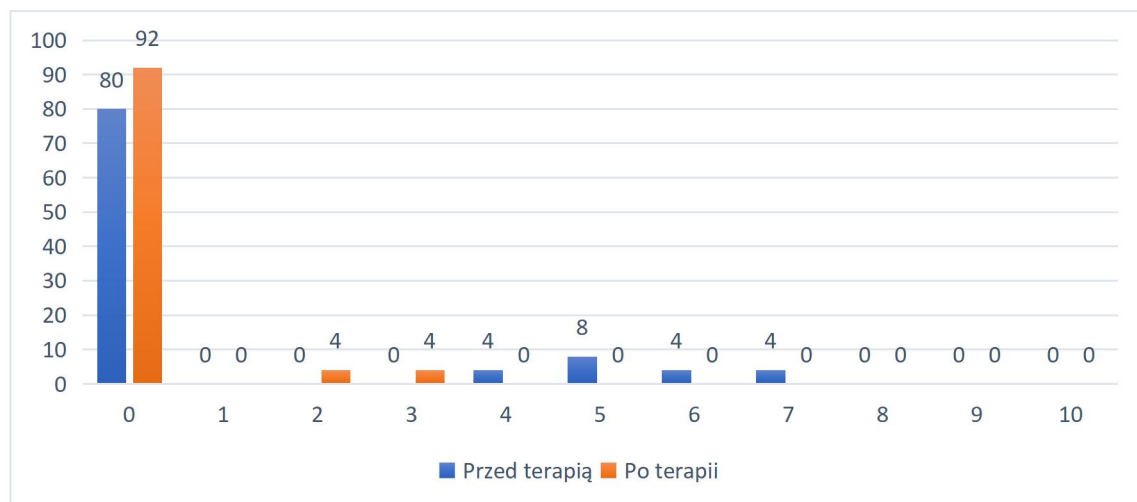
Diagram 2. Percentage conditions of pain occurrence before and after the end of therapy in patients with jumper's knee



Source: Own study

When assessing the degree of pain experienced by the respondents, before the therapy, 80% of the respondents (n = 20) did not feel pain at rest, and the remaining 20% (n = 5) marked values from 4 to 7 on the scale. After treatment, 92% of the respondents (n = 23) indicated no pain experienced at rest, and the remaining 8% of the respondents (n = 2) marked levels 2 and 3. There was an improvement in relation to the original condition, despite a small number of people with pain at rest before the therapy in the study group (Chart 3).

Diagram 3. Percentage of pain grade before and after therapy at rest in patients with a jumper's knee (0-no pain, 10-unbearable pain)



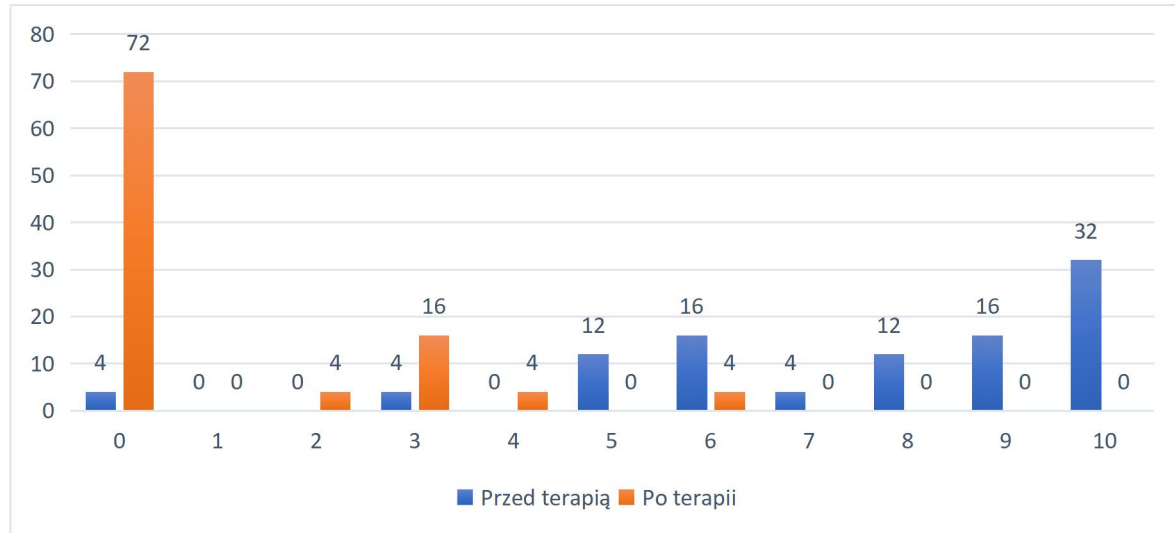
Source: Own study

The pain ratings of the respondents with the jumper's knee in terms of pain experienced during movement are different. Before the therapy, only one person (4% of the group) indicated the

absence of this pain. Another one indicated pain at level 3. As many as 92% (n = 23) of the studied group gave answers in the range of 5-10. The highest value for unbearable pain was marked by 32% (n = 8) of the respondents.

There was a significant improvement in this matter after the therapy. 72% of the respondents (n = 18) indicated no pain experienced in movement. For the remaining 28% (n = 7), level 3 was selected four times, and also levels 2, 4 and 6 (Chart 4).

Diagram 4. Percentage of pain grade before and after therapy during movement in patients with jumper's knee (0-no pain, 10-unbearable pain)

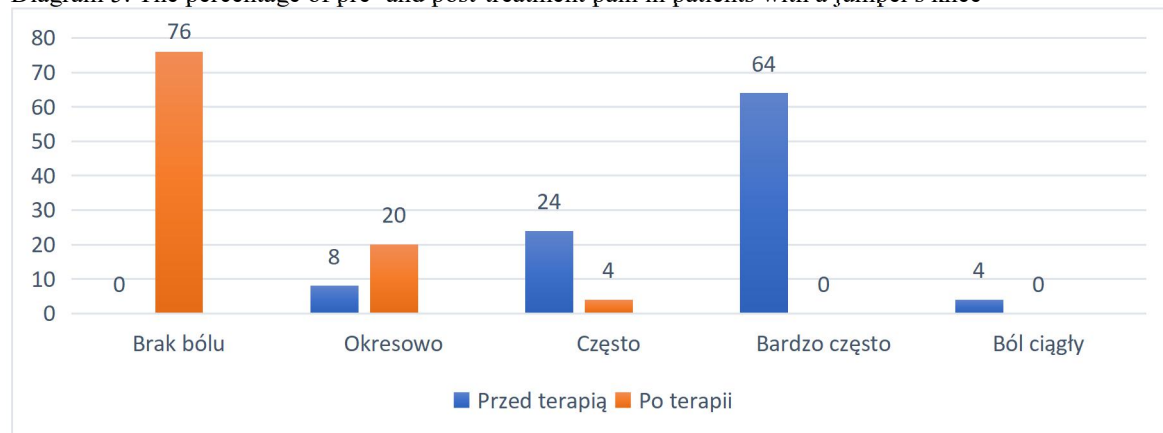


Source: Own study

Before the procedure, 64% of the respondents (n = 16) experienced pain very often, 24% (n = 6) often, 8% (n = 2) periodically, and 4% (n = 1) had continuous pain. After treatment, 4% of the group (n = 1) experienced pain frequently, 20% (n = 5) periodically, and 76% (n = 19) had no pain at all.

The responses in Figure 5 represent a significant improvement in the pain frequency following treatment in patients with patellar ligament enthesopathy.

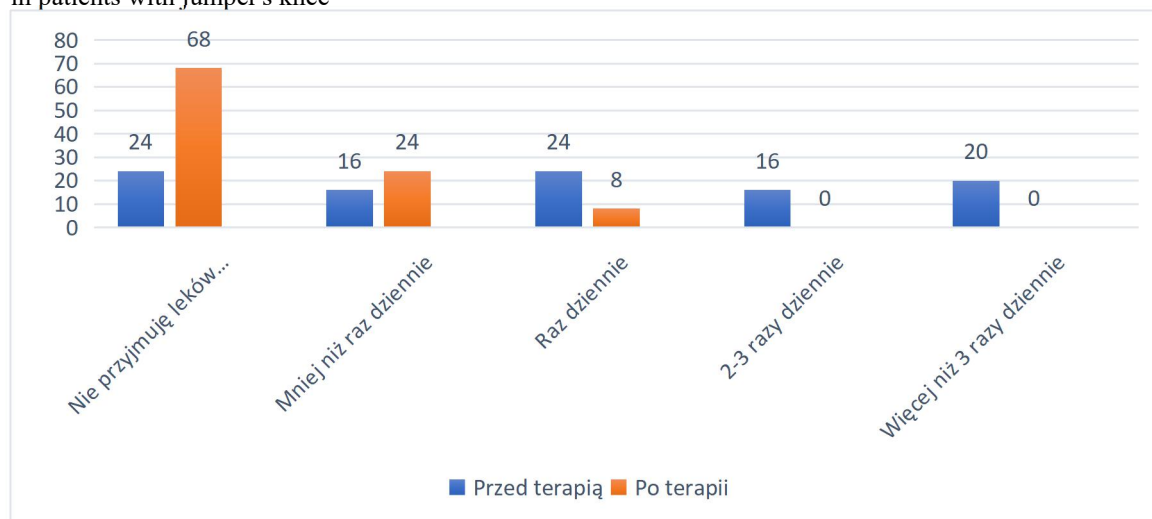
Diagram 5. The percentage of pre- and post-treatment pain in patients with a jumper's knee



Source: Own study

Comparing the above-mentioned results in Figure 5 with those in Figure 6, the correlation between the frequency of pain after therapy and the use of analgesic and anti-inflammatory drugs and ointments is visible.

Diagram 6. Percentage frequency of taking analgesic / anti-inflammatory drugs / ointments before and after therapy in patients with jumper's knee



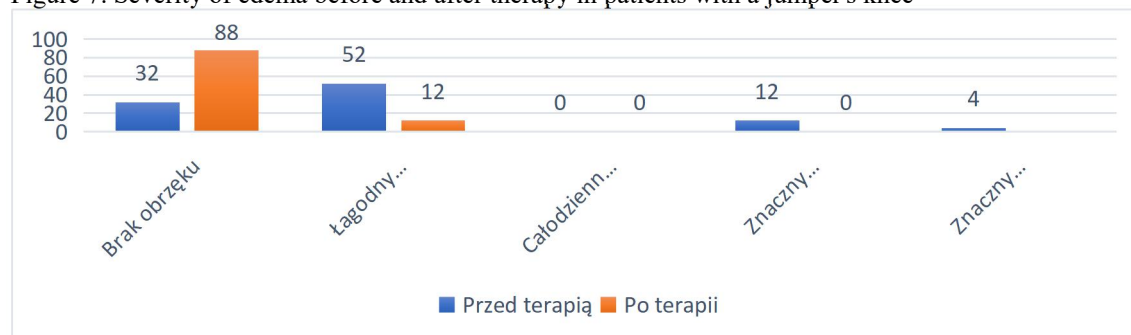
Source: Own study

At the end of treatment, among patients with a jumper's knee, 68% (n = 17) were off medications and ointments, 8% (n = 2) did so once a day, and 24% (n = 6) less than once a day.

Before the therapy, the percentage of people taking medications less than once a day was 40% (n = 10), including 24% (n = 6) of the respondents not taking medications at all. 24% (n = 6) of respondents used drugs once a day, another 16% (n = 4) 2-3 times a day, and 20% (n = 5) of respondents used drugs and ointments more than 3 times a day.

Another issue included in the survey questions was the severity of the swelling of the affected limb. Before the therapy, 32% (n = 8) of the respondents reported no edema, 52% (n = 13) mild edema, and 16% (n = 4) had significant edema (including one person representing 4% of the group it was a distorting edema). limb). After the therapy, the intensity of swelling in the study group decreased. 12% of respondents (n = 3) indicated mild limb edema, and 88% (n = 22) indicated no edema at all (Figure 7).

Figure 7. Severity of edema before and after therapy in patients with a jumper's knee

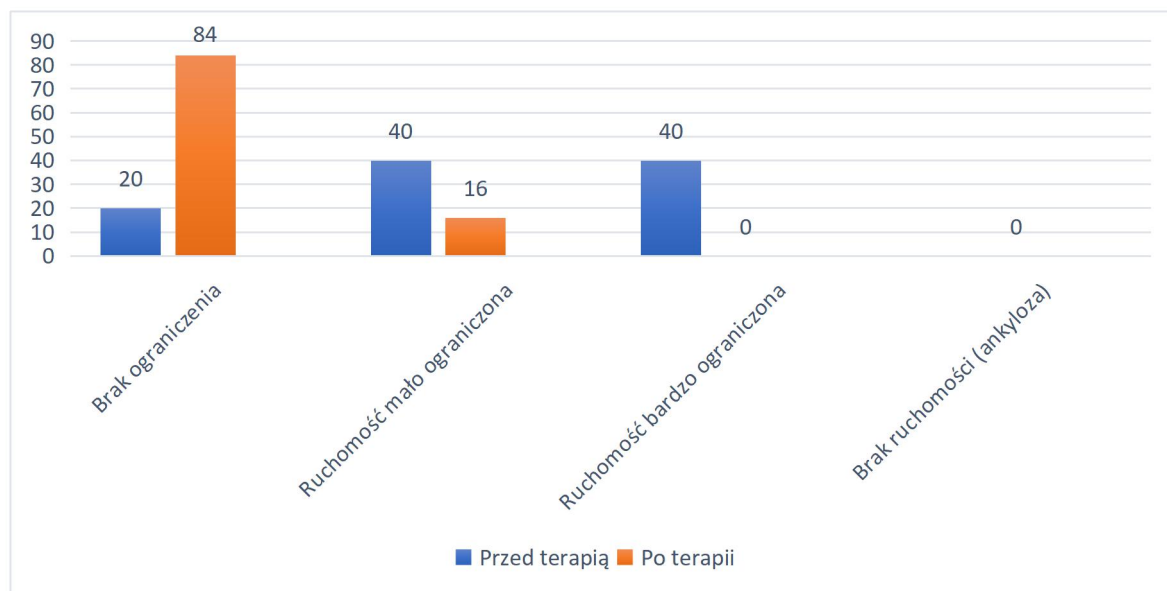


Source: Own study

Before the therapy, the mobility of 40% of the respondents (n = 10) was very limited, and in another 40% to a small extent. The remaining 20% (n = 5) did not have limited mobility in the affected joint. There was no case of ankylosis.

After the therapy, a slight limitation appeared in only 16% of respondents (n = 4), and the remaining 84% (n = 21) did not find such a limitation (Figure 8).

Diagram 8. The percentage of limitation of the mobility of the diseased joint before and after the therapy in patients with a jumper's knee

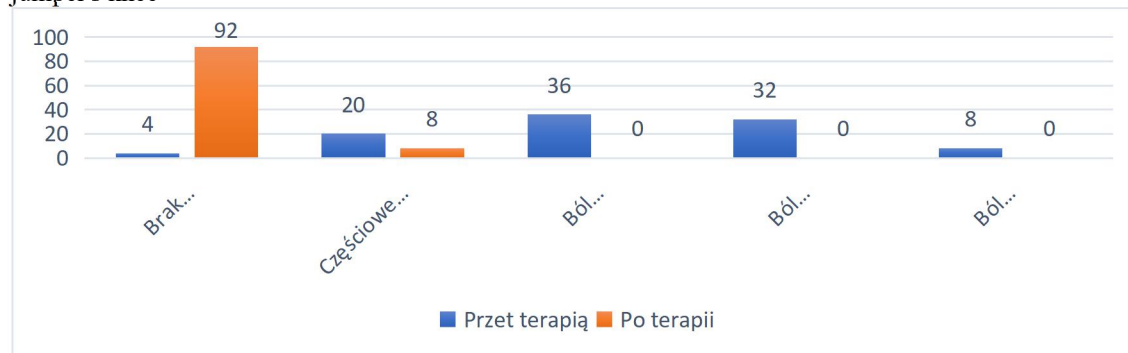


Source: Own study

Also in the case of limitation of general physical activity before the therapy, most of the respondents noted some difficulties. In 8% (n = 2) of them, pain made it impossible to function independently, in 32% (n = 8) it made it impossible to work, and in 36% (n = 9) it made it difficult. 20% (n = 5) of the respondents indicated a partial limitation of physical activity and only 4% (n = 1) did not notice such limitation.

After the therapy, there was a definite improvement. Partial mobility limitation caused by dysfunction concerned only 8% of the respondents. The restriction did not apply to the remaining 92% (Figure 9).

Diagram 9. The degree of limitation of motor activity in percentages before and after the therapy in patients with a jumper's knee



Source: Own study

After analyzing the results from the OKS questionnaire, it was shown that before the treatment, 8% of patients (n = 2) had no problems with functioning. 12% of the respondents (n = 3) achieved a score of 30-39 points on the OKS scale, so their functioning before the therapy can be assessed as good. 40% of patients (n = 10) had an impairment in pre-treatment daily activities, while 40% (n = 10) had severe impairment. After the therapy, 40% of people (n = 10) functioned very well, 36% well. 20% of respondents (n = 5) achieved a score of 20-29 points equivalent to a functional impairment, and one person (4%) <19, which means that their function was severely impaired. The level of significance was calculated, assuming the value of $p < 0.05$, therefore the results are statistically significant (Table 1).

Table 1. Functioning of patients with patellar ligament enthesopathy based on the OKS questionnaire

Liczba punktów OKS	Przed terapią		Po terapii	
	n	%	N	%
>40-bardzo dobre funkcjonowanie	2	8	10	40
30-39- dobre funkcjonowanie	3	12	9	36
20-29- upośledzone funkcjonowanie	10	40	5	20
<19- bardzo upośledzone funkcjonowanie	10	40	1	4
Analiza statystyczna	p<0,05			

Source: Own study

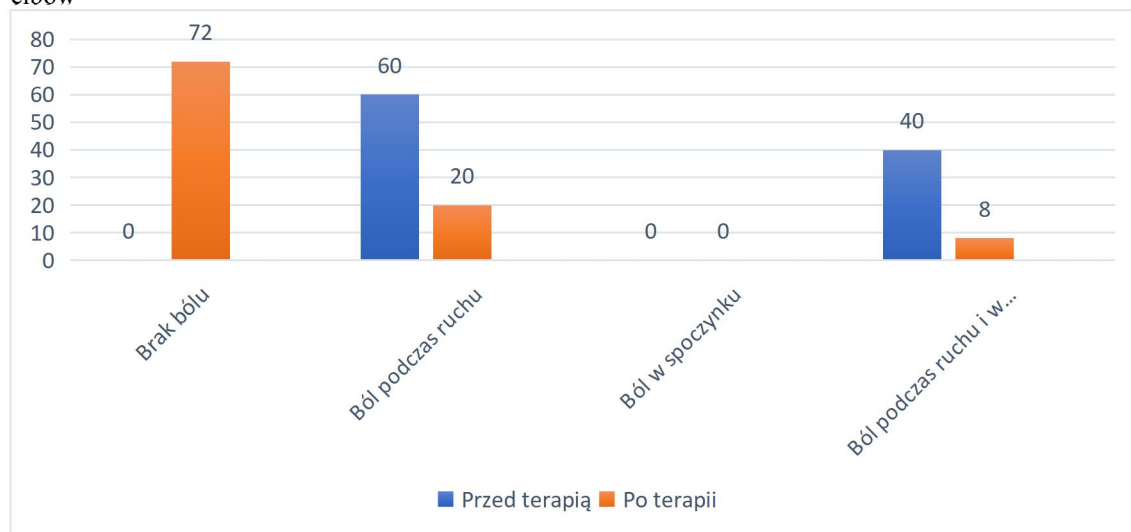
Summarizing the above analysis, it can be stated that among the respondents with patellar ligament enthesopathy, there was a clear improvement in the condition of patients in the vast majority of studies conducted.

The only question for which the answers did not show a clear tendency to improve health was the assessment of the degree of pain experienced by patients at rest. It should be noted, however, that most of the patients did not notice any severe pain symptoms before the examination. Moreover, by supplementing the analysis of this group of respondents with pain experienced in movement, the improvement is decisive.

2. Inflammation of the lateral epicondyle of the humerus

The next study group consisted of patients suffering from tennis elbow. Before the shockwave application, all of them felt pain when moving, and 40% (n = 10) of them also at rest. As in patients with patellar ligament enthesopathy, after each subsequent shock wave treatment, the functioning of the patients improved and the pain ailments decreased. After the end of therapy, pain during movement was experienced by 28% (n = 7) of patients, and two patients from this group also experienced pain at rest. The remaining 72% of respondents indicated no pain, which proves the high effectiveness of the therapy (Figure 10).

Diagram 10. Conditions of pain occurrence in percent before and after the end of therapy in patients with tennis elbow

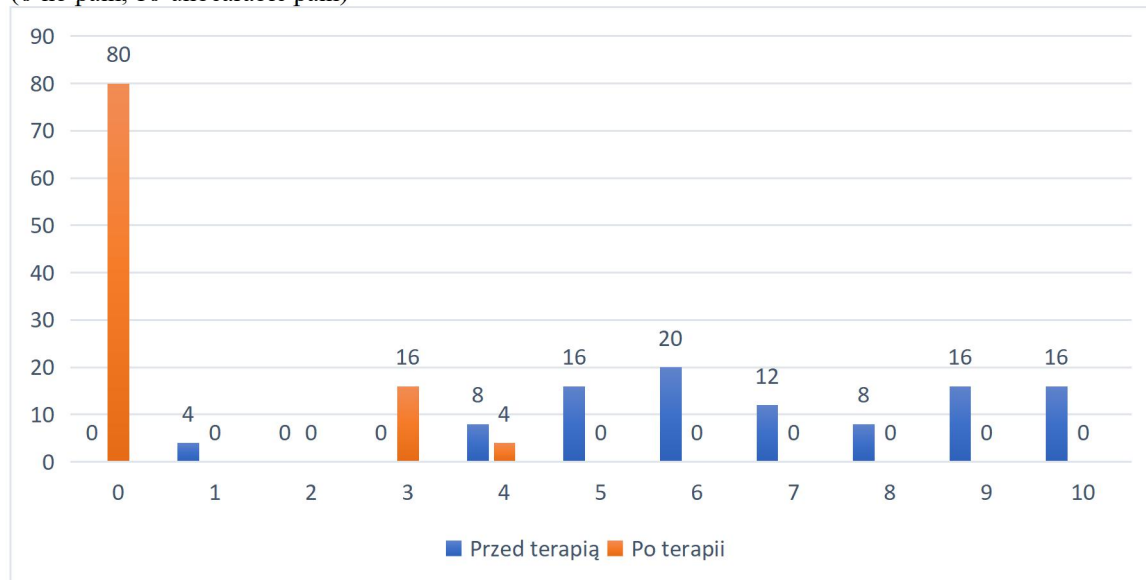


Source: Own study

Regarding the degree of pain experienced at rest before the therapy, apart from one respondent (5% of the group), who marked pain on a scale of 1 on a 0-10 scale, the remaining 96% (n = 24) of subjects marked pain on a level in the range of 4–10. Each of these answers was chosen by 8% (n = 2) to 20% (n = 5) of the respondents. The results are presented in Chart 11.

After the end of the therapy, 80% of the respondents (n = 20) did not feel any pain while resting. Four people, representing 16% of the group, had level 3 pain. One person, representing 4%, marked level 4 on the scale.

Diagram 11. Assessment of the degree of pain in percent before and after therapy at rest in patients with tennis elbow (0-no pain, 10-unbearable pain)



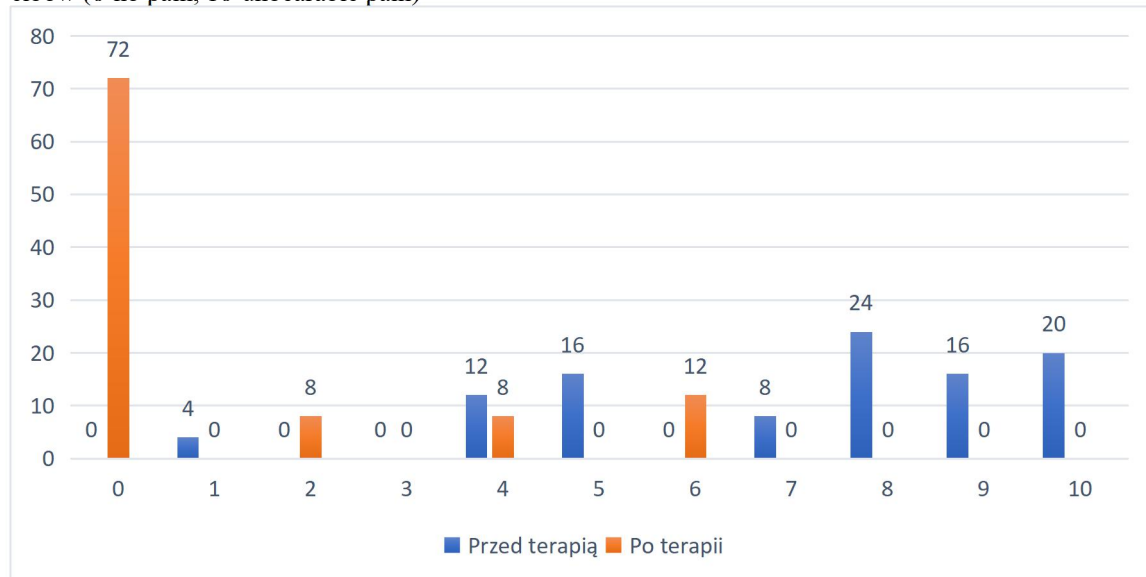
Source: Own study

The results of studies on the degree of pain experienced in movement are similar (Figure 12). In this respect, before the therapy was applied, the percentage of people who marked the answers in the range of 4-10 was 96% (n = 24) of the research sample. Level 4 was marked by 12% of the

respondents (n = 3), level 5 and 9 by 16% each, level 7-8% of the respondents (n = 2). Pain at level 8 appeared in 24% (n = 6). Level 10, meaning unbearable pain, was declared by 20% (n = 5) of people. Only 4% of the group (n = 1) marked mild pain level 1.

After the therapy, 8% (n = 2) of the respondents indicated pain on level 2, similarly to level 4. Level 6 was marked by 12% of the group (n = 3). Most of the respondents, because the remaining 72% (n = 18), after completing the therapy, indicated on the scale 0, i.e. no pain during movement.

Diagram 12. Assessment of pain degree in percent before and after therapy during movement in patients with tennis elbow (0-no pain, 10-unbearable pain)

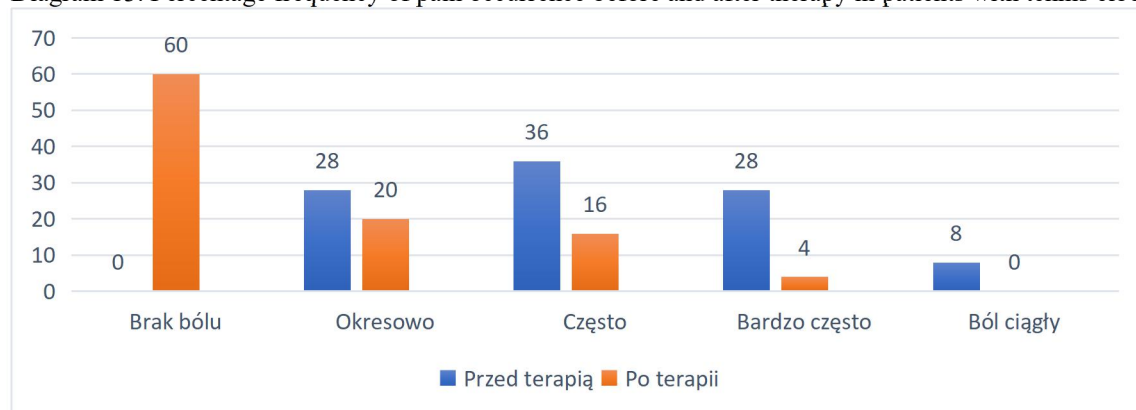


Source: Own study

As presented in the graphs above, all patients with tennis elbow experienced pain before the therapy. Regarding the frequency of pain sensation, 28% of respondents (n = 7) experienced pain periodically, 36% (n = 9) often, 28% (n = 7) experienced pain very often, and 8% (n = 2) had pain continuous.

After the therapy, only 4% (n = 1) of the respondents experienced pain very often, and 16% (n = 4) - often. In 20% (n = 5) of the subjects pain appeared periodically, and 60% (n = 15) did not experience pain (Figure 13).

Diagram 13. Percentage frequency of pain occurrence before and after therapy in patients with tennis elbow

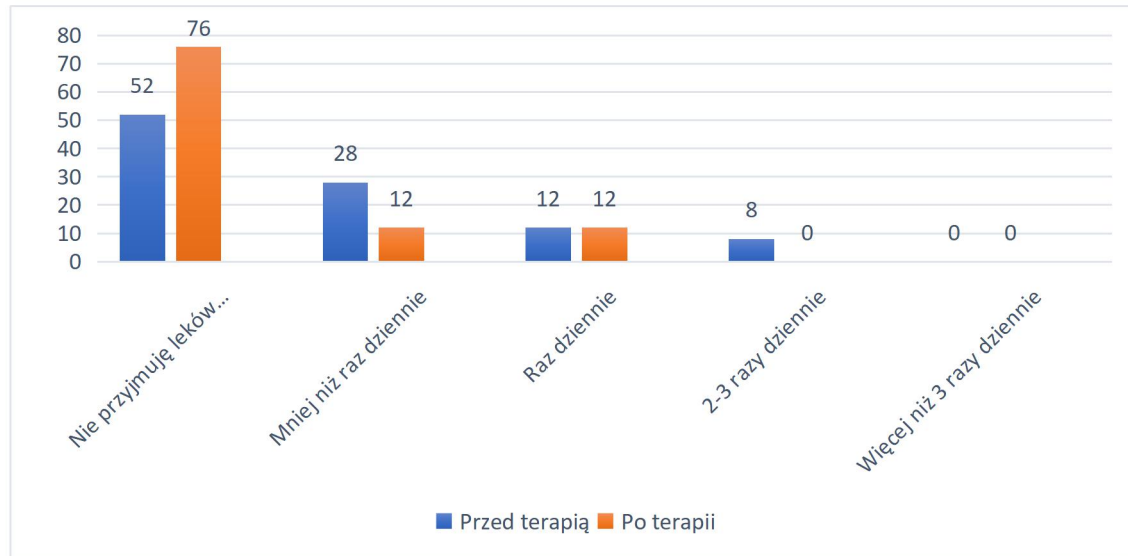


Source: Own study

Despite the fact that all respondents experienced pain before the therapy, as many as 52% (n = 13) were not taking painkillers at that time. The rest of the group in 28% (n = 7) took it less than once a day, in 12% (n = 3) once a day, and 8% took it 2-3 times a day. No one in the study group took painkillers and anti-inflammatory drugs more frequently.

After the treatment, 12% (n = 3) of the group used drugs and ointments once a day, another 12% (n = 3) did so less than once a day, and 76% of the group stopped using drugs and ointments (Figure 14).

Diagram 14. Frequency of taking analgesic / anti-inflammatory drugs / ointments in percent before and after therapy in patients with tennis elbow

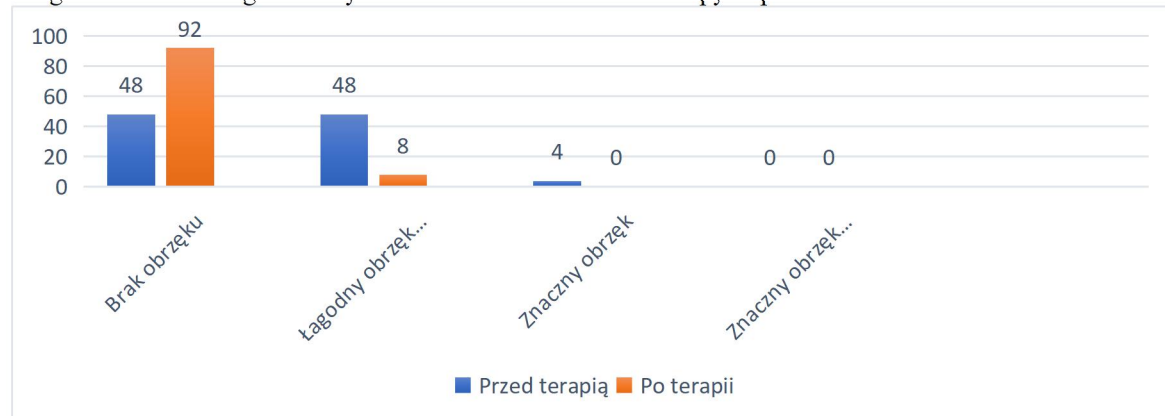


Source: Own study

In 4% of the respondents (n = 1), before the therapy was applied, the affected area was significantly swollen. 48% of the respondents (n = 12) declared the occurrence of mild edema (thickening of the limb), while edema did not appear in the remaining 48% of the respondents (n = 12).

After treatment, 92% of the respondents (n = 23) showed no edema, and the remaining 8% (n = 2) had mild thickening of the limb. Thus, a clear improvement is noticeable (Figure 15).

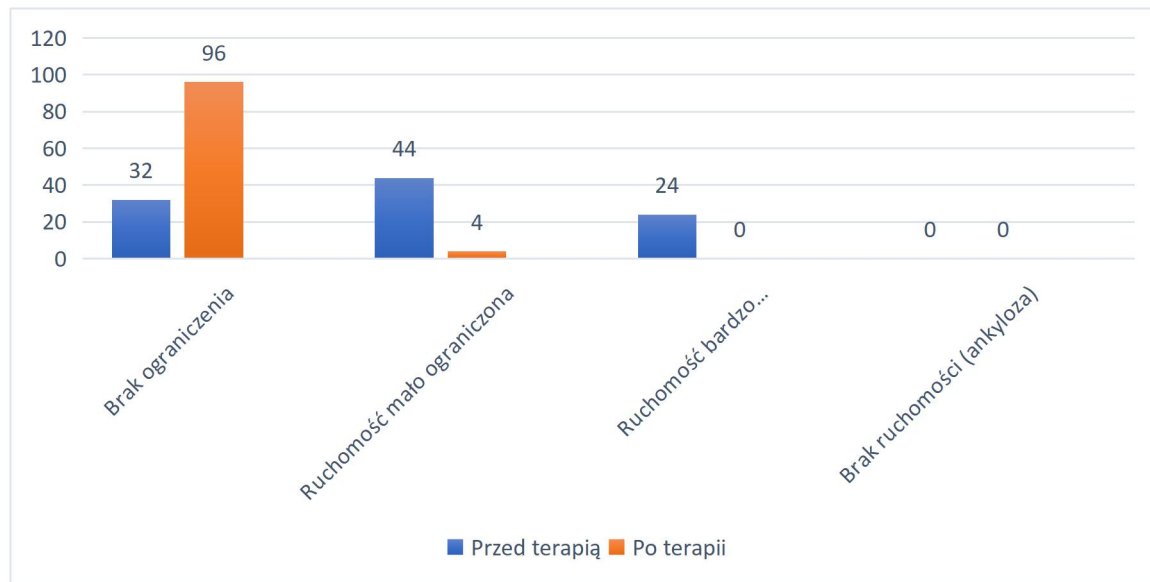
Diagram 15. Percentage severity of edema before and after therapy in patients with tennis elbow



Source: Own study

Before the shockwave application, 24% (n = 6) of respondents indicated very limited mobility in the affected joint, 44% (n = 11) a slight restriction, and 32% (n = 8) indicated no restriction. After completing the therapy, only 4% of the study group indicated a slight limitation, and 96% (n = 24) indicated no limitation (Figure 16).

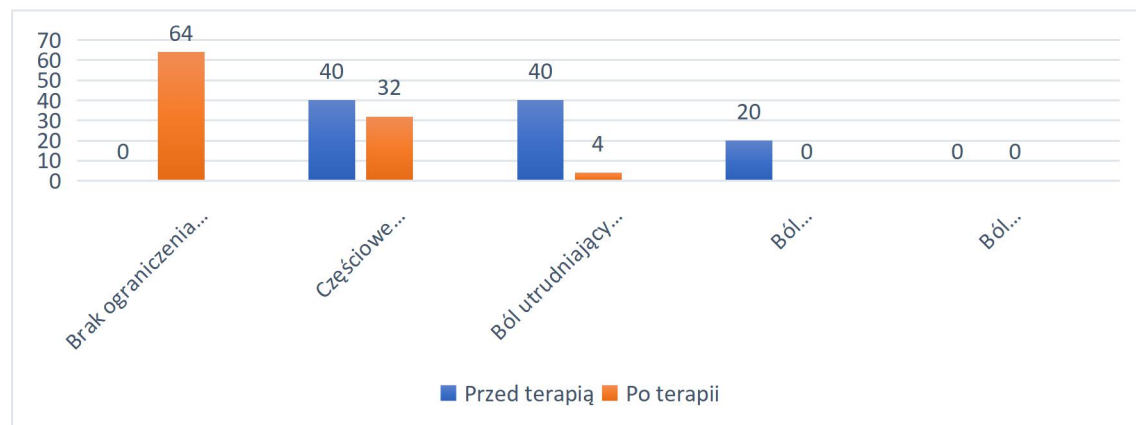
Diagram 16. The degree of limitation of the mobility of the diseased joint in percentage before and after the therapy in patients with tennis elbow



Source: Own study

In the case of limitation of general physical activity (Figure 17) before the therapy, pain made it impossible for 20% (n = 5) of the respondents, and it made it difficult for another 40% (n = 10). The remaining 40% (n = 10) of the respondents indicated a partial limitation of physical activity. After the therapy, the situation improved. For 32% (n = 8) of the respondents, pain was the cause of a partial limitation of movement, in 4% (n = 1) it was an obstacle at work, and the remaining 64% (n = 16) did not have any mobility restrictions at all.

Diagram 17. The percentage of reduced physical activity before and after therapy in patients with tennis elbow



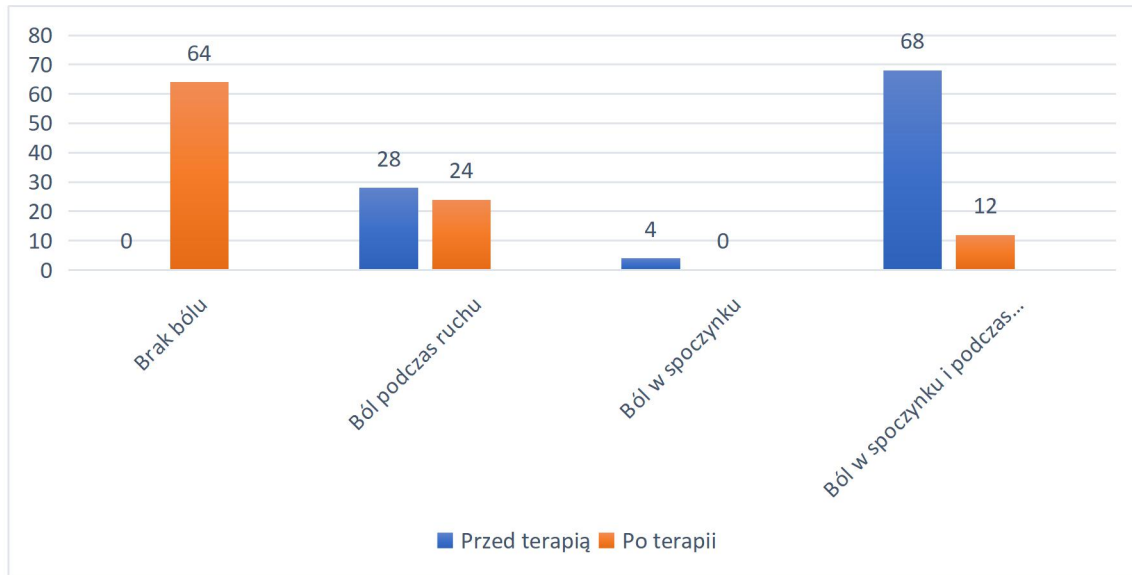
Source: Own study

3. Heel spur

Pain resulting from the heel spur was felt in motion by 96% of the respondents (n = 24), including 68% of the respondents (n = 17) at the same time experiencing pain at rest. The remaining 4% of respondents (n = 1) felt pain only during rest.

This structure changed after the therapy was applied. 64% (n = 16) of the respondents did not experience pain, 24 (n = 6) felt pain only when moving, and 12% (n = 3) both during movement and at rest (Figure 18).

Diagram 18. Pain conditions in percent before and after the end of therapy in patients with heel spur



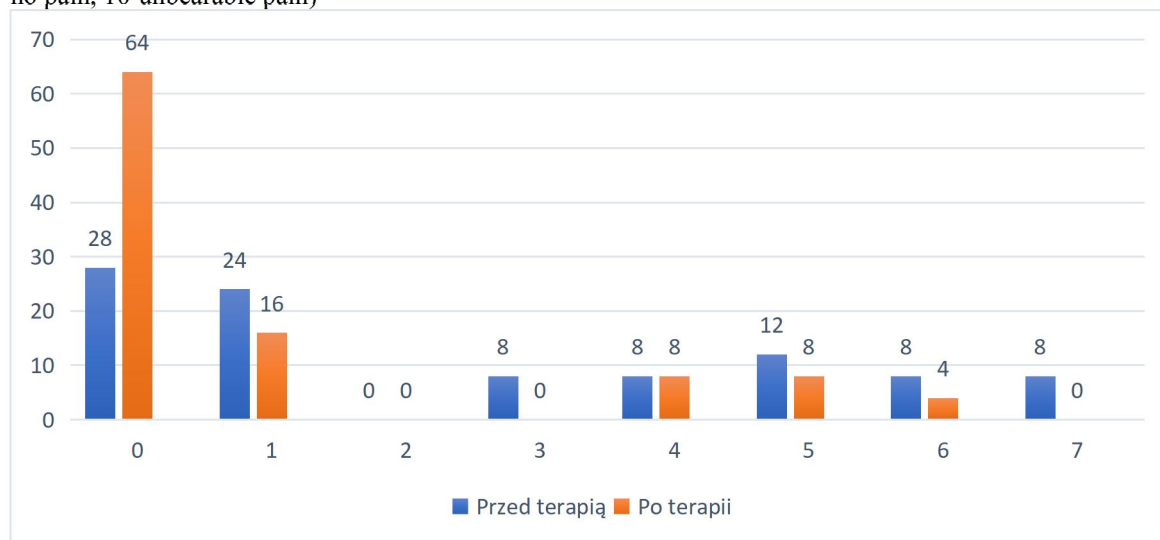
Source: Own study

The next questionnaire for patients with a heel spur concerned the assessment of the degree of pain experienced at rest. Before the therapy, 24% of respondents (n = 6) indicated mild pain level 1 and 28% (n = 7) no pain. The level of 3,4,6,7 was marked by two people. Pain at the level of 5 was declared by 4% of the study group (n = 1). 4% of respondents (n = 1) experienced unbearable pain at rest.

After the therapy, the percentage of people who reported no pain was as much as 64% (n = 16). Four people, representing 16%, had pain level 1. The remaining 20% of the group (n = 5) had pain level 4, 5, and 6 (Figure 19).

It can therefore be unequivocally stated that in terms of the degree of pain experienced at rest, shockwave therapy led to a significant improvement in the study group.

Diagram 19. Assessment of the degree of pain in percent before and after therapy at rest in patients with heel spur (0-no pain, 10-unbearable pain)

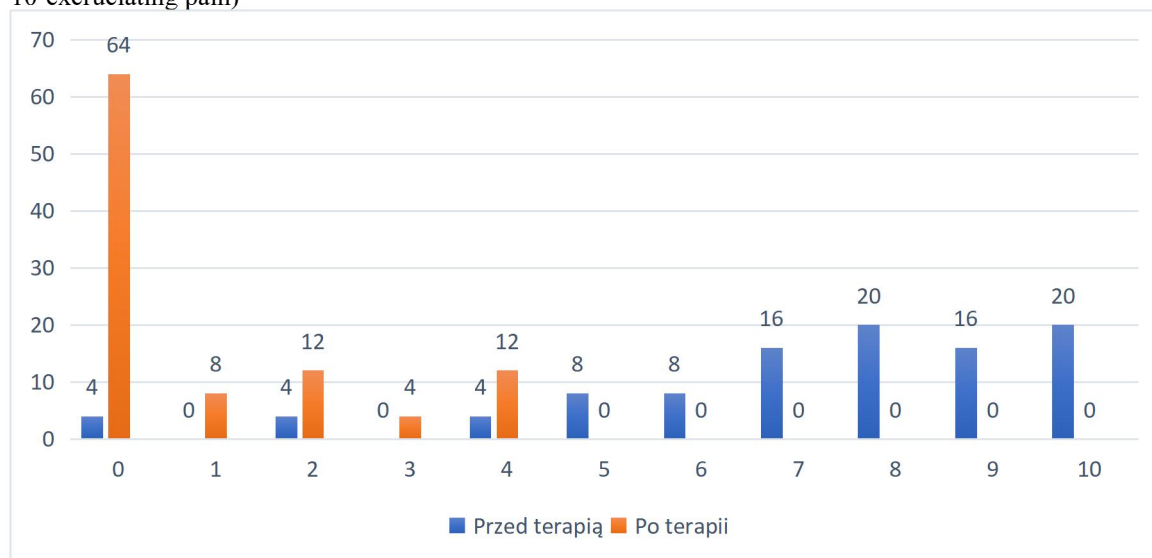


Source: Own study

When assessing the degree of pain experienced in motion before the procedures, 64% of the respondents (n = 16) marked values from 5 to 10. As many as 20% (n = 5) of the respondents indicated the highest level of pain. Only 4% of the respondents (n = 1) marked the answers 0, 2, 4 on a scale of 0-10.

After the procedures and completion of the therapy, 64% of respondents (n = 11) did not feel pain anymore, 8% (n = 2) indicated slight pain at level 1, 12% (n = 3) at level 2 and 4 each, one person specified pain on 3 (Figure 20).

Diagram 20. Percentage of pain level before and after therapy during movement in patients with heel spur (0-no pain, 10-excruciating pain)

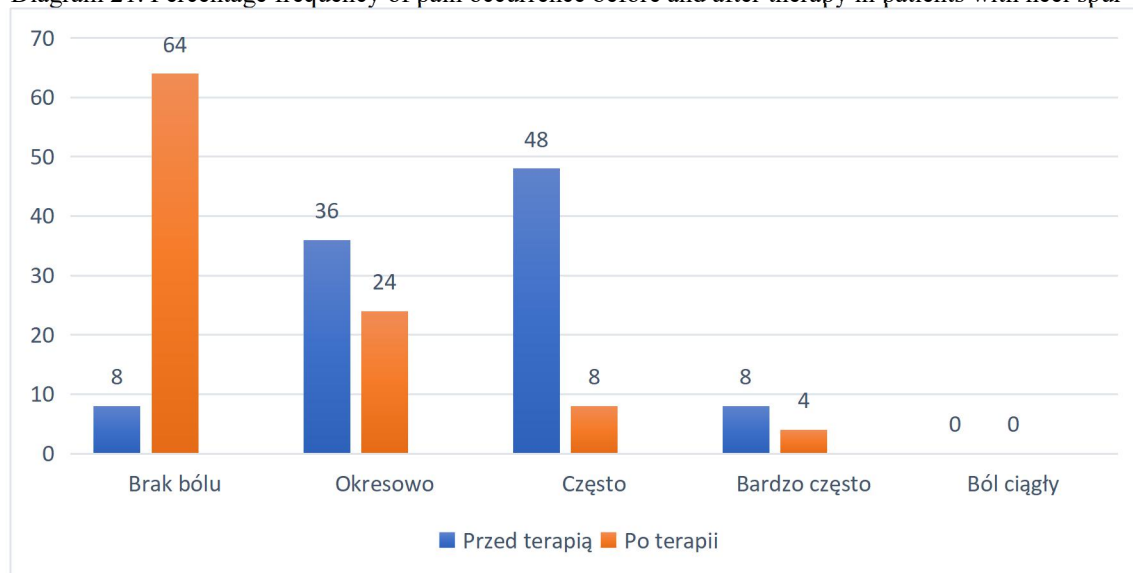


Source: Own study

Although on a smaller scale than pain experienced at rest, the use of the shock wave here also has resulted in a reduction in the extent of pain experienced during movement.

Before the therapy, 48% of respondents (n = 12) experienced pain very often, and 36% (n = 9) often. 8% of the study group (n = 4) each indicated periodic pain and continuous pain. After the therapy As many as 64% (n = 16) of respondents did not feel pain anymore. In 24% (n = 6), pain appeared periodically, in 8% (n = 2) it appeared frequently, and in one person, representing the remaining 4% of the group, it appeared very often (Figure 21).

Diagram 21. Percentage frequency of pain occurrence before and after therapy in patients with heel spur



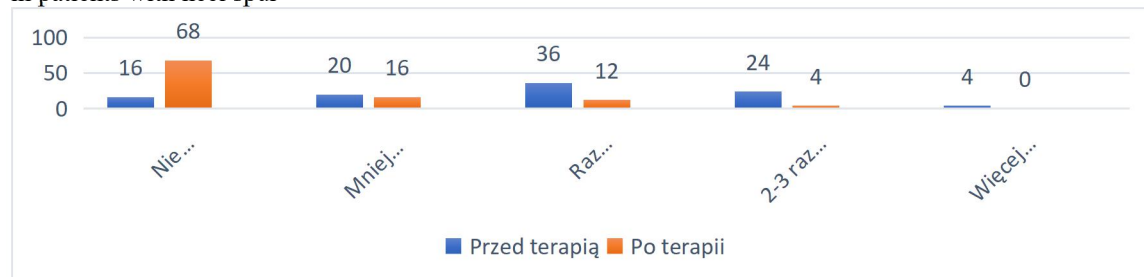
Source: Own study

The distribution of responses to the question about the frequency of pain in the post-treatment questionnaires changed significantly compared to the baseline. The frequency of taking painkillers and anti-inflammatory drugs was similar to the appearance of pain (Figure 22).

Before the therapy, all 84% of respondents (n = 21) used medications and ointments, including 20% (n = 5) less than once a day, 36% (n = 9) once a day, 24% (n = 6) 2- 3 times a day, and 4% (n = 1) more often.

After the shockwave treatment and completion of therapy, 68% of respondents (n = 17) stopped using painkillers and anti-inflammatory drugs, 16% (n = 4) used them less than once a day, 12% (n = 3) once a day, and 4% (n = 1) 2-3 times a day. None of the respondents took the drugs in question more often. In connection with the above information, it can be concluded that the frequency of pain incidence limited by the use of the therapy resulted in a marked reduction in the frequency of taking painkillers and anti-inflammatory drugs and ointments among the surveyed patients with heel spur.

Diagram 22 .Percentage frequency of taking analgesic / anti-inflammatory drugs / ointments before and after therapy in patients with heel spur

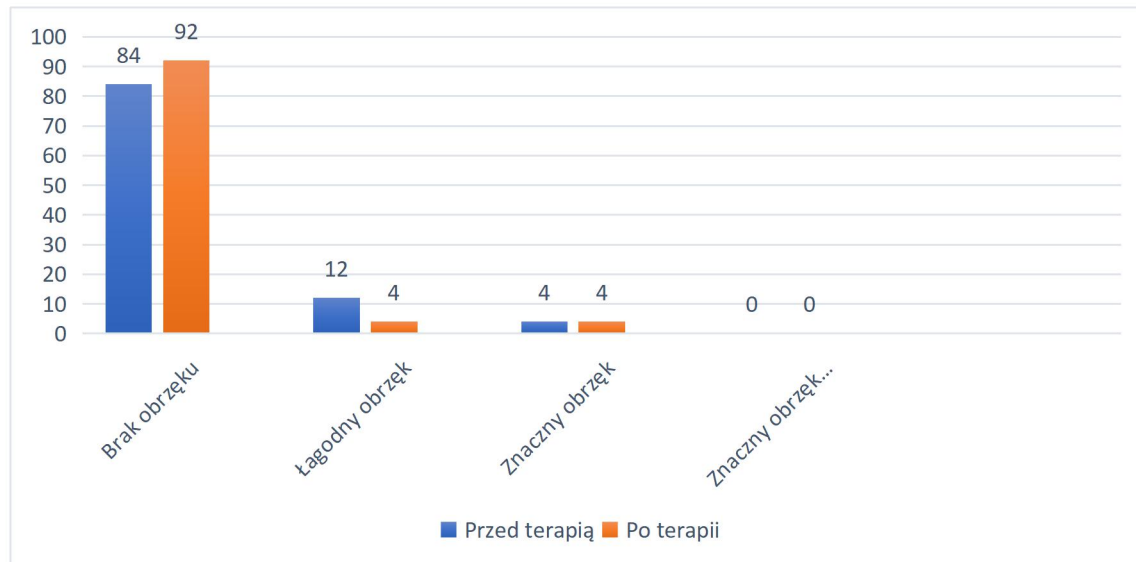


Source: Own study

In the case of increased edema in the affected limb, the changes, albeit positive, are not as clear as presented in Figure 23. Before the therapy, 84% (n = 21) of patients indicated no edema, 12% (n = 3) indicated mild edema, swelling, while significant swelling was indicated by only 4% (n = 1) of the respondents.

After the therapy, the percentage of respondents without edema increased to 92% (n = 23), and 4% of patients each reported limb thickening and significant swelling.

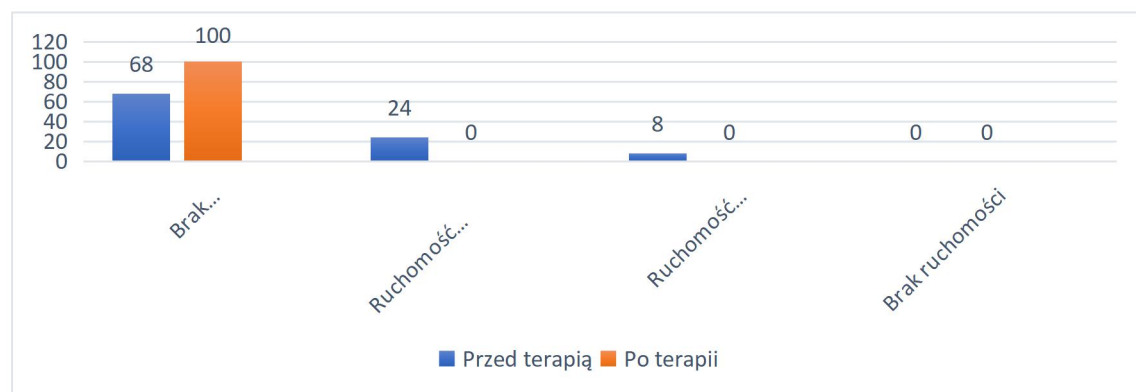
Figure 23. Percentage severity of edema before and after therapy in patients with heel spur



Source: Own study

In terms of mobility of the diseased joint before the therapy, 68% (n = 17) did not indicate any limitation. 24% (n = 6) of people marked a slight restriction, and 8% (n = 2) marked a large restriction. After the therapy, none of the respondents had limited mobility of the diseased joint (Figure 24).

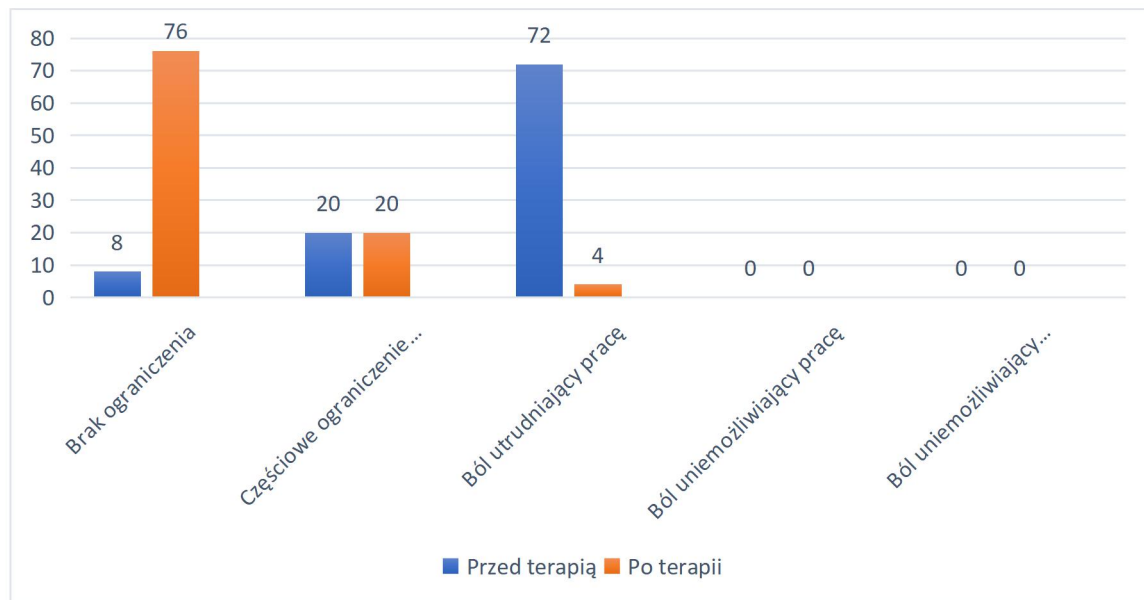
Diagram 24. The percentage of reduced mobility of the diseased joint before and after therapy in patients with heel spur



Source: Own study

Restriction of general motor activity of patients with heel spur before the therapy was observed in 92% (n = 23) of the patients. 20% (n = 5) of the respondents indicated a partial limitation, in 72% (n = 18) pain made it difficult to work. After the therapy, 76% of patients did not struggle with limited physical activity. 20% (n = 5) declared a partial reduction in activity. One person, representing 4% of the group, experienced pain that made work difficult (Figure 25).

Diagram 25. The percentage of reduction in physical activity before and after therapy in patients with heel spur



Source: Own study

As presented in the analyzed results of the questionnaire studies, the application of the shock wave resulted in an improvement in each examined group of patients with heel spur. Only in the case of increased swelling of the affected limb, the improvement was smaller, which resulted not from the lack of effectiveness of the therapy, but from good results in the study conducted before the therapy.

Discussion

Analyzing the reports of the available literature, it can be concluded that symptoms associated with inflammation of the lateral epicondyle of the humerus occur in 1-3% of the population [8,9]. Patellar ligament enthesopathy manifests itself mainly in athletes who are chronically jumping and it affects as much as 15% of them [10]. In the case of the heel spur, its prevalence in the population is estimated at 10-15% [11]. Numerous studies show that the shock wave is effective in the treatment of all of the above-mentioned diseases.

The results of own research have shown that shock wave therapy reduces the intensity of pain and swelling. In addition, it contributes to the improvement of the functioning of patients in everyday life.

75 people were examined, divided into three groups of twenty-five people, based on the presence of the disease. 25 respondents were diagnosed with patellar ligament enthesopathy, another 25

with epicondylitis of the humerus. The remaining 25 people received shock wave treatments for the heel spur.

Among patients with patellar ligament enthesopathy, pain intensity decreased markedly. Pain at rest before the therapy concerned 20% of respondents, who assigned it values from 4 to 7 on the VAS scale. After the therapy, 92% of respondents did not feel pain at rest, and the remaining 8% assigned it the values 2 and 3. Before the therapy, only one person indicated no pain during movement, while as many as 32% felt unbearable pain. After the gradual reduction of pain after the therapy, no pain in motion was recorded in 72% of the respondents, and the highest value marked on the VAS scale was 6. Vulpiani et al. In their studies on 73 athletes with a jumper's knee came to similar conclusions. Researchers noticed a reduction in knee pain intensity with shock wave therapy [12]. There was also a clear difference in the case of edema. The number of respondents who had no swelling increased from 32% before treatment to 88% after treatment. Before the treatments, only 20% of people had no problems with reduced mobility of the affected joint, while after the treatment it was 84%. The percentage of people with limited physical activity after therapy decreased by 88% compared to the baseline. Taunton et al. In their work examined 20 patients in whom they noticed an improvement in functioning and a reduction in pain [13]. 40% of patients with lateral epicondylitis of the humerus experienced pain at rest before the therapy. After the end of therapy, 92% of respondents did not experience any pain at rest. In the case of pain during movement, 20% of respondents marked a 10 on the VAS scale, while after the procedures such intense pain did not occur in any of the respondents. The percentage of people without edema increased from 48% before therapy to 92% after therapy, while the percentage of people with no mobility restriction increased from 32% to 96%. Significant improvement in the functioning of patients has also been noticed. Before the therapy, each respondent described their physical activity as limited, while after the therapy as many as 64% of the respondents had no problems in functioning. Razavipour et al. Subjected 40 people to extracorporeal shock wave therapy with a tennis elbow. They observed that the therapy may reduce pain intensity and improve the daily functioning of patients [14]. Kocjan reached the same conclusions in his work [15]. On the other hand, Melikyan et al. Did not find any differences in the functioning of patients treated with shockwave therapy and patients treated with placebo [16]. In patients with heel spur, the percentage of people not experiencing pain at rest increased from 28% to 88%. On the other hand, the percentage of respondents who did not feel pain while moving increased by 60% compared to the state before the therapy. The percentage of people with no swelling in the treated area increased by 8%. In terms of mobility of the diseased joint before the therapy, 68% of the respondents did not indicate any limitation. After treatment, none of the patients had limited range of motion. Problems in the functioning of patients with heel spur before the therapy concerned as much as 92%, while after the therapy these disorders affected only 24% of the respondents. The scientific research conducted so far on the effectiveness of the shock wave in the treatment of the heel spur has mainly focused on the pain complaints of patients. Koch, Chochowska and Marcinkowski in their work checked the effectiveness of using ESWT on 30 people with heel spur. They showed that the therapy reduces pain [17]. The same conclusions were drawn by Krukowska et al. In their research, 47 patients were divided into two groups, one of which underwent 10 and the other 4 treatments. In both groups, the level of pain after therapy decreased [5]. Walasik, Gałęcki and Dudkiewicz examined 50 people diagnosed with heel spur. They found that the application of the shock wave reduces pain and improves the patients' quality of life [18]. Król et al. Observed that both the focused and the radial shock waves bring very good results in the form of pain reduction in people with heel spurs [19].

The obtained results confirm the high effectiveness of the shock wave application in patellar ligament enthesopathy, lateral epicondylitis of the humerus and heel spur. However, it would be worth conducting additional studies on a larger number of patients.

Conclusions

1. The application of the shock wave reduces pain among the respondents.
2. The application of the shock wave reduces the swelling in the treatment area.
3. The use of a shock wave improves the mobility of the sick joint.
4. Shock wave treatments improve the functioning of patients in everyday life.
5. Shock wave treatments improve the quality of professional work.

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