

An assessment of the efficacy of degenerative knee joint disease treatment using vibroacoustic therapy

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**European Journal
of Medical Technologies**
2016; 2(11): 37-42

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www.medical-technologies.eu
Published online 19.07.2016

Abstract

Introduction. The constantly growing number of patients suffering from degenerative kneejoint disease and the increasingly earlierage of patients require modern physiotherapy to seek new and effective methods of countering the effects of arthrosis. Among these innovative methods there is vibroacoustic therapy.

Objectives. The objective of this study was to compare the effectiveness of vibroacoustic therapy (acoustic wave) combined with ultrasounds and cryotherapy with a therapy consisting of ultrasounds combined with cryotherapy in patients with gonarthrosis.

Materials and methods. All 40 patients enrolled in this study have suffered from ailments associated with degenerative knee disease for at least 5 years. The patients were divided into two 20-person groups, differentiated by the therapy employed. Patients in the group (A) were subjected to vibroacoustic therapy, combined with cryotherapy and ultrasounds, while in respect of individuals in the second group (B), only cryotherapy and ultrasounds were used.

Results. Before and after therapy the points obtained from the WOMAC questionnaire (part concerning pain intensity) in men part of group A was 0.89 pts less. Similar results were achieved in group B, where the average pain intensity decreased in men by 0.58 pts. The results obtained from the WOMAC questionnaire (part concerning physical function) show that in the group which received vibroacoustic therapy (group A) one could observe a greater reduction in the diameter of the knee joint than in group B (no vibroacoustic therapy). An analysis of knee-mobility-range measurements did not reveal statistically significant differences between the results obtained before and after therapy.

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Key words:

Vibroacoustic therapy; degenerative kneejoint disease; WOMAC questionnaire

Conclusions. Vibroacoustic therapy, combined with ultrasounds and cryotherapy, results in reduced pain, decreased knee joint diameter, and improved mobility and the ability to perform daily activities by the patient.

Combining vibroacoustic therapy with ultrasounds and cryotherapy results in better therapeutic efficacy than when using those methods on an exclusive basis.

Introduction

The knee is the largest joint in the human body. Mechanical trauma [1,2], excessive body weight, genetic, racial and gender-related conditions, and more importantly age, are all factors that increase the risk of the accelerated development of the degenerative disease – gonarthrosis [3,4,5]. It is assumed that nearly 25% of all the degenerative conditions of peripheral joints and facet joints are degenerative lesions of the knee [6]. Their clinical course is especially troublesome for patients due to exacerbating pain, progressive mobility restriction and deformations of the joint, which lead to the impairment of locomotor capacity, and, consequently, to disability [7].

The constantly growing number of patients suffering from degenerative knee joint disease and the increasingly earlier age of patients require modern physiotherapy to seek new and effective methods of countering the effects of arthrosis [8]. Among these innovative methods there is vibroacoustic therapy. It originates from microvibrations occurring naturally in the body, which were first observed at the beginning of the 20th century. Over the course of a disease, inflammation or exhaustion, one can observe a decrease in the intensity of the so-called microvibrational background. Vibroacoustic therapy consists of subjecting the organism to vibrations identical to those occurring naturally in the body. This is achieved with the specially designed VITAFON-T apparatus, which generates acoustic waves with a determined frequency and amplitude [9,10].

The objective of this research was to compare the effectiveness of vibroacoustic therapy (acoustic wave) combined with ultrasounds and cryotherapy with a therapy consisting of ultrasounds combined with cryotherapy in patients with gonarthrosis.

Materials and methods

The study design was accepted by the Committee on Bioethics of the Medical University of Lublin (Resolution No. KE-0254/215/2014).

As part of the studies, 40 patients from the St Johns' Oncology Center in Lublin were enrolled. All patients have suffered from ailments associated with degenerative knee disease for at least 5 years. Lesion progression displayed on x-ray film included grades 2, 3 and 4 on the Kellgren–Lawrence scale.

The patients were divided into two 20-person groups, differentiated by the therapy employed. Patients in the first group (A) were subjected to vibroacoustic therapy, combined with cryotherapy and ultrasounds, while in respect of individuals in the second group (B), only cryotherapy and ultrasounds were used. Group A included 10 women and 10 men, whose mean age was $66.3 (\pm 8.9)$ years. Group B also included 10 women and 10 men, whose mean age was $63.3 (\pm 8.9)$ years.

Patients from group A, over the course of 2 weeks of therapy, were subjected to 20 vibroacoustic therapy procedures, each lasting 20 minutes, twice a day (morning and evening), performed in the joint area affected by the disease, as well as in the lumbar-spine area. Cryotherapy procedures were carried out using carbon dioxide vapour on the affected joint area, and lasted 3 minutes. Sonotherapy (ultrasounds) was conducted in 3-minute sessions using a 1 MHz head, with an area of 5 cm^2 and a dose of 0.8 W/cm^2 . The parameters and method for carrying out the ultrasound procedures and cryotherapy were the same in groups A and B.

The WOMAC (*Western Ontario and McMaster Universities Arthritis Index*) questionnaire was used to assess the effects of therapy and evaluate the subjective levels of pain and physical function in patients

while performing daily activities. Knee diameter measurements were taken 5 cm above the knee joint space. Knee mobility measurements were taken in line with the methodology proposed by Zembaty [11]. The measurements were taken twice – before starting the therapy and 2 weeks after its conclusion.

The obtained study results were subjected to statistical analysis. The values of the analysed parameters were characterised using the mean value, median, standard deviation, minimum and maximum. Qualitative variables were characterised using population size and percentage. For measurable features, the normality of the distribution of the analysed parameters was assessed using the Shapiro–Wilk test. The Mann–Whitney U test was used to compare two independent groups, while the Wilcoxon matched-pairs test was used in relation to dependent variables. Spearman's Rank Correlation significance test was used to determine the presence of a correlation between two quantitative attributes. The significance level was assumed at $p < 0.05$, indicating the presence of statistically significant differences or correlations. The database was established and the statistical research was conducted using the STATISTICA 10.0 software (StatSoft Polska).

Results

The number of points obtained by men in group A after therapy was 0.95 pts, which was 0.89 pts less than the value indicated before therapy ($Z=3.61$; $p < 0.05$). The mean number of points in group A decreased by 1.08 pts – from 1.92 to 0.84 pts ($Z=4.37$; $p < 0.05$). Similar results were achieved in group B,

where the average pain intensity decreased in men by 0.58 pts ($Z=3.34$; $p < 0.05$) and in women by 0.73 pts ($Z=3.59$; $p < 0.05$). All differences between the values before and after therapy were statistically significant ($p < 0.05$) (Table 1).

The results obtained from the WOMAC questionnaire concerning physical function in patients were expressed in terms of patients' difficulties in the performance of daily activities. The maximum points to be achieved in this section was 52, and the lower the score the better was the patient's physical function. The differences in the number of points obtained by men in group A before and after therapy amounted to 14.4 pts ($Z=4.69$; $p < 0.05$), and by women to 16.1 pts ($Z=4.95$; $p < 0.05$). In group B, in which no vibroacoustic therapy was employed, the differences in points obtained before and after therapy were 8.3 ($Z=3.58$; $p < 0.05$) (men) and 9.4 ($Z=3.71$; $p < 0.05$) (women). All differences between the results obtained before and after therapy were statistically significant ($p < 0.05$) (Table 2).

In the group which received vibroacoustic therapy (group A) one could observe a greater reduction in the diameter of the knee joint than in group B (no vibroacoustic therapy). In group A, among men and women alike, the diameter of the knee joint decreased by 2.2 cm on average ($Z=2.94$; $Z=3.03$; $p < 0.05$), and in group B the diameter of the knee joint decreased by 1.3 cm ($Z=2.60$; $p < 0.05$) and 1.1 cm ($Z=2.55$; $p < 0.05$) on average in men and women respectively. The obtained results were statistically significant ($p < 0.05$) (Table 3).

An analysis of knee-mobility-range measurements did not reveal statistically significant differences between the results obtained before and after therapy

Table 1.

A comparison of pain intensity according to WOMAC questionnaire in the studied groups (n=40).

		Before therapy (max 4 pts)	After therapy (max 4 pts)	p	Z
Group A	Men (n=10)	1.84	0.95	$p < 0.05$	3.61
	Women (n=10)	1.92	0.84	$p < 0.05$	4.37
Group B	Men (n=10)	1.92	1.34	$p < 0.05$	3.34
	Women (n=10)	2.14	1.41	$p < 0.05$	3.59

($p>0.05$). In group A, among both men and women, the average value of active movement in terms of knee flexion, measured after the employed treatment, was 1.1° greater than before therapy ($Z=1.52, Z=1.38; p>0.05$). In the comparison group (B) the scope of active movement in men increased by 1.4° ($Z=2.06; p>0.05$), and in women in the same group, by 0.8° ($Z=0.97; p>0.05$) (Table 4)

Discussion

Vibroacoustic therapy dates back to the mid-1990s; however, it was not until recently that we could observe increased interest in this field. Global scientific reports include research into the use of vibroacoustics

in treating patients with prostate gland hyperplasia [12] or a calcaneal spur [13], treating lumbosacral spine pain [14], as well as respiratory system ailments [15] and bone fractures [16].

In our own studies we attempted to assess the usefulness of vibroacoustics in the treatment of degenerative knee-joint disease. The research tools included the WOMAC questionnaire, with part 1 concerning pain experienced while performing five daily activities (walking, going up and down stairs, sleeping, sitting or lying, and standing upright). The difference between scores obtained after therapy by patients who underwent vibroacoustic therapy, combined with ultrasounds and cryotherapy, was almost one point greater (from 1.88 to 0.9) than in the case of cryotherapy only, combined with ultrasounds, where

Table 2.

A comparison of patients' physical function according to the WOMAC questionnaire (n=40).

		Before therapy (max. 52 pts)	After therapy (max. 52 pts)	p	Z
Group A	Men (n=10)	27.7	13.3	$p<0.05$	4.69
	Women (n=10)	29.9	13.8	$p<0.05$	4.95
Group B	Men (n=10)	25.1	16.8	$p<0.05$	3.58
	Women (n=10)	29.3	19.9	$p<0.05$	3.71

Table 3.

A comparison of knee joint diameters before and after therapy (n=40).

		Before therapy (max. 52 pts)	After therapy (max. 52 pts)	p	Z
Group A	Men (n=10)	27.7	13.3	$p<0.05$	4.69
	Women (n=10)	29.9	13.8	$p<0.05$	4.95
Group B	Men (n=10)	25.1	16.8	$p<0.05$	3.58
	Women (n=10)	29.3	19.9	$p<0.05$	3.71

Table 4.

A comparison of knee joint active movement in terms of flexion before and after therapy (n=40).

		Before therapy	After therapy	p	Z
Group A	Men (n=10)	107.9	109.0	$p>0.05$	1.52
	Women (n=10)	104.7	105.8	$p>0.05$	1.38
Group B	Men (n=10)	106.3	107.7	$p>0.05$	2.06
	Women (n=10)	107.0	107.8	$p>0.05$	0.97

a difference of 0.65 pts was recorded (from 2.03 to 1.38). Łukasiak et al. [13], who treated patients with a so-called calcaneal spur, observed a similar trend. They demonstrated that pain intensity measured using the VAS scale among a group of patients treated solely with vibroacoustic therapy decreased after therapy by 2.6 pts, while the score on the McGill Pain Questionnaire decreased by 17 pts. In turn, patients in the comparison group (laser therapy + ultrasounds) experienced a decrease in pain intensity amounting to 0.6 pts on the VAS scale and 6 pts on the McGill Pain Questionnaire. In studies carried out by Drężewska et al. [14] consisting of a two-week acoustic therapy for patients complaining about lumbosacral spine pain, similarly to our own studies, we could observe a decrease in the point values of pain intensity measured using the VAS scale from 5.81 to 3.38 pts and from 316 to 194 pts using the Laitinen questionnaire.

In our own studies we could observe a statistically significant decrease in the number of points obtained in the part of WOMAC questionnaire related to difficulties in daily activities. All surveyed patients obtained lower scores (indicating their better physical function) after the administration of therapy in both groups A and B. In group A the number of points scored in comparison to pre-therapy results was smaller by 15.25, while in group B it was smaller by 8.85 pts. The results of our own studies are analogous to those obtained by Skopowska et al. [17], who, in their studies of the use of vibroacoustic therapy in patients with gonarthrosis, observed that patients did better in functional tests (increased fluidity while walking, less time needed for completing the TUG – the Timed Up and Go Test – and an increase in the number of painless sit-ups). Based on the aforementioned results and the results of our own studies, one can presume that the utilisation of vibroacoustic therapy improves the performance of daily activities by patients with gonarthrosis.

The effect of a degenerative process taking place in the joint is a decrease in the joint's mobility. Joint swelling significantly impacts on this process and makes it impossible for the patient to achieve full joint mobility. The degree of swelling can be assessed by measuring joint diameter. In our own research we

observed that the use of vibroacoustic therapy combined with cryotherapy and ultrasound waves resulted in a decrease in knee joint diameter in patients in group A (both women and men) by 2.2 cm on average. This was a better result than the one in group B (cryotherapy + ultrasounds), in which the diameters decreased by 1.3 cm and 1.1 cm on average in men and women respectively. In studies by Skopowska et al. [17], a 0.88 cm (on average) decrease in the diameters of knee joints was demonstrated; however, it is worth highlighting that these authors employed only vibroacoustic therapy.

In our own studies, the change in knee joint mobility in terms of flexion achieved following vibroacoustic therapy was not statistically significant. The literature, however, includes reports indicating a positive impact of vibroacoustics on joint mobility. Stępień et al. [18] administered therapy to patients after the surgical treatment of Dupuytren's contracture. In group (A), which entailed laser therapy and vibroacoustic therapy, the achieved distance between the fingertips and the centre of the line linking the styloid processes of the forearm was greater than in the case of the group treated using laser only (B). In group A the degree of flexion of the MCP and PIP joints (inclusively) of the treated fingers improved by 3.4 cm on average, while in group B, by 2.2 cm. On the other hand, in group A the degree of extension of these joints improved by 1.1 cm on average, while in group B, by 0.9 cm. The discrepancies between the results of our own studies and those observed by Stępień et al. [18] could have stemmed from the fact that the treated joints were different in terms of size and structure.

The use of physiotherapeutic procedures is common practice in patients with degenerative joint disease. Physiotherapy makes it possible to reduce pain and improve mobility, which on the whole translates into the maintaining or improving of function. In our own research we have demonstrated that improvement in terms of function, joint mobility, decreased joint diameter and reduced pain were possible in the group of patients subjected to cryotherapy and ultrasounds, as well as in those who were also treated using vibroacoustic therapy. The results of treatment in the group which received vibroacoustic therapy were

better than in the group which lacked this method, which can prove the assisting effect of vibroacoustic waves on the reduction of symptoms of degenerative disease. The carried-out studies do not exhaust the issue of the impact of vibroacoustic waves in the treatment of degenerative joint disease, and the possible common use of such a stimulus requires further research.

Conclusions

1. Vibroacoustic therapy, combined with ultrasounds and cryotherapy, results in reduced pain, decreased knee joint diameter, and improved mobility and the ability to perform daily activities by the patient.
2. Combining vibroacoustic therapy with ultrasounds and cryotherapy results in better therapeutic efficacy than when using those methods on an exclusive basis.

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