ANNOTATION
of Minbayeva Larissa Sergeyevna's
dissertation thesis for the degree of Philosophy Doctor (PhD)
on specialty 6D110100 - Medicine
on the topic "Biomechanical substantiation of shock-wave therapy application in patients with knee osteoarthritis"

Actuality of theme

According to the results of recent epidemiological studies, 30% of the population at the age group over 65 years have an X-ray symptoms of degenerative-dystrophic changes in knee joints (Saloni Tanna et al., 2013).

According to World Health Organization predictive data on the increase of osteoarthritis (OA) morbidity (2013), a threefold increase of OA-affected people in the age over 60 is expected to the year 2050, which would be about 20% of the world's population (Lim K, Lau C., 2011; Saloni Tanna et al., 2013). About 30% of cases would be accompanied with severe disabilities development. To the year 2030 it is expected that the need in surgical interventions for total hip and knee joint replacement would increase by 174% and 673%, respectively (Bitton R., 2009).

The leading clinical symptom of knee joint osteoarthritis is knee pain, which makes patients seeking specialized care for the first time (Sofat N. et al., 2011). The pain syndrome has a multifactorial genesis, which is caused by the multicomponent lesion of intra- and periarticular tissues in knee joint OA with involvement of musculoskeletal and tendon-ligament apparatus of the entire lower limb in pathological process (Симонс Д.Г. et al., 2005; Нечаев В.И., 2013). However, the main area of physiotherapeutic methods application at knee joint OA therapy is usually restricted only by intra- and periarticular components of knee joint. Other muscle and ligament structures of lower extremities that take an active part in formation of biomechanical stereotype of movement are not exposed to therapeutic action. As a result, efficacy of therapy is insufficient and achieved results are short-term.

Thus, conservative and surgical methods of osteoarthritis rehabilitation and treatment, used in modern medical practice, do not show absolute efficacy towards the main clinical symptoms relief and slowing down of disease progression. Constant monitoring of side effects and complications risk development that makes their improvement relevant is also needed (NICE, 2014).

Considering etiopathogenetic and clinical and symptomatic aspects of OA development, implementation of therapeutic effects in knee joint OA should be carried out both at the level of the affected joint and periarticular structures, and at the level of the entire lower extremity. It becomes possible to render a comprehensive impact, shorten rehabilitation period and improve the quality of life of patients with knee joint OA by inclusion of various new physiotherapeutic methods in treatment and rehabilitation programs. The most relevant and justified method is extracorporeal shock-

wave therapy (ESWT), successfully applied at a wide range of locomotorium diseases (Wang C.J. et al., 2007; Rompe J.D. et al., 2010; Gur A. et al., 2013; Yildiz S.K. et al., 2015).

The use of ESWT acquires special significance in patients with knee joint OA due to the corrective influence on the main patho- and sanogenetic factors and capability to stimulate physiological biomechanical systems of the body (Rompe J.D. et al., 2010; Goertz O., 2012; Gur A. et al., 2013; Bannuru R.R. , 2014; Yildiz S.K. et al., 2015).

Analysis of literature revealed the lack of clear recommendations on the use of ESWT in patients with knee joint OA to perform effective correction of changes in musculoskeletal apparatus of lower extremities according to the stage of pathological process. Given the ability of any physical factor to play a role of biological stimulator, its application should be justified in a comprehensive study of adaptation mechanisms to the stimulus used, with selection of dosage parameters on the basis of scientific principles.

Taking into account the relevance of the problem of high prevalence of knee joint OA (Насонов Е.Л., 2008; Peter W.F. et al., 2011; Saloni Tanna, 2013; NICE, 2014; McAlindon T.E., 2014), and appearance of extracorporeal shock-wave therapy – a new and effective method of locomotorium pathology treatment, as well as absence of published data regarding its application to correct musculoskeletal system changes, characteristic for knee joint OA, extracorporeal shock-wave therapy techniques development and evaluation of its effectiveness in patients with knee joint OA represented an undoubted interest for us.

Purpose of the study

To increase efficacy of treatment of patients with knee joint OA by improvement of extracorporeal shock-wave therapy technique based on the results of analysis of biomechanical indicators dynamics.

Objectives of the study

1. Scientifically substantiate the application technique of extracorporeal shock-wave therapy based on correction of biomechanical disorders in patients with knee joint OA.

2. To evaluate the effect of extracorporeal shock-wave therapy single procedure, applied according to the developed technique.

3. To investigate clinical and X-ray efficacy of biomechanically substantiated extracorporeal shock-wave therapy course application in knee joint OA.

4. To determine the long-term (in 4 months) efficacy of biomechanically substantiated extracorporeal shock-wave therapy course application in patients with knee joint OA.

Scientific novelty

As a result of complex study, it was revealed for the first time that the use of biomechanically substantiated extracorporeal shock-wave therapy in patients with knee joint OA allows to improve clinical and functional indices and compensatory-adaptive

capabilities of patients. Based on the obtained data, causative interrelation was established between pain syndrome formation and trigger zones presence in tendon-muscle structures of lower limb on the side of the joint affected by OA.

It has been established that the course use of trigger extracorporeal shock-wave therapy in patients with knee joint OA is more effective in comparison with locally acting technique, which is confirmed by more expressed dynamics of clinical, functional and X-ray indices.

At analysis of the study results, the dominant clinical, functional and X-ray parameters were revealed, which determination in dynamics allows evaluating of recovery processes in patients with knee joint OA. This also allows using the obtained data for outcome prediction.

Theoretical novelty and practical significance

The results of the conducted study made it possible to recommend the following for practical public health:

- an effective technique of scientifically based extracorporeal shock-wave therapy;
- the method of X-ray knee joint space asymmetry index calculation in patients with knee joint OA, accounted the presence of characteristic biomechanical imbalance of lower extremities, developed in the course of the study. Calculation of the index makes it possible to assess the changes in the anatomical congruence of the knee in the dynamics and use the data obtained after statistical processing to monitor recovery processes;
- "Appendix to the card of patient (Form No.044/y) with knee/hip joint OA treated in physiotherapeutic department" developed by us, that provides an opportunity of registration and visual representation of basic clinical, functional and instrumental examination indicators dynamics as a result of treatment of patients with knee/hip joint OA.

Introduction of the results into practice

The materials of dissertation are used in educational process at the Department of Medical Rehabilitation, Visual Diagnostics and Physical Education of Karaganda State Medical University in additional and postgraduate education (profiling and elective disciplines of residency and magistracy programs), and by specialists in medical rehabilitation, orthopedics and traumatology, rheumatology and therapy.

Two acts of introduction into the educational and medical process (lecture: Shock-wave therapy in knee joint OA treatment; method of treatment: Shock-wave therapy in treatment of knee joint OA).

3 certificates of government registration of rights for the object of copyright were obtained upon the results of the study.

Based on the materials of the research, an educational and methodological manual was published: Sheveleva N.I., Minbayeva L.S. "Shock wave therapy in knee joint OA" (educational and methodical manual). - Karaganda, 2017. - p. 59.

Key points of dissertation to be defended

1. Single application of extracorporeal shock-wave therapy based on the correction of biomechanical disorders contributes to the effective reduction of pain syndrome in patients with knee joint OA.

2. Biomechanical disorders at knee joint OA are characterized by X-ray joint space asymmetry in 100% of cases.

3. Course application of biomechanically substantiated extracorporeal shock-wave therapy can be used as a pathogenetic therapy for knee joint OA, as a tool for effective correction of functional disorders and increase of the level of compensatory-adaptive capability.

4. The results, achieved in the course application of biomechanically based extracorporeal shock-wave therapy in patients with knee joint OA persist for more than 4 months.

Relation of the dissertation with other research papers

The dissertation was performed at the Department of Medical Rehabilitation, Visual Diagnostics and Physical Education of the KSMU as part of the initiative topic of the research work "Introduction of new technologies into medical rehabilitation".

Approbation of the dissertation

The main points and results of the dissertation were reported at the international conference of young scientists "The World of Science and Youth: Achievements and Prospects" (Karaganda, 2015); at meetings of the scientific and medical society of medical rehabilitation and sports medicine doctors (Karaganda, May 2016, April 2017); at the 8th International Student Medical Congress ISMCK'16 (Košice, 2016); at the Silk Road Forum on hydrotherapy with thermal waters and rehabilitation in Central Asia (Urumqi, 2016); at the international scientific and practical conference "Actual questions of medical rehabilitation and balneology" (Bishkek, 2017); at the Vth international scientific and practical conference "Priority directions of rehabilitation and balneology" (Astana, 2017).

The preliminary defense was held at the meeting of the Department of Medical Rehabilitation, Visual Diagnostics and Physical Education of the KSMU, Protocol No. 9 of 2nd of May, 2017; at the meeting of the Scientific and Expert Commission "Therapy and Pharmacology" Protocol No 9 of 31th of May, 2017.

Publications

15 works were published on the materials of the doctoral thesis, including 1 educational and methodical manual; 2 articles and 2 theses in English in indexed in the Scopus database journals; 5 publications in collections of articles of international conferences outside of Kazakhstan; 2 articles in journals recommended by the Committee for Control in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan.

3 certificates of governmental registration of rights to the object of copyright were received:

- No. 250 "Method of the X-ray knee joint space asymmetry definition" dated 07.02.2017, issued by the Ministry of Justice of the Republic of Kazakhstan;

- № 2756 "Appendix to the card of patient (Form No.044/y) with knee/hip joint OA treated in physiotherapeutic department" dated 29.12. 2016, issued by the Ministry of Justice of the Republic of Kazakhstan;

- No. 11 "Lecture: Shock-wave therapy in knee joint OA treatment" dated 4.01. 2017, issued by the Ministry of Justice of the Republic of Kazakhstan.

Conclusions

1. The features of clinical and functional picture in patients with knee joint OA of 2-3 degrees, according to the results of palpation and shock-wave diagnostics, are the presence of changes on tractus iliotibialis, in tendo calcaneus, in m. vastus lateralis and in the area of tendon m. sartorii, in m. flexor digitorum longus, in retinaculum mm. peroneorum, m. peroneus longus, m. popliteus, lig. patellae, in the tendon of m. rectus femoris and sacrococcygeal articulation in more than 80% of examined patients.

The presence of the detected triggers in mentioned above areas indicates a biomechanical overload of not only intra- and periarticular tissues of the affected with osteoarthritis knee joint, but also other tendon and musclar structures of the lower extremities participating in the movement act, that righteously aggravates the processes of arthrosis formation and makes correction of biomechanical disorders pathogenetically substantiated.

Shock-wave diagnostics was more effective method of trigger zones searching in comparison with palpation, showing significantly higher results in the area of sacrococcygeal articulation, in the tendon m. rectus femoris and lig. patellae ($p < 0.01$), as well as in m. vastus lateralis, m. semimembranosus, m. biceps femoris, m. gastrocnemius caput laterale, m. peroneus brevis, m. peroneus longus, tendo calcaneus, retinaculum mm. peroneorum ($p < 0,05$), that allows to state its necessity before extracorporeal shock-wave therapy.

2. A single application of ESWT procedure based on the correction of biomechanical disorders contributes to more effective pain reduction in patients with knee joint OA in comparison with the locally acting technique, which is confirmed by the presence of statistically significant differences ($Z=-2.83$, $p=0.0045$) according to the results of comparative analysis of the dynamics of Visual Analogue Scale (VAS) in the examined 1st and 2nd groups (from 6(5; 6) to 3(2; 3) vs from 5.5(5; 6) to 3(3; 4) points , when represented in the form of (ME (Q1; Q3)).

3. The course application of ESWT improves the clinical and functional state of patients with knee joint OA of II-III degree, which is confirmed by the results of X-ray and podometrical examinations. In this case, the course of ESWT procedures on the developed method corrects functional disorders in knee joint OA and increases the level of compensatory and adaptive capabilities more efficiently, which is confirmed by more expressed decrease of VAS values (from 6 (5; 6) to 2 (1; 2) vs from 5.5 (5; 6) to 3 (3; 3) points ($Z=-6.21$, $p<0.05$)), the Lequesne Index values (from 7.5 (5; 10.5) to 1.5 (0.5,

3.5) vs from 6.5 (5; 9.5) to 4.5 (3.5.5) points (Z=4,95, p<0,05)) and WOMAC values (from 24 (15; 30) to 3 (0; 9) vs 22 (10; 29) 14 (2; 21) points (Z=-3,73; p=0.00019)), the X-Ray Knee Joint Space Asymmetry Index (from 0.22 (0.16; 0.24) to 0.11 (0.1; 0.14) vs 0.2 (0.18; 0.23) to 0.17 (0.16; 0.2) (Z=-6.17, p<0.05)) and podometry results (from 14 (8; 24) to 4 (0; 4) vs from 12 (4; 20) up to 8 (4; 16) (Z=-3.84; p=0.0001)) when represented in the form of (ME (Q1; Q3)).

A comparative analysis of the course ESWT clinical efficacy according to the Rawls and Maudsley scores also showed better results in patients of the 1st group, which was statistically significant (Pierson's chi-square test - 6.031, Pearson chi-square critical value at significance level p<0.05 - 5.991).

4. The course application of biomechanically substantiated ESWT in patients with knee joint OA is accompanied by preservation of the obtained clinical and functional results within 4 months, which is confirmed by the presence of statistically significant differences (Z=4.62, p=0.00004) at performing of comparative analysis of the dynamics of the initial values of the WOMAC index (ME (Q1; Q3) = 25.5 (21.5, 31) points) with the index values determined after the ESWT course (ME (Q1; Q3) = 6 (1.75; 10) points) and in 4 months (ME (Q1; Q3) = 11.5 (9; 14) points). There was no return of the obtained WOMAC index values to the initial values in 4 months observed in any of the patients, despite of increase of the index values from the end of the course of ESWT to the 4-month endpoint after therapy (ME (Q1; Q3), from 6 (1 , 75, 10) to 11.5 (9; 14), respectively (Z=4.62, p=0.00004)). The best long term results were achieved for the pain syndrome and functional activity, and were characterized by increase of the index by only 13.33% (Z=4.45, p=0.000008) and 15.63% (Z=4.54, p=0.000006) respectively, compared with initial.