



World Scientific News

An International Scientific Journal

WSN 122 (2019) 1-11

EISSN 2392-2192

Assessment of the function of the knee after rehabilitation in patients with gonarthrosis - the KOOS scale

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ABSTRACT

Osteoarthritis (OA) of the knee joints is nowadays a significant medical and economic problem in the world. The percentage of people diagnosed with degeneration of the knee joint is increasing rapidly. Not only does it cause negative social consequences, but also generates large treatment costs. The treatment consists in taking preventative measures and educating patients, as well as pharmacological therapy, physiotherapy and, as a last resort – surgery. Suitable and comprehensive measures can decrease symptoms of gonarthrosis. The research was conducted among 110 patients diagnosed with OA of the knee joints in one of the rehabilitation clinics in Podkarpacie voivodeship. A self-construction questionnaire, the KOOS scale and the VAS scale were the research tools. The respondents were informed about the anonymity of the survey. The research was carried out twice before and after the rehabilitation. Among the respondents, the highest percentage of people with gonarthrosis involved women (74.5%). Overweight and obesity were important factors correlating with the occurrence of gonarthrosis. The cryotherapy (66.4%), exercise in relief (42.7%), followed by laser

therapy, magnetronics and individual exercises were considered the most helpful treatments. Electrotherapy and massage were considered as the least effective. Having analysed the result of the KOOS questionnaire and the VAS scale provided to the patients before and after the treatment, the positive effects of physiotherapy have been noted. The patients have noticed improvement in daily activities, quality of life, severity of symptoms and pain relief ($p < 0.05$). The research indicates that physiotherapy is an effective measure, therefore it should be included in the treatment of patients diagnosed with OA.

Keywords: Osteoarthritis (OA), knee, KOOS scale, VAS scale, rehabilitation

1. INTRODUCTION

The ageing trend in the Polish society has been observed for several years. The continuous development of medicine and thus improvement of diagnostic possibilities, especially diseases associated with the motion system, generate a large percentage of people with disabilities. This effect involves increasing financial efforts for health care and economic problems of countries. For comparison, in the United States, the disease generates costs of 60 billion a year. Scientists predict that this value will increase by 15% by 2020. The estimates show that annual expenses for the treatment of degenerative disease absorb 1-2.5% of gross domestic product. [1]

The factors predisposing to degenerative changes are gender (the changes occur more often in the group of women), age (the first symptoms can appear after the age of 40), and genetic factors. A correlation was found between the mutation of the COL2A gene, which is responsible for the coding of type 2 collagen, and the increased incidence of degenerative changes. [2]

The symptoms of gonarthrosis appear gradually and slowly; pain intensifying during movement and disappearing at rest is usually the first symptom. In the later phase of the disease, the pain does not disappear even at rest and appear at night. In the next stage, joint stiffness, swelling, deformation of the joint contour and joint axis disorders occur. In the diagnosis of knee arthrosis, a physical examination and an interview with a patient are applied. In addition, radiological examinations and other imaging examinations, for example, ultrasound or computed tomography are applied. In order to check the patient's feelings, the KOOS scale can be used, which allows to examine such aspects of the disease as symptoms, pain, quality of life and sport activity. [3]

The purpose is to assess the effectiveness of rehabilitation and its influence on the knee function in the examined patients.

2. RESEARCH MATERIAL AND METHODS

The outpatient rehabilitation of a patient referred to rehabilitation due to degenerative changes within the knee joint was the criterion to include in the research. The rehabilitation process was planned individually for the patient and performed in accordance with the doctor's recommendation. The research was conducted among 110 patients of the rehabilitation surgery. Participation in the research was anonymous and voluntary.

The research was based on a self-developed questionnaire supplemented with the visual and analogue VAS scale, assessing the level of perceived pain before and after rehabilitation, and a standardized KOOS questionnaire (Knee Injury and Osteoarthritis Outcome Score) for patients with degenerative knee joint changes.

The results of the research were subject to statistical analysis using the STATISTICA PL 13.1 program. The normality of the distribution was checked using the Shapiro Wilk Test. The Wilcoxon test was used to assess the dependence of variables in a two-fold measurement. Statistical dependences were significant if their level of significance was $p \leq 0.05$.

3. RESULTS

The research group consisted of 110 people, including 82 women and 28 men. The average age of the subjects was 52.7 ± 13.0 years (23 - 77 years). The mean value of the BMI index in the research group was 27.6 ± 2.8 (21.5 - 33.9). Over half of the respondents performed physical work (52.7%), the remaining part of the group performed intellectual work. The work of the majority of the respondents forced bending of knee joints (25.5%) or prolonged standing or kneeling (24.5% each, respectively).

Table 1. Nature of the performed work

| Nature of the performed work | N | % |
|--|------------|-------------|
| Long-term exposure of forced standing position | 26 | 23.7 |
| Long-term exposure of standing position | 27 | 24.5 |
| Frequent kneeling position | 27 | 24.5 |
| Frequent bending of the knee joints | 28 | 25.5 |
| Moving of heavy objects | 2 | 1.8 |
| TOTAL | 110 | 100% |

N-number of observations; %-percent

Most of the respondents did not show sports activity (78.2%, N = 86). On the other hand, among the remaining group, 10 people declared running and exercising at the gym, 6 people attended swimming, 3 - rode a bike, and 2 practised fitness. In the group of 71.8% of the respondents, no previous injuries in the knee joint were noted. In the subjective opinion of the patients, degeneration of the joint occurred as a result of overload in 74.5% (N = 83) of the examined. In the examined group, none of the respondents (100%) suffered from the knee joint degeneration as a result of congenital defects in the construction of the musculoskeletal system.

The treatments applied in each of the subjects in the subsequent series of referred rehabilitation are presented below. In the examined group, the most effective physiotherapeutic

procedures applied in osteoarthritis of the knee joints were primarily: electrotherapy (19.9% of the “unhelpful” responses) and massage (16.8% of the “unhelpful” answers). In turn, the laser therapy was effective according to the respondents (15.2% of “helpful” responses), magnetron (13.4% of the “helpful” responses) and individual exercises (12.6% of the “helpful” responses). However, the best results were obtained for cryotherapy (22.6% of the “very helpful” responses) and exercises in relief (14.6% of the “very helpful” responses).

Table 2. Subjective assessment of the effectiveness of the treatments applied in the rehabilitation process of the examined group

| Type of treatments | Effectiveness of treatments | | | | | |
|-----------------------------|-----------------------------|-------------|---------|-------------|--------------|-------------|
| | Unhelpful | | Helpful | | Very helpful | |
| | N | % | N | % | N | % |
| Electrotherapy | 57 | 19.9 | 40 | 10.5 | 13 | 4.0 |
| Laser therapy | 23 | 8.0 | 58 | 15.2 | 29 | 9.0 |
| Ultrasounds | 29 | 10.1 | 42 | 11.0 | 39 | 12.1 |
| Cryotherapy | 15 | 5.2 | 22 | 5.8 | 73 | 22.6 |
| Massage | 48 | 16.8 | 43 | 11.3 | 19 | 5.9 |
| Magnetronics | 20 | 7.0 | 51 | 13.4 | 39 | 12.1 |
| Hydrotherapy | 36 | 12.6 | 46 | 12.1 | 28 | 8.7 |
| Exercises at home | 32 | 11.2 | 31 | 8.1 | 47 | 14.6 |
| Individual exercises | 26 | 9.1 | 48 | 12.6 | 36 | 11.1 |

* $\sum \neq 100\%$, N-number of observations; % - percent from the column

The research involved a two-time assessment of the knee joint function in the examined patients (before and after the rehabilitation) using the KOOS scale. In each of the analysed subscales, the point value was significantly increased after the rehabilitation. This result confirms the increase in the functionality of the knee joint and lowering the subjectively felt effects of the joint dysfunction. As a result of the applied rehabilitation, the quality of life of the patients improved.

The pain in the knee joint decreased significantly, the symptoms severity and difficulties in performing everyday activities decreased. The sports and recreational activity of the examined patients increased due to a decrease in dysfunction ($p < 0.001$).

Table 3. Assessment of the knee joint in the individual KOOS categories before and after the rehabilitation procedure.

| KOOS scale | BEFORE rehabilitation Me±SD | AFTER rehabilitation Me±SD | p |
|--|--|---|---------------|
| KOOS – Pain | 54.2±17.6 | 62.0±16.01 | 0.000* |
| KOOS - symptoms | 52.8±17.1 | 60.7±16.7 | 0.000* |
| KOOS - activities of daily living | 53.3±17.6 | 61.2±15.7 | 0.000* |
| KOOS - sports and recreation activities | 35.3±19.4 | 41.1±20.7 | 0.000* |
| KOOS – Life quality | 45.7±16.3 | 55.6±15.0 | 0.000* |

In the research group, the average subjective level of pain experienced before the rehabilitation was 6.7 ± 2.1 in the VAS scale, and 4.4 ± 1.9 in the rehabilitation period. Therefore, a statistically significant effect of the rehabilitation on the reduction of the subjective assessment of the level of pain perceived on the VAS scale was found ($p = 0.000$).

Table 4. Subjective assessment of pain in the VAS scale in the research group before and after the rehabilitation.

| | BEFORE rehabilitation Me₁±SD | AFTER rehabilitation Me₁±SD | p |
|------------------|--|---|---------------|
| VAS scale | 6.7±2.1 | 4.4±1.9 | 0.000* |

By analysing the risk factors for the occurrence of ailments within the knee joint, the influence of the BMI on particular parameters of the KOOS scale and on the VAS scale was assessed. This analysis was made before the rehabilitation of the examined patients. There were statistically significant, negative, weak and average correlations between all examined parameters of the KOOS scale and the BMI value.

According to them, the larger the BMI was, the more pain was felt. In addition, the patients experienced more symptoms in the knee joints, daily activities, sports and recreational activities, and quality of life decreased. However, no statistically significant correlation was found between the subjective pain assessment on the VAS scale and the BMI value.

Table 5. The influence of the BMI on individual parameters in the KOOS scale and on the VAS scale researched before the rehabilitation

| Scales | BMI | |
|--|--------------|--------------|
| | r | p |
| KOOS – Pain | -0.28 | 0.002 |
| KOOS - symptoms | -0.23 | 0.015 |
| KOOS - activities of daily living | -0.26 | 0.005 |
| KOOS - sports and recreation activities | -0.20 | 0.033 |
| KOOS - quality of Life | -0.35 | 0.000 |
| VAS | 0.15 | 0.119 |

4. DISCUSSION

In recent years, it has been noticed that the problem of osteoarthritis of the joints is important, including osteoarthritis of the knee joint, exposed to overload and damage of periarticular structures and joint surfaces due to its complicated structure. The number of people diagnosed with degenerative changes in the knee joint is increasing. The result of the observed increasing trend is the large financial efforts associated with the treatment of patients. In the opinion of scientists, it is important to introduce preventive measures and reduce the percentage of people suffering from osteoarthritis [4].

The degenerative changes in the knee joint occur due to an increased risk of subsequent coexisting diseases [5,6]. In addition, the risk of falls [7] and the death rate [8, 9], as well as the coexisting disorders and problems with sleep [10, 11] increase, mood is worse - all these factors significantly reduce the quality of life [8]. It is interesting to note that the earlier stages of OA can be painful for the patients and there will be no radiographic changes. [12]

There is an increasing number of publications that provide evidence of a beneficial effect of patient education, the use of physiotherapeutic procedures, physical exercise, weight control, making it possible to avoid surgical intervention and delay the effects of the disease [13]. The effectiveness of physiotherapy of the patients with diagnosed gonarthrosis is the subject of numerous researches.

Own research indicates that the important determinant of osteoarthritis of the knee joints is female sex. In the own research, as many as 74.5% of the respondents with degenerative changes of knee joints were women. This percentage is not surprising considering the differences in terms of epidemiology, radiology, hormonal and cellular conditioning due to gender. In the group of women, there are often much lower values in the level of pain caused by OA and the subjective level of quality of life compared to men. [14, 15]

Age is another factor considered. It is believed that after the age of 40 the risk of developing symptoms of gonarthrosis increases. Our own research shows that the average age at which the symptoms worsen is 52 years old. In the ranking of global disability, knee and hip OA are found to be on the 11th place of the age prevalence, accounted for 3.8% [16]. The disabilities increased with the increase in age. Knee osteoarthritis is found to be present in high number in the elderly populations of Beijing where it accounted for more than 150 million people. They were above the age of 60 and mostly comprised of women. [17]

The BMI of the majority of the respondents indicated overweight or obesity, the average value was 27.6 kg/m², the BMI above 33 kg/m² was also recorded, which indicated the first degree of obesity. The research evidenced that body weight is a strong determinant of the emergence of knee joint disease processes. In addition, there was a large correlation between overweight and lowering the quality of life and the severity of pain symptoms. Similarly, in the Michigan Bone Health and Metabolism Study, in obese women, the presence of two or more cardiovascular risk factors was associated with more reports of persistent knee pain in the last 3 years [18].

In the research from 2011 conducted by Sanghi et al. with the group of 180 patients with confirmed gonarthrosis, the relationship between the increase in the BMI index and the severity of pain was demonstrated. The increase in body mass influences on higher pressure putting on the knee joints, thus destroying its structures and contributes to faster progression of degenerative processes and increases the consumption of analgesics, which was highlighted in numerous publications. [19]

In the conducted study, the respondents were asked about the type of performed professional work. The result does not allow to state clearly whether intellectual or physical work correlates with the occurrence of changes of degenerative knee joint; however, slightly more people performed physical work (52.7%). On the other hand, having analysed the next question about the nature of the performed work, one can conclude that both sedentary lifestyle, which connects with intellectual work, maintaining a long-lasting forced position, and intense and strenuous physical activity can contribute to degenerative changes in the knee joints. [20]

Physical activity and lifestyle are also a decisive factor in the occurrence of degenerative disease. Among the respondents, only 21.8% take elementary physical activity. This result is worrying. Researchers believe that even moderate activity significantly influences the improvement of joint motility and inhibition or delay of lesions. Mansournia et al. report that the appropriately selected activity results in decreased pain in the joints, but it has no influence on functional capacity. [21]

It is also important to choose the right physical activity, because sports such as running, lifting weights, or incorrectly done exercises at the gym can load the knee joints leading to damage, this is mentioned in the research conducted by Vrezas. [22] In our own research, it is noticed that it the aforementioned sports were chosen the most often. The authors recommend mainly sports that do not load the joints, such as walking, swimming, cycling. [23]

Among the respondents, slightly less than one-third suffered from knee joint injury in the past, bruises and sprains of which were the most common. Such a result can be justified by the fact that degenerative changes on a traumatic basis occur most frequently in young people up to 35 years of age, engaging in professional or amateur sports, and in the conducted research, the average age of the respondents was approximately 50 years.

Then, the researchers checked which of the physiotherapeutic treatments, according to the respondents, are the most helpful and useful in reducing or alleviating symptoms.

Cryotherapy (66.4%) and exercises in relief are the most frequently chosen treatments and the most effective according to the respondents. Cryotherapy has a good effect in the case of degenerative diseases, eliminating ailments, causing better blood supply to periarticular tissues, which increases the range of motion.

The best effects in the treatment of gonarthrosis are obtained by using it before kinesitherapy, but the order of individual physiotherapeutic activities is not examined in the paper. Brinker et al. examined the effect of cryotherapy in terms of its influence on tissues, demonstrating that this procedure accelerates metabolism and faster discharge of harmful metabolites, causes higher oxygen saturation of tissues treated with cold [24], Based on our own research and available publications, it should be noted that cryotherapy is highly effective in reducing pain, increasing knee joint mobility, reducing swelling and muscle relaxation and allows for good effects of this treatment before exercising.

Among the involved patients, 12.1% indicated a high efficiency of ultrasound applied to the knee joint. In the author's research, however, the applied dose was not assessed. The research available in the literature also confirm the effectiveness of using ultrasounds of varying intensity in lowering the subjective assessment of the level of pain. However, they do not determine the increase in the range of mobility in the joint. [25, 26]

Other treatments considered helpful were: laser therapy, low frequency magnetic field (magnetronics) and individual exercises. There are many scientific reports confirming the effectiveness of laser biostimulation. Gasztych et al. dealt with the selection of appropriate parameters in the treatment of gonarthrosis with laser radiation, the best results were obtained with a dose of 3.95J/cm². A significant improvement was noted at that time regarding the reduction of joint stiffness and pain reduction. [27]

Mosiejczuk et al. divided the patients into a group applied only laser therapy and another group applying laser therapy and exercises. The muscle strength of the quadriceps and biceps femoris, ranges of motion and the VAS scale were monitored before and after the procedures. Better results were obtained in the case of laser exercises and biostimulation. Improvement was noticed both in terms of muscle strength, bending and extension range and decrease in pain sensations. [28] According to the authors, treatment with a low frequency magnetic field combined with other physical treatments provides good results.

In the subjective opinion of the patients, individual kinesitherapy was helpful. The proper selection and dosage of exercises are of great importance in the treatment of degenerative changes in the knee joints. There was also a statistically significant therapeutic effect in the patients performing recommended home exercises, as described by Thomas et al. [29] Electrotherapy and massage were considered the least effective treatments.

The knee joint functional level was assessed twice with the KOOS scale before and after the rehabilitation. The subjective level of pain perceived by the VAS scale was assessed twice. Statistically significant results were obtained in each category of the KOOS questionnaire. The highest effectiveness of the applied physiotherapy in terms of improving the quality of life, alleviating symptoms and significant impact on everyday activities was demonstrated. Sports and recreational activities were rated the worst. Pain assessed on the basis of the VAS scale decreased on average by 2.3 (Me₁-Me₂).

The analysis of the obtained results allows to conclude about the high efficiency and effectiveness of physiotherapy in the patients with diagnosed osteoarthritis of the knee joints and the need to use it in the conservative treatment.

5. CONCLUSIONS

- 1) Cryotherapy and relief exercises are the most effective treatments in the field of physiotherapy in the research group of patients.
- 2) The BMI influenced on all KOOS parameters examined before the rehabilitation. The higher BMI index determined the occurrence of major pain, symptoms in the knee joints, limitations in the performance of everyday activities, sports and recreational activities, and reduced the quality of life.
- 3) There was a statistically significant effect of physiotherapy on the subjective feeling of pain. In the research group, after the rehabilitation, the level of pain in the knee joints decreased.
- 4) The physiotherapeutic treatments positively influenced on all examined parameters in the KOOS scale. After the ordered physiotherapy, less painful complaints were found, fewer symptoms occurred in the knee joints, everyday activities, sports and recreational activities as well as quality of life improved.

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