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Rehabilitation of knee mobility using hydrokinesitherapy in patients with gonarthrosis

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Abstract. Knee joint arthrosis is the most frequent type of rheumatic injury; the symptoms are: pain, articular stiffness and functional deterioration. Hydrokinesitherapy represents the carry out of kinesitherapy under specific conditions determined by the fact that subjects are in immersion in water. Application of hydrokinesitherapy methods depending on diagnosis, needs and limits of the patient with gonarthrosis by developing individual and group programs will lead to the significant increase in the quality and effectiveness of the recovery process. Thus, the purpose of this study was to introduce to the recovery plan the hydrokinesitherapeutic means that would lead to gaining stability, flexibility and mobility of knee arthrosis. The methodological approach of the study consisted of two equal batches - experimental and control-made up of 6 patients each aged between 44-58 years. Differentiation between the two batches - experimental and control - was made through the therapy program applied. The control batch underwent a usual kinetic program, while the experimental batch underwent a kinetic program in aquatic environment as well. The results obtained proved that the application of hydrokinesitherapy procedures, based on diagnosis, needs and limits of the patient with arthrosis, correlated with tests for assessment of quality and effectiveness of the recovery process shows an increase in the quality of functional recovery of the knee.
Key words: *hydrokinesitherapy, knee joint arthrosis, recovery of knee mobility*.

Introduction

Osteoarthritis is one of the most common diseases and a major cause of disability, having as preferential localization the large joints of the body, specially the knee joint (1).

Osteoarthritis of the knee joint, gonarthrosis, represents the most frequent form of degenerative rheumatic disease, uni or bilateral, being responsible for the wear and tear (progressive degradation) of hyaline cartilage in the femoral-patellar and femoral-tibial joints, subchondral bone condensation and marginal osteophytosis, which is manifested by pain, joint stiffness and functional impairment with great potential of disability (2, 3).

Although osteoarthritis of the knee joint occurs most often in old age, many experimental studies indicate the presence of general metabolism and collagen disorders, problems concerning the basic biosynthesis of protein, which demonstrates that osteoarthritis can occur in young subjects too (4).

Recent studies demonstrate that the progression of osteoarthritis of the knee joint is different, being more rapid in some patients. It was also observed a more severe symptomatology, respectively morning stiffness, joint swelling and night pains, in case of women patients. (5)

Physical therapy provides, by its own means and methods, the improvement of joint function, facilitating joint mobility, muscle strength and endurance, venous return, sympathetic nervous tone - to adapt to the blood circulation to the effort specific demands and to promote muscle coordination (6).

Hydrokinetotherapy (performing physical therapy in specific conditions determined by finding the subject in well) is one of the most important means of physical exercise implementation (execution) to without pain (or reducing it) due to the lower intra-articular pressure in the knee, improved blood circulation in skeletal muscle movements, muscle relaxation, which will consequently increase the patient motivation.

Effects of hydrokinesitherapy in the recovery of knee arthrosis*:* produces vasodilation, muscle relaxation; improves flexibility of tendons, lubrication of the synovial fluid; decreases the articular compression forces; allows better perception of limbs by sensory stimulation;

reduces pain through partial loss of gravity; decreases oedemas due to the pressure created constantly around the limbs; facilitates articular mobilization; ensures the subjective feeling of wellbeing (7).

Material and Method

The purpose of this study is to introduce to the recovery plan the physical therapy and hydrokinesitherapy means that would lead to gaining in stability, flexibility and mobility of the arthritic knee joint. The objective of this study was to identify the most effective kinetic and hydrokinetic operational structures and to convert them into individual and group programs to recover the functionality of knee arthrosis using aquatic environment.

Hypotheses of this study were: the application of hydrokinesitherapy methods depending on diagnosis (depending on clinical stage), needs and limits of the patient with gonarthrosis by developing individual and group programs will lead to significant increase in the quality and effectiveness of the recovery process of knee arthrosis; the application of kinetic means in the aquatic environment by observing the strategy regarding the building-up and adaptation of the medical training's content to the possibilities of the patient with gonarthrosis will induce a general positive state (due to the adjacent effects of hydrokinesitherapy), which contributes to an increase in the recovery capacity, thus influencing positively the final outcome of the recovery from knee arthrosis.

The gonarthrosis diagnosis was made based on clinical and paraclinical signs.

Clinical signs were limping gait, limitation of knee joint mobility, knee deformation (flexum), crepitation, hypotonia and hypotrophy of the quadriceps and hamstrings.

Radiological changes were joint space narrowing (narrowing of the articular space between the femur and tibia), condensation of the subchondral bone, marginal osteophytes (developing bone protrusions in the tibial plateaus, femoral condyles and knee-cap edges).

Differentiation between the two batches - experimental and control one - was made through the therapy program applied.

The control batch underwent a usual kinetic program, while the experimental batch underwent the kinetic program which we created, in an aquatic environment.

The objectives of the kinesitherapy programs for knee arthrosis were: recovery of passive and active stability, recovery of antigravity muscle tone, recovery of knee mobility - namely 0 extension degrees, 120 degrees flexion for an optimum functionality, 145 degrees for functional normality.

The objectives of the specific programs for hydrokinesitherapy of knee arthrosis: increase of articular mobility; increase of muscle strength; increase of musculoarticular structures; improvement of balance and coordination; increase of proprioceptive control; cardiovascular and respiratory training to effort; pain reduction; increase of the global functional level.

Since the recovery of knee arthrosis mobility was addressed to different patients in terms of their main characteristics such as age, sex, body mass index, lifestyle (sedentary or active) associated diseases, the kinesitherapy and hydrokinesitherpy means of intervention were applied differently (depending on factors such as the frequency, intensity and duration).

The main techniques, methods, procedures and types of exercises applied in this study to recover the arthritic knee are presented in the following table (Table I).

Table 1**.** The main means used in the recovery of knee osteoarthritis and their indications / therapeutic applications

THERAPEUTIC MEANS	INDICATIONS / THERAPEUTIC APPLICATIONS
Upside down positions "Bürger" gymnastics	to avoid knee flexum to decrease the swelling and to stimulate the venous return.
Neuromuscular facilitation techniques	to re-educate the active control of the lower limb - knee
Controlled active exercises (assisted)	to maintain and increase the strength and elasticity of different muscle groups.
Resistance exercises	to increase muscular strength and endurance.

Passive-active and active assisted exercises	to maintain (increase) the range of motion and the trophicity of joint structures.
Isometric exercises from different stating positions	to develop muscular strength, especially of the quadriceps and hamstrings.
Dynamic exercises	ergometric bicycle, treadmill, press, stepper, force seat for the quadriceps.
Breathing exercises	for blood oxygenation, tissue perfusion, better and deep inspiration - the lower limb raised to 45° helps the return of venous circulation of the affected limb.
Coordination exercises	to prepare the patient in restoring a normal activity.
Hydrokinetotherapy and swimming exercises	to develop both the quadriceps and hamstrings muscle force, requesting also the training of knee stability.

Elaboration of the kinesitherapy and hydrokinesitherapy intervention program applied in the recovery of the arthrosic knee, flexion-extension exercises of the knee executed alternatively, then simultaneously using: auto-passive or active-passive techniques – the patient assisted the knee movement by traction made either directly, or indirectly using a rubber tape; active muscular contraction executed without weight – on the plane of the bed or the working mattress – or with resistance at the ankles level and antigravity (the patient being in prone position); exercises for the improvement of muscular strength, especially of the quadriceps and hamstrings, carried out by: isometric contractions – with maintenance, first 5 seconds and then 10 seconds); isotonic contractions combined with isometric contractions at different degrees of flexion and extension; adopting and maintaining corrective postures (for about 5 minutes) to combat knee flexum; hydrokinetotherapy exercises using active-passive and active exercises performed at the pool bar, walking exercises with different variants (front, then back, with support, side walking), swimming exercises.

The duration of the physical therapy exercise program varied, on average of 30 minutes and the length of the hydrokinetotherapy program was about 15 minutes, preceded and/or followed by another 15min of swimming exercises.

Results

Data gathered from the batches of subjects were summarized and statistically analysed. The experimental batch was made up of 6 patients, aged between 44 and 57 years.

With regard to the gender feature, 3 of the patients were males (standing for 50% of the total) and 3 females (standing for 50% of the total). The control batch was made up of 6 patients, aged between 44 and 58 years. With regard to the *gender* feature, 2 of the patients were males (standing for 33% of the total) and 4 females (standing for 67% of the total).

Evolution of knee mobility. Upon analysis of the data gathered initially and in the end- by initial and final goniometric measurement- improvement of knee mobility, respectively increase of flexion and reduction of the extension deficit are noticed. By realizing the difference between the initial and final results of the goniometric testing in the two batches, better evolution of the experimental batch is noticed.

The evolution of these results is illustrated by the descriptive tables (tables 2 and 3) and bar charts shown below (figure 1 and figure 2).

Table 2. Difference between initial and final results of goniometric testing depending on patients' age and gender – descriptive table- experimental batch

	P1	P2	P3	P4	P5	P6
Gender	F	F	M	M	M	F
Age (years)	49	56	54	44	46	57
Flexion (degrees)	7	8	17	22	12	12
Extension deficit (degrees)	5	7	11	15	12	5

Figure 1. Difference between initial and final results of goniometric testing depending on patients' age and gender – bar chart - experimental batch

Table 3. Difference between initial and final results of goniometric testing depending on patients' age and gender – descriptive table- control batch

	P1	P2	P3	P4	P5	P6
Gender	F	F	F	M	M	F
Age (years)	55	54	57	53	44	58
Flexion (degrees)	6°	2°	7°	12°	5°	9°
Extension deficit (degrees)	6°	5°	3°	4°	5°	7°

Figure 2. Difference between initial and final results of goniometric testing depending on patients' age and gender – bar chart - control batch

During the research, we found that the mobility of the knee joint has evolved in a positive way, for both groups, but a better outcome was observed at the patients from the experimental group.

At the initial test, there was no significant difference between the experimental group and the control one regarding the knee flexion. This was one of the basic conditions requested by the experimental design.

Instead of this, the results of the final test revealed significant differences ($p < 0,05$) of knee flexion between the two groups, better values being registered among the patients in the experimental group. Initial testing showed also a knee extension deficit in both groups, without considerable differences between the subjects. At the final test, the results were significantly improved ($p < 0.05$) for the subjects in the experimental group, these having less extension deficit comparing with the subjects in the control group.

Conclusions

Application of hydrokinesitherapy procedures based on diagnosis, needs and limits of the patient with arthrosis correlated with tests for assessment of quality and effectiveness of the recovery process from knee arthrosis show an increase in the quality of recovery for the experimental batch, which verifies our first research hypothesis.

There are statistically significant differences ($p<0,05$) among patients in the experimental and the control group regarding flexion of the knee joint, higher flexion values being found on the experimental group subjects.

Significant differences between the studied groups were found also in terms of knee extension deficit,

the lower deficit values being attributed to the subjects from the experimental group.
Observance of the strategy to practice physical exercises in water shows an increase in the recovery of functionality of knee arthrosis in the experimental batch, which verifies the second research hypothesis.
The results were encouraging during the treatment programme and at the end of it. There were no exacerbation of the knee symptoms after the hydrokinesitherapy, there were no clinical signs of knee instability the pain was absent and the patients enjoyed the program.

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