

Impact of a structured aquatic therapy program on patients with knee osteoarthritis

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ABSTRACT

Osteoarthritis is a pervasive, chronic rheumatic, multifactorial, degenerative joint disease, afflicting 10% of the population over 65 years of age. It affects both genders, and in women the incidence is higher after menopause. This disease comprises 65% of the causes of disability, exceeded only by cardiovascular and mental disorders. The rehabilitation of patients with osteoarthritis is a complex process that involves specialized procedures. **Objective:** To evaluate the effects of a hydrotherapy program on the ability to perform activities of daily living in patients with osteoarthritis. **Method:** This is a prospective study where twenty-six patients with knee osteoarthritis history underwent a treatment program in aquatic therapy, often twice a week lasting 50 minutes each session. The program consisted of four phases, namely: warming up, stretching, strengthening, and relaxation. These patients were evaluated before and after treatment. Assessments were done with the goniometer, EVA pain scale, and Six Minute Walk Test. **Results:** There was significant improvement in range of motion when performing flexion of the affected knees, as well as a significant decrease in pain and a significant improvement in the ability to perform the activities of daily living, assessed by the distance walked in the six-minute walk test. **Conclusion:** There was an improved ability to perform ADLs and inn physical capacity, as well as reduced pain and increased range of motion.

Keywords: Osteoarthritis Knee, Hydrotherapy, Physical Therapy Modalities, Rehabilitation

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INTRODUCTION

Osteoarthritis is a pervasive, chronic rheumatic, multifactorial, degenerative joint disease, afflicting some 10% of the population in individuals over 65 years of age.^{1,2} It primarily affects individuals starting in middle age, equally in both sexes, although for women the incidence is higher after menopause, due to reduced hormone levels. The diagnosis of the disease in those under 40 years of age is not very common.³ The incidence of this disease increases with age,^{4,5} but only 20% of the cases presented alterations considered serious or moderate.

This disease comprises 65% of the causes of disability, exceeded only by cardiovascular diseases and mental disorders.⁶⁻⁸ Osteoarthritis is a functional disorder that disables individuals, especially in activities of daily living that demand greater range of motion of limbs such as squatting to pick up something on the floor, kneeling down, going up and down stairs, and even walking a short distance.⁹

Although some therapeutic methods have been undertaken for this group of patients, is not yet known whether semiweekly hydrokinesiotherapy sessions of 50 minutes can improve the ability of patients with osteoarthritis in the lower limbs to perform activities of daily living. However, it is known that hydrokinesiotherapy improves the pain of patients with chronic inflammation of the joints, in addition to other benefits such as well-being and a longer period of symptomatic remission related to the physiological effects of immersion in water that play an important role in improving and maintaining the range of motion in the joints, in the reduction of muscle tension, and relaxation.⁹⁻¹⁰

There are no studies yet associating the improvement of pain symptoms with an improved ability to perform ADLs in patients with osteoarthritis.

OBJECTIVE

To evaluate the effects of a hydrotherapy program on the ability to perform activities of daily living in patients with osteoarthritis.

METHOD

This is a prospective study that had the participation of individuals clinically diagnosed,

according to the ACR¹¹ classification, with osteoarthritis of the knee; it was carried out on those who feel knee pain on most days during the previous few weeks, who were aged over 50 years, and who met at least two of the following criteria:

- Stiffness after resting less than 30 minutes.
- Cracking in the affected knee;
- Increased firm consistency of the joint;
- Lack of temperature increase;
- Painful sensitivity on palpation.

The presence of knee pain in individuals older than 55 years, associated with at least two of the five criteria listed, represent 95% sensitivity and 69% specificity in the diagnosis of OA of the knee.

The study was conducted at the Policlínica do Centro Universitário Adventista of São Paulo - UNASP during the period from January to November 2013 and received approval from the UNASP Research Ethics Committee under No. 086232/2014. All patients were selected from the medical records of patients of the Physiotherapy Polyclinic, but only those with clinical diagnoses of osteoarthritis of the knee were considered.

Individuals of both genders with ages ranging between 50 and 64 years were selected. After contacting the patients and advising them of the methodology of the study, those who agreed to participate signed a free and informed consent form. Initially included in the study were those patients who presented a dermatological examination as a condition and permission for entry in the pool

To participate in this study, patients needed to present the following inclusion criteria: have a clinical diagnosis of osteoarthritis of one or both knees; report knee pain at least at level four on the Visual Analogue Scale (VAS) at the initial assessment; agree to participate in this research by signing the consent form. Those excluded from the study were patients with clinical diagnoses of osteoarthritis of the knee combined with previous stroke or with a cardiopathy that would hamper their participation in the hydrokinesiotherapy program as well as patients with urinary incontinence and those who did not have skin conditions to use the pool.

The following instruments were used for assessments: a goniometer, to measure the range of motion of the knee; the Six-Minute

Walk Test, to assess the ability to perform the activities of daily living (ADL); and the Visual Analogue Scale of Pain (VAS), to assist in measuring the intensity of pain.

Goniometry

All patients had bilateral goniometric measurements of the knees before and after the hydrokinesiotherapy program. A universal goniometer was used to make these measurements and is formed by two pivoting arms. During the exam one arm of the goniometer will track the movement while the other remains fixed until the end of the measurement, the pivot will remain on the joint being assessed. Some factors can influence the accuracy of the measurement such as the quality of the goniometer, the procedure used, and the use of active or passive movement.¹²

The measurements must always be compared with the contralateral side, if it is not affected, and thus establish a baseline parameter. Each joint has a normal range of angles and it is important to know these values so that changes in the articular amplitude can be identified.

The six-minute walk test (6MWT)

Since the act of walking is one of the main activities of daily living, the six-minute walking test has been proposed to measure the patient's status or functional capacity. The six-minute walk test has proven to be reproducible and is well tolerated by patients. It evaluates the distance that a person can travel on a flat rigid surface in six minutes and is used to determine one's tolerance to exercises of moderate intensity.¹³

The patients underwent two 6MWTs before and two 6MWTs after rehabilitation in accordance with the technique proposed by the ATS.¹³ The distance traveled was defined as the larger distance obtained of the two tests. The patients walked for six minutes along a 30-meter corridor with of heart rate monitored by a sport tester Polar T31 (Polar Electro Oy, Kempele, Finland) and the hemoglobin oxygen saturation (SpO₂) by means of a pulse oximeter (model 920M, Healthdyne Technologies, Marietta, USA). Measurements of heart rate, blood pressure, and pain in the knees were evaluated before and after the test.

Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS) is an instrument for evaluating the severity of the patient's pain; it is an important and reliable

instrument to check the progress of the patient during treatment and at every appointment. It is also useful for examining whether the treatment is being effective. The VAS has been widely used in clinical practice, although it is a subjective tool for quantifying pain.¹⁴

While relaxing at the beginning and end of treatment, as well as pre and post 6MWT, the patient was asked about the intensity of pain in the affected knee; he could report from zero to ten, with zero for no pain and ten the highest intensity possible.

Hydrokinesiotherapy Program

A group of twenty-six patients participated in a treatment consisting of 15 semiweekly sessions of therapeutic hydrokinesiotherapy in a pool heated to 30 °C for a duration of 60 minutes. The exercise protocol consisted of four phases of treatment, and all patients were advised as to the degree of difficulty of certain exercises.

Phase 1 - First was the active stretching of the main neck muscles (sternocleidomastoid muscle, scalene, platysma), the upper limbs (deltoid, teres minor and major, biceps brachii, upper arm circumference, triceps, and brachioradialis, extensors and flexors of the wrist), the lower limbs (gluteus maximus, gluteus medius, gluteus minimus, adductors and abductors, quadriceps, hamstrings, tibialis anterior, and gastrocnemius). This phase lasted 10 minutes.

Phase 2 - Warm-up exercises such as walking forward, backward, and sideways, across the whole length of the pool. Aerobic exercises that emphasize movement of all muscles. This phase lasted 10 minutes.

Phase 3 - For strengthening, closed chain kinetic exercises were performed with movement of knee flexion and extension and supported on the side of the pool (3 sets of 12 repetitions with interval training). Kicking Drills with hip extension associated with knee flexion, followed by hip flexion and knee extension (3 sets of 12 repetitions).

Exercises for abdominal strengthening with the use of pool noodles under the arms. Strengthening exercises of the upper limb doing abductions, adductions, flexions, and extensions (3 sets of 12 repetitions). Initially the exercises were performed with no external load, but evolved with the use of pool noodles and weights. This phase lasted 20 minutes.

Phase 4 - Relaxation was done using floats, life jackets and breathing exercises that promoted progressive relaxation. This phase lasted 10 minutes.

The treatment protocol was applied semiweekly, totaling 15 sessions of 60 minutes

each, entirely in the aquatic environment, collectively, while respecting the individual limits and the evolution of each patient seen during the initial physical examination.

Blood pressure was checked before each hydrokinesiotherapy session. Each session of the treatment program was composed of four phases: the first with 5 minutes duration consists of overall warm-up by means of walking the length of the pool in a straight line forwards, backwards, and then sideways; the second phase lasted a total of 15 minutes, consisting of muscle stretching for the upper limbs, lower limbs, and dorsal muscles. All stretching positions were held twice for 20 seconds. The third phase lasted 30 minutes, with active exercises for upper and lower limbs, initially undertaken with no external load, evolving with the use of floats and aquatic weights ranging from 0.5 to 1 Kg. The exercises were performed with a frequency of 3 sets of 12 repetitions. The last phase consisted of relaxation for 10 minutes, doing active stretching of upper limbs, lower limbs, and posterior and anterior muscle torso chains, along with respiratory exercises to promote progressive relaxation.

Statistical Analysis

The results before and after treatment were assessed by means of the paired t test, the correlations were performed by using Pearson's correlation test where $p < 0.05$ was considered as statistically significant.

The sample was analyzed considering $\alpha = 0.05$ with a statistical power of 80% ($\beta = 0.20$) and considering that there is one point of difference in the Visual Analog Scale between pre and post intervention, since this difference of one point was chosen for being the minimum clinically significant difference for this measure. For comparison between the averages a sample variation of 5% is considered, a standard deviation of 5.4 units, and a difference of 3% to be detected. To answer the main question of the study, the calculation showed that it would be necessary to assess 34 patients per group.

RESULTS

Initially 36 patients were evaluated, however 10 patients could not attend for not having met the inclusion criteria. Of the remaining 26 patients with osteoarthritis of the knee who were able to participate in the study, four patients did not complete the treatment and were excluded from the final analysis. However, the anthropometric data of these four pa-

tients were not different from the remaining 22 who did complete the study.

Among these twenty-two patients only one was male. Eleven patients had bilateral osteoarthritis. Of those who participated in the study, 98% had some associated disease; the most common one was hypertension (HTN). Of these, 90% had their blood pressure controlled and were making correct use of medicines. All patients were monitored for the treatment of osteoarthritis and used the medication correctly. Only two patients were physically active. Stiffness and swelling of joints and painful sensitivity were present in all 26 patients.

Another important finding was that all of patients showed a reduction of body weight during the program (Table 1).

There was significant improvement ($p < 0.0001$) in the ability to perform activities of daily living, as evaluated by means of the distance covered in the six-minute walk test (6MWT) after the implementation of the hydrokinesiotherapy program. The average distance travelled previously was 391.8 ± 80.7 meters and post-treatment of 490.2 ± 61.3 meters (Figure 1), and the pain in the knee reduced from 9.1 ± 2.0 to 7.2 ± 2.8 points on the VAS.

There was a significant reduction of pain in the knees of patients after they had participated in the hydrokinesiotherapy program. The average score on the visual analog scale pre-treatment was 8.9 ± 1.2 , while after treatment it was 5.1 ± 1.7 ($p < 0.0001$) (Figure 2). A significant increase was found in the range of articular of flexion of the affected knee ($p = 0.01$).

There was no statistically significant improvement in extension after the patients had participated in the hydrokinesiotherapy program. The average range of motion in flexion pre- and post-treatment was 100 ± 21.7 and 112 ± 19.4 degrees and for extension, it was 52.3 ± 21.3 and 50 ± 22.6 degrees, respectively (Figure 3). Significant correlation was found between the distance walked in six-minute walk test and the pain in the knees ($r = -0.60$) ($p < 0.0001$) (Figure 4).

DISCUSSION

The most important result from this study is that patients with knee osteoarthritis show an improved ability to perform activities of daily living evaluated by the six-minute walk test. Other important results were a reduction of pain and an increased range of motion in the knees affected.

Table 1. The anthropometric characteristics of the sample

Variables	N (22)
Female	25
Age (years)	57,3 ± 5,8
Time with diagnosis (years)	1 to 9
History of falls in the last year (n)	10
Off work (n)	7
Difficulties in performing ADLs (n)	15

This is the first study to evaluate the effects of a hydrokinesiotherapy program on the ability to perform activities of daily living in patients with osteoarthritis of the knee, and patients were seen to improve the distance covered in the six-minute walk test and can more easily accomplish the activities of daily living. The six-minute walk test has been widely used for evaluation of physical capacity and ability to perform activities of daily living in patients with chronic non-communicable diseases^{15,16} and has proven to be a safe method for both physical capacity and for their ADLs.

The six-minute walk test is useful in assessing the ability to perform ADLs, for it is a viable method for both research and clinical practice and makes it possible to evaluate the difficulty of performing ADLs through impairment of the knees.

It has been demonstrated that the treatment of patients with knee osteoarthritis by hydrokinesiotherapy presents positive results such as: improved ROM, increased flexibility, and gains in balance and coordination.¹ This study was conducted on 16 women with ages ranging from 65 to 70 years and used a

program of 32 sessions implemented during 16 consecutive weeks. The improvement occurred probably due to the treatment being performed in an environment that allowed the exercise free of the negative effects of the joints bearing weight, which aided in performing the movements.

Another study¹⁷ with hydrokinesiotherapy demonstrated that this treatment can improve the quality of life, quality of sleep, and functional capacity in patients with fibromyalgia. The patients in the current study walked 99m farther in the six-minute walk test after completing the hydrokinesiotherapy program. Studies on patients with chronic obstructive pulmonary disease (COPD) have determined 54m as the minimum clinically important difference (MCID)^{18,19} after intervention.

The current patients have increased the distance travelled by almost double the MDCl, which shows the effectiveness of the hydrokinesiotherapy program on the physical capacity and performance of ADLs. Possibly this improvement occurred because the proposed treatment was effective in reducing some symptoms of osteoarthritis of the knee

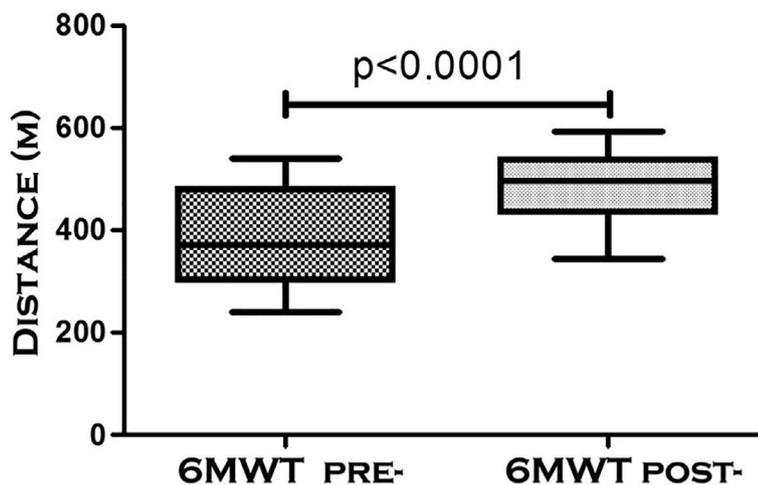
as pain, loss of ROM, and the inflammatory process.

In the current study, 92% of the patients showed an increase of range of motion of bilateral knee flexion, this possibly occurred due to the improvement of the inflammation and pain that patients had prior to treatment; it is common that after muscle strengthening there is less overload on the joint, which can reduce inflammation; other studies on the subject have found similar results²⁰⁻²² such as significant gains in strength and range of motion in the affected joints, as well as improvement in function and pain among patients with knee arthrosis.

In a five-month program of aquatic therapy, another study²³ used 10 sessions of aquatic therapy for the treatment of osteoarthritis of the knee in four individuals and found variations in heart rate, blood pressure, and amplitude of knee flexion. Significant results were obtained only for the range of motion in the gain of knee flexion. A different study²⁰ also showed the efficiency of physiotherapeutic treatment in an aquatic environment in their study with seven individuals diagnosed with osteoarthritis; they obtained a significant increase in range of motion in both knees.

The current patients also found a reduction of pain in the afflicted knees. Possibly this was by reducing the inflammatory process and increasing the muscular strength, thereby reducing the overload; the results here are similar²⁴ to other authors, who showed a decrease in pain of patients undergoing hydrokinesiotherapy therapy. Similarly, a study²⁵ with aquatic aerobic exercises and walking on dry ground obtained effective therapeutic results for patients with rheumatoid arthritis and osteoarthritis, but the sample was too small to give statistical power.

The present results were also similar to another study²⁶ with a population of more than then seventy-three volunteers aged 65 years and over who were randomly distributed between the intervention group (37) who performed the treatment in swimming pool (2x/week, 6 weeks, 50 minutes) and control group (36) that received only educational protocol. They analyzed the muscle performance (strength, power, and resistance) of the quadriceps and hamstrings using an isokinetic dynamometer, in addition to pain, stiffness, and physical function using the WOMAC questionnaire. The authors found that a program of aquatic therapy resulted in significant improvements in pain, functionality, and hams-

**Figure 1.** Distance travelled in a six-minute walk test pre- and post-treatment

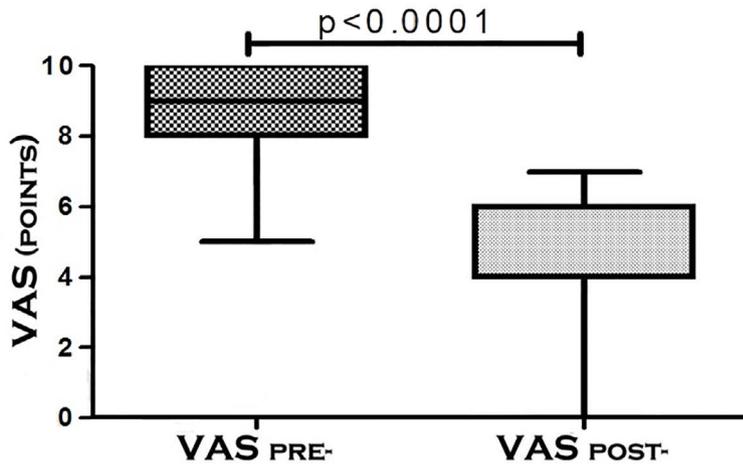


Figure 2. The assessment of pain in the knees via the Visual Analog Scale

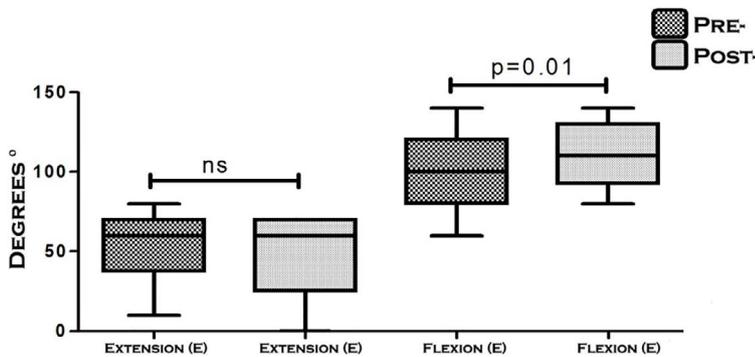


Figure 3. Assessment of the degree of flexion and extension of the left knee in patients with osteoarthritis pre- and post-treatment with hydrokinesiotherapy

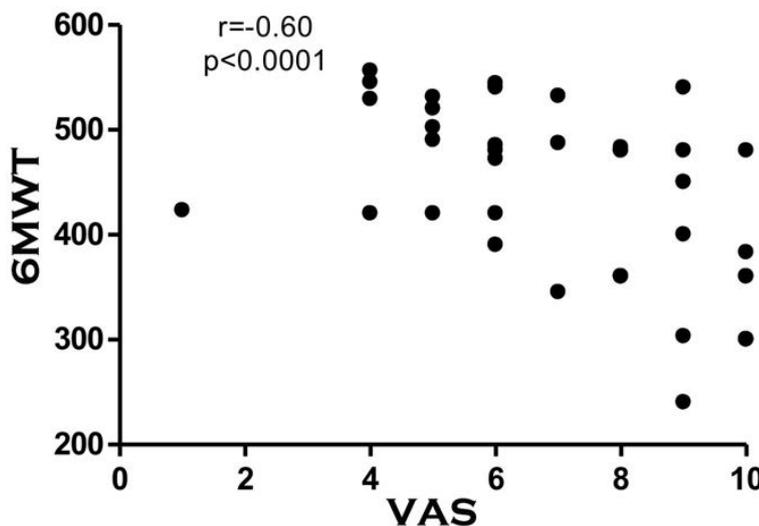


Figure 4. Association between the distance travelled in the 6MWT and pain

tring strength and power in elderly women with osteoarthritis of the knee.

The main limitation of the present study is related to the fact that a thorough assessment of ADLs was not performed in the patient's own environment, but arguably this does not invalidate the results because validated methods were used. Other studies that are longitudinal need to be performed in order to evaluate whether the specific training for activities of daily living can bring improvement and reduce the functional impairments of patients with knee arthrosis. Furthermore, an assessment of functional capacity should be done directed at the performance of the ADLs for all patients with osteoarthritis of the knee, and that the rehabilitation programs for those patients incorporate physical training, coordination, and mobility so that those patients can improve the performance of their everyday tasks and be more functional.

CONCLUSION

Having evaluated the ability to perform ADLs of patients with knee osteoarthritis undergoing hydrokinesiotherapy treatment allows us to conclude that there were improvements in the ability to perform ADLs and in physical capacity, as well as a reduction in pain and an increased range of motion.

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