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The benefits of low-intensity laser therapy associated with home exercises in elderly knee osteoarthritis

Os benefícios da laserterapia de baixa intensidade associados a exercícios domiciliares em idosos com osteoartrite de joelho

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RESUMO | INTRODUÇÃO: A Osteoartrite (OA) é uma doença musculoesquelética com predomínio na população idosa. O tratamento com Laserterapia tem sido um dos métodos seguros e não invasivos para o tratamento da OA. **OBJETIVO:** Observar a influência na dor, rigidez e função em idosos antes e depois da aplicação da laserterapia associados a exercícios domiciliares. **MÉTODOS:** Dez pacientes idosos com OA de joelho, submetidos a 12 sessões de Laserterapia, 3 vezes por semana e orientados a realizarem exercícios domiciliares durante o período do estudo. Foi utilizado o Laser de baixa potência Class 3B Chattanooga, com energia total de 36J (divididos em 6 pontos - 6J por ponto) conforme a dosagem da World Association of Laser Therapy (WALT). Para mensuração do quadro álgico foi utilizados a Escala Visual Analógica (EVA); Índice de Osteoartrite de Western Ontario (WOMAC) e Índice de Lequesne para dor, rigidez e funcionalidade. Os exercícios domiciliares foram explicados e demonstrados pelo avaliador e orientado a realizar 3 vezes por semana durante 12 sessões. **RESULTADOS:** Observamos que após aplicações de Laserterapia e exercícios domiciliares, não houve melhora na EVA, porém com melhora significativa nos quesitos WOMAC geral (p=0,01) e função (p=0,001) enquanto os demais não houve significância (p>0,5) quando avaliados por meio do t-test, já na comparação entre questionários houve correlação forte em WOMAC e LEQUESNE com a Correlação de Pearson. **CONCLUSÃO:** Pode-se concluir que a Laserterapia associada a exercícios domiciliares não evidencia melhora significativa do quadro álgico através da EVA, podendo ser uma resposta subjetiva com dificuldade de compreensão pelos pacientes, porém foi observado melhora significativa na evolução funcional do paciente medidas pelos questionários WOMAC e LEQUESNE nos pacientes com OA de joelho.

PALAVRAS-CHAVE: Osteoartrite. Terapia com luz de baixa intensidade. Artropatias. Dor. Atividade do dia a dia.

ABSTRACT | INTRODUCTION: Osteoarthritis (OA) is a musculoskeletal disease with predominance in the elderly population. Laser therapy has been one of the safe and non-invasive methods for treating OA. **OBJECTIVE:** To observe the influence on pain, stiffness and function in the elderly before and after the application of home exercise laser therapy. **METHODS:** Ten elderly patients with knee OA who underwent 12 laser therapy sessions 3 times a week. The Chattanooga Class 3B Low Power Laser was used, with a total energy of 36J (divided into 6 points - 6J per point) according to the dosage of the World Association of Laser Therapy (WALT). We used the Visual Analog Scale (VAS) for pain; Western Ontario Osteoarthritis Index (WOMAC) and Lequesne Index for pain, stiffness and functionality. Home exercises were explained and demonstrated by the evaluator and instructed to perform 3 times a week during 12 sessions. **RESULTS:** We observed that after laser therapy and home exercises, there was no improvement in VAS but there was significant improvement in the general WOMAC (p = 0.01) and function (p = 0.001), while the others were not significant (p> 0, 5), when compared to the t-test, when compared to the Pearson correlation, there was an improvement in the WOMAC and LEQUESNE questionnaires. **CONCLUSION:** It can be concluded that after applying home exercise laser therapy, there was no significant improvement in pain through VAS, which may be a subjective response with difficulty for patients to understand, but there was a significant improvement in the patient's functional evolution measured by the questionnaires. WOMAC and LEQUESNE in patients with knee OA.

KEYWORDS: Osteoarthritis. Low-level light therapy. Joint diseases. Pain. Activities of daily living.

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Introduction

Osteoarthritis (OA) is considered a predominant musculoskeletal disease in the older adult population, being one of the most common reasons for functional limitation and dependence. OA can be classified as: primary or idiopathic when its cause cannot be determined; or secondary, in cases where one or more etiological factors can be identified[1]. The knee most affected joint, with unknown cause and some possible etiological causes such as overload, occupational and overweight factors causing protokinetic joint pain, decreased muscle strength, and functional disability[4]. Knee OA is a disease with inflammatory signs and degenerative process that causes the destruction of joint cartilage and leads to joint deformities; the clinical characteristics of this disease are pain, crackling, bone enlargement, and progressive functional limitation, and can thus lead to joint deformities[7].

There is still no cure for this disease and its treatment aims at relieving pain and improving function and quality of life for health[8]. The recommended treatment should follow an order: non-pharmacological treatment, pharmacological treatment, and at last, surgical therapy. Non-pharmacological treatment brings fewer risks and complications, so it should privileged and widely used before moving on to pharmacological ones. Among the non-pharmacological treatments there are: acupuncture, manual therapy (therapeutic massage and joint mobilization and manipulation), kinesiotherapy (body balance, motor coordination, flexibility, endurance, and muscle strength of the lower limbs), thermotherapy (superficial and cold heat), ultrasound, transcutaneous electrical nerve stimulation, and laser therapy, which has been one of the safe and noninvasive methods that has drawn the attention of many researchers and specialists for the intervention in knee OA[4,10].

Low-level laser therapy (LLLT) is a noninvasive and low-cost treatment with physiological effects such as: anti-inflammatory, tissue regeneration, modulation of cell activity, and analgesic. The analgesic effect is the result of decreased inflammation by resorption of exudates and elimination of allergenic substances[11].

LLLT consists of a monochrome light source with non-thermal effect that stimulates the reparative properties of cartilage in humans[9]. Results found in many studies suggest that this method promotes increased collagen synthesis, increased proliferation and differentiation of osteoblasts and fibroblasts, increased mitochondrial breathing, increased synthesis of adenosine triphosphate (ATP), greater recruitment of macrophages and fibroblasts, increased angiogenesis, and increased phagocyte activity, which result in the acceleration of tissue repair[12]. Furthermore, according to Andrade, Clark, and Ferreira[13], the photobiological effects of laser radiation can be classified as short- and long-term. Short-term effects are seen shortly after the application of irradiation; long-term effects appear hours or days after the irradiation, and generally cover new cellular biosynthesis, especially in the inflammation proliferative phase.

Laser therapy has an analgesic effect; however, the means by which this happens remain uncertain. Some of these means would be the increase in mitochondrial ATP and mitochondrial oxygenation, improvement of neurotransmitters involved in the modulation of pain such as serotonin, and anti-inflammatory actions[9].

According to Raymundo et al.[4] another treatment is the kinesiotherapy, with a training program that focuses on improving overall fitness, body balance, motor coordination, flexibility, endurance, and muscle strength of the lower limbs, improving the OA patient's overall function and symptoms. The European League Against Rheumatism (EULAR) conduct guide emphasizes the importance of exercises in reducing pain and improving function, although the ideal regimen of exercises for the disease treatment has not yet been determined[1].

However, therapies involving LLLT are known to improve cartilage strength and quality, accelerating the tissue repair process and, consequently, improving the quality of life, thus being an extremely important inclusion in the protocols that treat patients with knee OA.

The objective of this study is to verify the pain improvement and improved function in older patients with knee OA with the functional index.

Methodology

This is an experimental and descriptive study with patients recruited at the Physical Therapy Clinic of the Universidade Municipal de São Caetano do Sul. Individuals aged 60 years or older were selected, from both sexes, diagnosed with knee OA, with no cognitive alterations promoted by neurological disorders, not having any type of metallic implant and/or pacemaker, and with no history of deep venous thrombosis in the lower extremities, or neoplastic processes, following the pre-established inclusion and exclusion criteria. All participants signed an informed consent form. The project was approved by the research and ethics committee of Universidade Municipal de São Caetano do Sul (04388018.5.0000.5510).

The first assessment was applied for data collection. In this assessment, personal information was collected, consisting of anamnesis, physical examination, visual analog scale (VAS), and WOMAC and LEQUESNE indexes application, and the body mass index (BMI) estimation (kg/m²).

The WOMAC and LEQUESNE indexes were applied by the researcher. After the first assessment, the home exercises were explained and an informative folder was given to the patients who started the LLLT treatment.

The home exercises performed by the patients are based on the study by Youssef, Muaidi, and Shanb[14].

1. Stretching for the quadriceps, hamstring, adductor and calf muscles for 30 seconds, and relaxation for 10 seconds and repeated three times; Total stretching time ≈ 5 minutes.

2. Strengthening exercises included knee extension, stretched leg lifting, and quadriceps adjustment exercise. Contraction was maintained for 6 seconds, followed by relaxation for 10 seconds and repeated eight times/adjusted in each exercise.

Patients were instructed to perform three series of eight repetitions and to practice them in their houses as a home program.

The interventions were performed three times a week, for four weeks, for 12 sessions total. Before and after each session, the patient communicated his pain frame with the VAS. During the sessions, the patients received home guidance such as energy conservation and joint protection, in addition to the application of LLLT in the affected limb, with a Class 3B Laser with a 850 nm wavelength, with 5 mW/cm² pulse output, six points per cm² with 6 Joules (J) each, according to the World Association of Laser Therapy (WALT) scale. The patient was positioned in dorsal decubitus and the laser pen positioned in the anterior region of the knee on the interjoint, with three points in the medial region and three points in the lateral region, having a total time of approximately 20 minutes per therapy (Figure 1).

Figure 1. Patient and equipment positioning

The patients underwent a physical therapeutic reassessment at the end of the treatment, also with anamnesis, physical examination, VAS, and again, assessed by the WOMAC and LEQUESNE indexes.

Data analysis was performed with the GraphPad Prism statistical package. All tests considered a α=5% level of significance, using the t-test and Pearson's correlation to perform the comparisons.

Results

Initially, 40 patients were intended to be recruited; however, only 24 patients contacted the researchers, and of these, only 13 attended for the application of the initial assessment. Considering the inclusion and exclusion criteria, 11 participants were selected participants (10 women and 1 man), with 64.7 years as the mean age and 27.74 BMI mean. Only one participant was excluded due to not achieving 75% presence in the study. Among the 10 participants left, only three practiced some physical activity.

Data are shown as mean values, evolution in percentage, Pearson's correlation and t-test (Table 1) with the following variables: EVA, Pain WOMAC, Stiffness WOMAC, Function WOMAC, General WOMAC, and LEQUESNE.

Table 1. Data are shown as mean values, evolution in percentage, Pearson's correlation and t-test (Table 1) with the following variables: EVA, Pain WOMAC, Stiffness WOMAC, Function WOMAC, General WOMAC, and LEQUESNE (to be continued)

Data	Initial	Final	Evolution in Percentage (%)	Pearson's correlation	T-test
	Mean values	Mean values			
VAS	3,2	3,9	**-21%**	**r=0,60**	**p>0,05**
General WOMAC	41,6	33,7	**19%**	**r=0,94**	**p=0,01**

Table 1. Data are shown as mean values, evolution in percentage, Pearson's correlation and t-test (Table 1) with the following variables: EVA, Pain WOMAC, Stiffness WOMAC, Function WOMAC, General WOMAC, and LEQUESNE (conclusion)

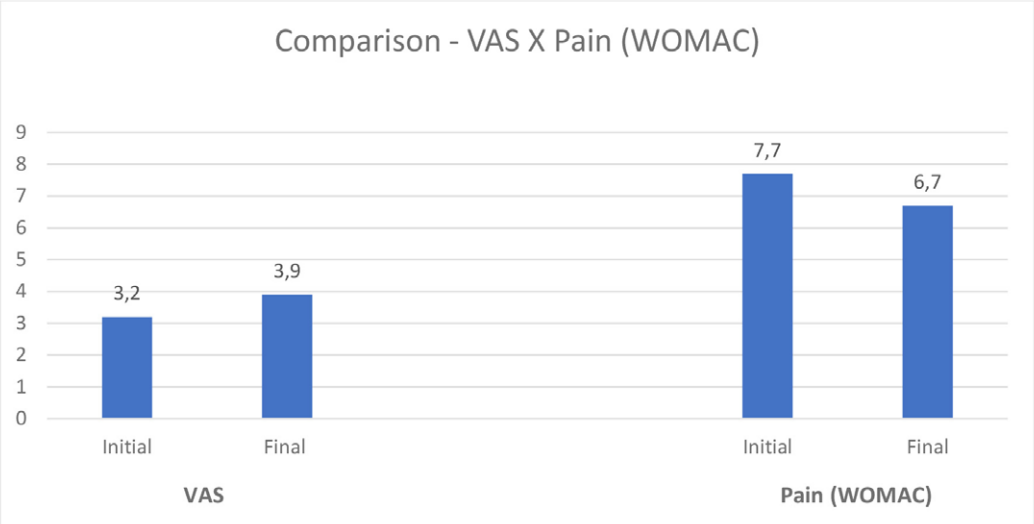
Data	Initial	Final	Evolution in Percentage (%)	Pearson's correlation	T-test
	Mean values	Mean values			
Pain WOMAC	7,7	6,7	**13%**	**r=0,72**	**p>0,05**
Stiffness WOMAC	3,2	3,1	**3%**	**r=0,59**	**p>0,05**
Function WOMAC	31,4	23,8	**24%**	**r=0,95**	**p=0,001**
LEQUESNE	9,5	7,9	**17%**	**r=0,75**	**p>0,05**

The data from this study were addressed in the form of graphs and table.

The following data show the comparisons between the Initial and Final EVA and the Initial and Final Pain WOMAC, Stiffness WOMAC, Initial and Final WOMAC versus Initial and Final LEQUESNE, Initial and Final General WOMAC, Initial and Final LEQUESNE, and WOMAC evolution in percentage.

Graph 1 shows the pain frame presented by the participants of this study, before and after the laser therapy intervention, with the VAS (r=0.60 – moderate correlation) and Pain WOMAC (r=0.72 – strong correlation) obtaining a significant difference in Pearson's correlation, but there was no significance with the t-test (p>0.05).

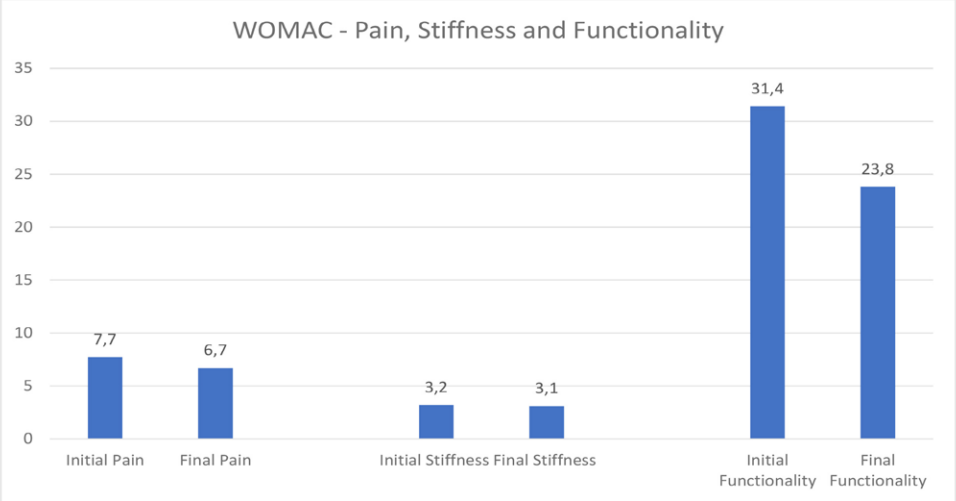
Graph 1. Initial and final mean of the participants before and after the intervention with laser therapy, with the data VAS and Pain WOMAC



In the comparison of the Initial and Final General WOMAC indexes, an improvement was observed after the laser therapy intervention, presenting a significant difference (r=0.94 – very strong correlation), also obtaining significant improvement in the t-test (p=0.01).

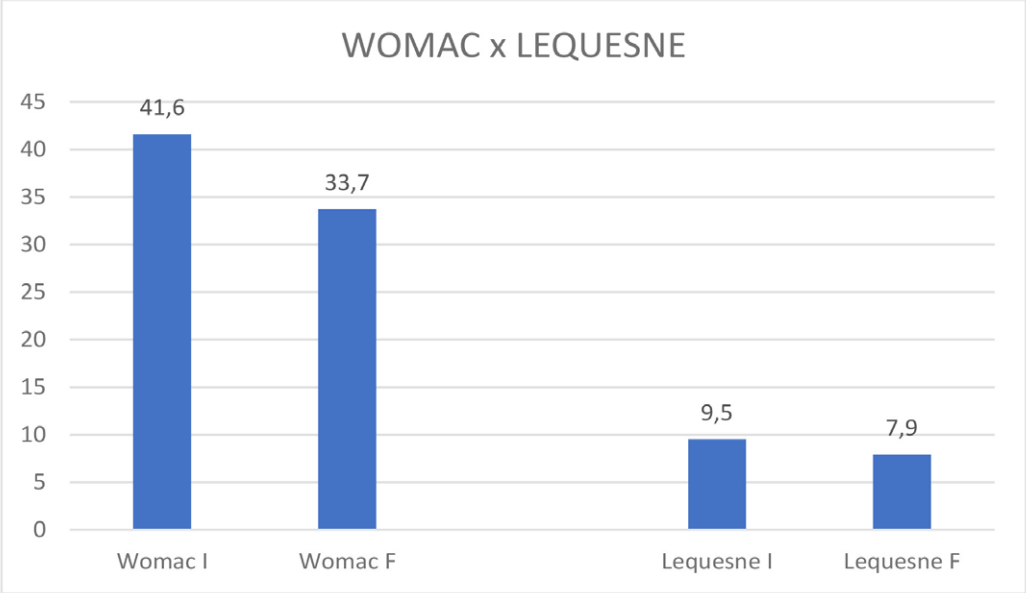
Graph 2 shows the mean Stiffness WOMAC, separated by Initial and Final Pain (r=0.72 – strong correlation), Initial and Final Stiffness (r=0.59 – moderate correlation), and Initial and Final Functionality (r=0.95 – very strong correlation). No significance was obtained in the Pain WOMAC and Stiffness WOMAC (p>0.05), but in the Functionality WOMAC there was significance in the t-test (0.001).

Graph 2. Initial and final mean of WOMAC pain, stiffness and functionality



Graph 3 shows the mean Initial and Final General WOMAC (p=0.94 – very strong correlation) with Initial and Final General LEQUESENE (p=0.75 – strong correlation), which shows that the significance was obtained in the General WOMAC (p=0.01), but no significance was obtained in the General LEQUESENE (p>0.05).

Graph 3. Mean initial and final General WOMAC and LEQUESNE



In the comparison of the Initial and Final Algofunctional LEQUESNE index, an improvement was observed after the laser therapy intervention, presenting significant difference (r=0.75 – strong correlation), but no significance was obtained in the t-test (p>0.05).

Discussion

Osteoarthritis is a chronic degenerative disease with predominance in the older adult population, thus being the most common cause of disability, involving pain and limitations in activities of daily living[13]. OA is determined as a joint cartilage deficiency due to the consequences of mechanical, genetic, hormonal, bone, and metabolic reasons, which cause wear in the joint cartilage[6].

There are several OA treatments such as non-pharmacological treatment, pharmacological therapy, and at last, surgery. Regarding the non-pharmacological treatment, it brings fewer risks and complications. Laser therapy has been one of the safe and noninvasive methods that has attracted the experts' attention for knee OA intervention[1]. The benefits are tissue regeneration, protein synthesis improvement, and easing the pain[10].

Findings from some studies show the effectiveness of laser therapy in function (Alfredo et al.[14]; Alghadir et al.[15]), as well as in this study.

In the study conducted by Alfredo et al.[14], laser therapy was performed for three weeks and after the laser application, exercises were performed for eight weeks. The obtained results showed a significant improvement in the function WOMAC (p=0.002 after laser and after exercises), and in the general WOMAC (p=0.008 after laser and p=0.003 after exercises), as in this study (p=0.001 and p=0.01, respectively). Pain WOMAC also showed significant improvement (p=0.033 after laser and p=0.001 after exercises), different from this study (p>0.05), which may have been caused by the exercises (three sessions per week, for eight weeks, and 45 minutes in each session).

The data found in the study by Fukuda et al.[7] presented good VAS results (p<0.001) and in the LEQUESNE indexes (p<0.001), different from this study that did not obtain a significant difference in these assessments (p>0.05). These results can be justified by the number of patients who committed themselves to the study, thus increasing the likelihood of having a more reliable outcome.

The study by Alghadir et al.[15] found a significant difference in all assessments performed (p<0.05) – VAS and WOMAC index. This study did not present a significant difference in VAS, Pain WOMAC, and Stiffness WOMAC (p>0.05 for all), which may be justified by the number of patients; as in the study by Fukuda et al.7, both had a higher sample number when compared to this study.

It was possible to find a major improvement in VAS (p<0.001) in the study by Rashoud et al.[16], which in turn, used a dosage lower than that recommended by WALT (five points with 1.2 J each, and 40 seconds per point), different from this study that used the parameters recommended by WALT and did not obtain a significant difference in VAS (p>0.05). This can be justified by the patients' age in each study, the mean age of the study by Rashoud et al.[16] was 54 years, in this study 70 years, and may have an increased difficulty in understanding the VAS and having lower neuroplasticity.

The results found in this study do not show a positive outcome in the pain aspect using VAS and can be justified by the difficulty of the participants' understanding during the assessment of this variable, but a significant improvement in both General WOMAC and Function WOMAC was observed. Thus, more studies with the theme in question and higher sample are considered necessary. But we can affirm that laser therapy associated with home exercises can be considered a viable and positive approach for patients with knee OA because the indexes are validated in the literature and encompass the requirements, such as Pain, Function, and Stiffness.

Conclusion

We can conclude that after the laser therapy application associated with home exercises there was no significant improvement in pain assessed by VAS, but in the General WOMAC and Function WOMAC significant improvements were identified, in addition to functional evolution with the WOMAC and LEQUESNE indexes in patients with knee OA.

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Author contributions

Abreu TS participated in the study conception, study design, research, statistical analysis, data collection, patient assessment, and laser therapy application. Boldrini F participated in the study conception, study design, statistical analysis, and study orientation. Kuriki GM and Sanches EMG participated in the study conception, study design, research, data collection, data assessment, and patient's reassessment. Oshiro JM participated in the study conception, study design, research, explanation of the home program to patients, laser therapy application, and statistical analysis.

Competing interests

No financial, legal, or political conflict involving third parties (government, companies, and private foundations, etc.) was declared for all aspects of the submitted study (including, but not limited to grants and financing, participation in council study, manuscript preparation, statistical analysis, etc.).

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