

# DIFFERENT THERAPEUTIC MODALITIES FOR THE TREATMENT OF SUPRASPINATUS TENDINOPATHY

*Diferentes modalidades terapêuticas no tratamento da tendinopatia do supraespinhoso*

*Distintas modalidades terapêuticas para el tratamiento de la tendinopatía del supraespinoso*

Original Article

## ABSTRACT

**Objective:** To determine the efficacy of different therapeutic modalities for the rehabilitation of supraspinatus tendinopathy. **Methods:** Clinical trial using a quantitative and longitudinal approach, conducted from January 2010 to October 2011 at the Physiotherapy Clinic of the University of Ribeirão Preto (UNAERP). Twenty-four adult patients of both genders, aged 40 to 50 years, with a diagnosis of supraspinatus tendinopathy, were selected and divided into three groups: Group 1 - ultrasound and standard kinesiotherapy; Group 2 - laser and standard kinesiotherapy; and Group 3 - enhanced kinesiotherapy. As criteria for evaluation were applied the DASH and McGill questionnaires and the assessment of range of motion (ROM) of flexion, extension, abduction, adduction, internal rotation (IR), and external rotation (ER). Data was analyzed statistically using the Mixed Effects Regression Model and the Kruskal-Wallis test, with the aid of the SAS<sup>TM</sup> 9.0 software. **Results:** After the treatments applied, all 3 groups showed a significant improvement of ROM ( $p < 0.01$ ) for the evaluated movements. Group 1 showed gain of ROM in IR ( $6^\circ$ ), and reduction in the score of the DASH questionnaire (-17.5). Group 3 showed gains for the movements of flexion ( $22^\circ$ ), extension ( $10^\circ$ ), abduction ( $26^\circ$ ), adduction ( $11^\circ$ ), and ER ( $13^\circ$ ), and a reduction in the score of the McGill questionnaire (-18.5). **Conclusion:** The enhanced kinesiotherapy, involving all the structures of the shoulder, was more effective regarding ROM gain in most of the parameters evaluated, in comparison with the electrotherapy and conventional kinesiotherapy.

**Descriptors:** Shoulder Impingement Syndrome; Electrostimulation Therapy; Exercise Therapy.

## RESUMO

**Objetivo:** Verificar a eficácia de diferentes modalidades terapêuticas no tratamento da tendinopatia do supraespinhoso. **Métodos:** Ensaio clínico, de abordagem quantitativa e longitudinal, realizado de janeiro de 2010 a outubro de 2011 na Clínica de Fisioterapia da Universidade de Ribeirão Preto (UNAERP). Foram selecionados 24 pacientes adultos entre 40 e 50 anos, de ambos os gêneros, com diagnóstico de tendinopatia do supraespinhoso. Eles foram divididos em três grupos: Grupo 1 - ultrassom e cinesioterapia convencional; Grupo 2 - laser e cinesioterapia convencional; e Grupo 3 - cinesioterapia aprimorada. Como critérios de avaliação, foram utilizados os questionários de DASH e McGill e a avaliação da amplitude de movimento (ADM) de flexão, extensão, abdução, adução, rotação interna (RI) e rotação externa (RE). Na análise estatística, foi aplicado o Modelo de Regressão com Efeitos Mistos e o teste Kruskal-Wallis, através do software SAS<sup>®</sup> 9.0. **Resultados:** Após os tratamentos aplicados, os 3 grupos apresentaram melhora significativa da ADM ( $p < 0,01$ ) para os movimentos avaliados. O Grupo 1 apresentou ganho na ADM de RI ( $6^\circ$ ) e diminuição do resultado do questionário DASH (-17,5). O Grupo 3 apresentou ganhos para os movimentos de flexão ( $22^\circ$ ), extensão ( $10^\circ$ ), abdução ( $26^\circ$ ), adução ( $11^\circ$ ) e RE ( $13^\circ$ ), e uma diminuição do resultado do questionário McGill (-18,5). **Conclusão:** A cinesioterapia aprimorada, abordando todas as estruturas do ombro, mostrou-se mais eficaz no ganho de ADM quando comparada ao tratamento de eletroterapia e cinesioterapia convencional.

**Descritores:** Síndrome de Colisão do Ombro; Terapia por Eletroestimulação; Terapia por Exercícios.

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Received on: 04/24/2012  
Revised on: 09/25/2012  
Accepted on: 12/28/2012

## RESUMEN

**Objetivo:** Verificar la eficacia de distintas modalidades terapéuticas en el tratamiento de la tendinopatía del supraespinoso. **Métodos:** Ensayo clínico de abordaje cuantitativo y longitudinal, realizado entre enero de 2010 y octubre de 2011 en la Clínica de Fisioterapia de la Universidad de Ribeirão Preto (UNAERP). Fueron seleccionados 24 pacientes adultos entre los 40 y 50 años, de ambos géneros, con diagnóstico de tendinopatía del supraespinoso. Ellos fueron divididos en tres grupos: Grupo 1 – ultrason y cinesioterapia convencional; Grupo 2 – laser y cinesioterapia convencional; y Grupo 3 – cinesioterapia primorosa. Los criterios de evaluación utilizados fueron los cuestionarios de DASH y McGill y la evaluación de la amplitud de movimiento (ADM) de flexión, extensión, abducción, aducción, rotación interna (RI) y rotación externa (RE). En el análisis estadístico fue aplicado el Modelo de Regresión con Efectos Mistos y la prueba Kruskal-Wallis a través del software SAS® 9.0. **Resultados:** Después de los tratamientos aplicados, los 3 grupos presentaron mejoría significativa de la ADM ( $p < 0,01$ ) de los movimientos evaluados. El Grupo 1 presentó ganancia de la ADM de RI (6°) y disminución del resultado del cuestionario DASH (-17,5). El Grupo 3 presentó ganancias de los movimientos de flexión (22°), extensión (10°), abducción (26°), aducción (11°) y RE (13°), y una disminución del resultado del cuestionario McGill (-18,5). **Conclusión:** La cinesioterapia primorosa, incluyendo todas las estructuras del hombro, se mostró más eficaz en la ganancia de ADM al compararla con el tratamiento de electroterapia y cinesioterapia convencional.

**Descriptores:** Síndrome de Pinzamiento del Hombro; Terapia por Estimulación Eléctrica; Terapia por Ejercicio.

## INTRODUCTION

In the presence of pathological processes, the tendon presents its morphology altered, demonstrating degeneration in most cases, losing its solid and shiny appearance, showing more brownish or gray tones and without its characteristic slippery appearance<sup>(1,2)</sup>. It also becomes more friable, its fiber separating easily. Empty spaces appear among them<sup>(1)</sup>, in addition to vascular changes (neovascularization)<sup>(1,3)</sup> and a nervous proliferation<sup>(4)</sup>.

Among the best-known tendon injuries, the injuries associated with the rotator cuff are very common, with an incidence ranging from 7 to 40%<sup>(5)</sup>. Amid the rotator cuff tears, the supraspinatus tendinopathy, also known as “impingement syndrome”, is the most common<sup>(6)</sup>. It is more frequent in individuals who practice certain occupational activities involving movements with the arm above shoulder level, such as swimmers, tennis and volleyball athletes and jobs like replenisher of goods or window cleaner<sup>(4)</sup>. The age

group most affected by this syndrome is the third age<sup>(7)</sup>. However, the population aged over 40 already has a high incidence of this type of injury<sup>(8)</sup>.

The main complaints of people suffering from impingement syndrome may include insidious, progressive pain, located in superior and lateral regions in the shoulder, which increases with lifting movements, existing a typical painful arc from 60 to 120 degrees of elevation and limiting the movement of the affected limb<sup>(9)</sup>.

Physical therapy has several therapeutic modalities that can and should be applied in the treatment of tendinopathy. Among the most used therapeutic resources in the rehabilitation of tendon disorders, are conventional kinesiotherapy, therapeutic ultrasound and low level laser therapy.

Ultrasound aims to accelerate healing, decrease joint stiffness, reduce pain and muscle spasm, in addition to increasing collagen synthesis and regeneration of peripheral innervation<sup>(10)</sup>. As to low level laser therapy, it features fibroblast proliferation, reducing inflammation, accelerating collagen synthesis and increase in the ultimate tensile strength of tendons in repair process<sup>(11)</sup>. Nevertheless, the various therapeutic modalities can leave the therapist in doubt about the best form of treatment.

Like in previous studies<sup>(5)</sup>, a very high prevalence of patients with supraspinatus tendinopathy in the Physical Therapy Clinic of the University of Ribeirão Preto (UNAERP). The objective of this study is to assess the efficacy of different therapeutic modalities for their treatment.

## METHODS

This work is characterized as a clinical trial, of a quantitative and longitudinal approach, conducted from January 2010 to October 2011. Initially, through personal contact with the patients treated in the Physical Therapy Clinic of UNAERP, they were explained the purpose of the study and their participation was requested, so that dates and times were scheduled for the application of research.

The inclusion criteria were: 1) having been diagnosed with supraspinatus tendinopathy more than 12 months ago, 2) without history of any type of fracture in the region, 3) without complete rupture and/or calcification of the supraspinatus tendon; 4) without any type of metallic implant in the region; 5) without episodes of glenohumeral dislocation.

In total, 24 patients (16 men and 8 women) participated, aged from 40 to 55 years, volunteers, physically and mentally independents, referenced by the Unified Health System (*Sistema Único de Saúde*) with the diagnosis

of supraspinatus tendinopathy. After the selection of participants, they were evaluated by the responsible teacher and the students in the study.

The participants were then divided into 3 groups by means of a simple lottery, and subjected to 18 physical therapy appointments, at a frequency of 3 times per week. The treatment applied to each group is described following.

- *Group 1: Composed of 8 patients who were submitted to treatment based on the application of digital ultrasound 1 Mhz - Sonomed IV, continuous mode, during six minutes, associated to the conventional kinesiotherapy, with total time of one hour of therapy.*

- *Group 2: Composed of 8 patients who were submitted to laser therapy (Lasermed) 905 nm (5 joules/cm<sup>2</sup>) by the punctual application method associated to the conventional kinesiotherapy, the time of therapy being of one hour per appointment.*

The exercises of conventional kinesiotherapy consisted of: lengthening of internal and external rotators of the shoulder, associated with traction of the glenohumeral joint in neutral position (3x20 seconds); strengthening of flexors, extensors, adductors, abductors and rotators of shoulder, through isometric exercises (resistance applied by Thera-Band, 3x30 sec); and concentric and eccentric strengthening of the brachial biceps, trapezius (middle and lower fibers) and rhomboid (3x15 repetitions). The load used corresponded to 80% of the maximum value supported by the patient (calculation basis - 15 maximum repetitions - MR).

- *Group 3: Composed of 8 patients who were submitted to enhanced kinesiotherapy, consisting of soft-tissue mobilization (transverse friction on the tendon and massage on the glenohumeral and scapular muscles); elongation of trapezius (upper fibers), levator scapulae, pectoralis minor; internal and external rotators of the shoulder, associated with traction of the glenohumeral joint in neutral position (3x20 seconds); exercises of neuromuscular control: protraction/retraction, elevation and depression of the scapula with the shoulder flexed to 90 ° and an outstretched arm; strengthening: eccentric supraspinatus exercises, concentric and eccentric exercises of trapezius (middle and lower fibers), rhomboids and external shoulder rotators (3x15 repetitions - calculation basis - MR 15), internal rotators, biceps and triceps (3x10 repetitions - calculation basis - MR 10), totaling 1 hour 20 minutes of therapy per appointment.*

The participants were evaluated regarding pain intensity and functional capacity, using respectively the McGill questionnaire<sup>(12)</sup> and the DASH (Disabilities of the Arm, Shoulder and Hand) index<sup>(13,14)</sup> before the beginning of treatment and after the last appointment. The mobility of the

shoulder was measured by means of a universal goniometer Carci™, through protocols known from the literature<sup>(15)</sup>. The assessment of range of motion (ROM) included the movements of flexion-extension, abduction-adduction and external rotation-internal rotation, being limited according to the patient's pain or muscle shortening.

To analyze the results obtained during the pre- and post-treatment periods, the Regression Model with Mixed Effects was applied; for comparison of the groups, the nonparametric Kruskal-Wallis test was used, by means of the software SAS™ 9. Difference was considered significant when  $p < 0.05$ .

This study has been approved by the Ethics Committee on Human Research of UNAERP (number 082/09). As patients agreed to participate in the study, they signed the Free Informed Consent Form.

## RESULTS

Regarding the characteristics of the sample, Group 1 consisted of 3 men and 5 women,  $48 \pm 7$  years of age, with an injury time of  $9 \pm 2$  months. Group 2 consisted of five males and three females, aged  $51 \pm 5$  years, with  $12 \pm 5$  months of injury. Group 3, in turn, comprised 4 males and 4 females,  $46 \pm 8$  years and  $8 \text{ months} \pm 1$  from lesion onset.

Table I shows the results of the ROM (flexion, extension, abduction, adduction, internal rotation - IR and external rotation - ER), whereas Table II shows the results of the McGill and DASH questionnaires.

With regard to the movement of flexion assessed, it was observed that the three groups showed a significant difference in the ROM when comparing the pre-and post-treatment periods ( $p < 0.01$ ), being also found statistical difference. It was observed that Group 3 showed a higher gain in ROM ( $22^\circ$ ) compared to Group 2 ( $20^\circ$ ) and Group 1 ( $13^\circ$ ) ( $p < 0.05$ ) (Table I).

In the extension movement, statistical difference was found in the 3 groups, when comparing the pre-and post-treatment periods ( $p < 0.01$ ). Group 3 showed an increase of  $10^\circ$  in ROM, while Group 2 showed a gain of  $6^\circ$  and Group 1 gained  $5^\circ$ . However, no differences were found between the groups in both the assessed periods (Table I).

In shoulder abduction, the three groups showed no statistical difference ( $p < 0.01$ ) when comparing the values of ROM obtained during the pre-and post-treatment, and when compared in the two periods assessed. Group 1 showed a gain of  $6^\circ$  in ROM, while groups 2 and 3 had a gain of  $5^\circ$  (Table I).

Similar to the abduction, the adduction movement showed no statistical difference ( $p < 0.01$ ) in the three groups, when comparing the values of pre-and post-treatment.

Group 1 showed a gain of 10°, while Group 2 gained 7° and Group 3, 9°. However, there was statistical difference ( $p<0.01$ ) when comparing the groups among them (Group 1 x Group 2, Group 1 x Group 3 and Group 2 x Group 3) only in the post-treatment period.

Table I - Presentation of data related to ADM of the 3 groups in the pre- and post-treatment periods. Ribeirão Preto-SP, 2011.

	Mean ± SD	Mean ± SD
Groups	Flexion Pre-	Flexion Post-
1 <sup>a,b,c</sup>	126 ± 6	139 ± 7
2 <sup>a,b,c</sup>	98 ± 2	118 ± 3
3 <sup>a,b,c</sup>	108 ± 6	130 ± 5
Groups	Extension Pre-	Extension Post-
1 <sup>a</sup>	38 ± 3	43 ± 2
2 <sup>a</sup>	36 ± 4	42 ± 1
3 <sup>a</sup>	32 ± 4	42 ± 1
Groups	Abduction Pre-	Abduction Post-
1 <sup>a,b,c</sup>	146 ± 4	156 ± 3
2 <sup>a,b,c</sup>	106 ± 4	128 ± 5
3 <sup>a,b,c</sup>	128 ± 11	154 ± 5
Groups	Adduction Pre-	Adduction Post-
1 <sup>a,c</sup>	22 ± 5	32 ± 5
2 <sup>a,c</sup>	22 ± 3	29 ± 3
3 <sup>a,c</sup>	24 ± 3	33 ± 2
Groups	IR Pre-	IR Post-
1 <sup>a</sup>	79 ± 4	85 ± 3
2 <sup>a</sup>	78 ± 3	83 ± 4
3 <sup>a</sup>	81 ± 2	86 ± 3
Groups	ER Pre-	ER Post-
1 <sup>a,b</sup>	75 ± 3	79 ± 4
2 <sup>a,b</sup>	57 ± 6	68 ± 7
3 <sup>a,b</sup>	65 ± 13	78 ± 5

SD: Standard Deviation; IR: Internal Rotation; ER: External Rotation.

<sup>a</sup> $p<0.01$  Difference into the same group in Pre- versus Post-treatment period.

<sup>b</sup> $p<0.01$  Difference among groups in Pre-treatment period.

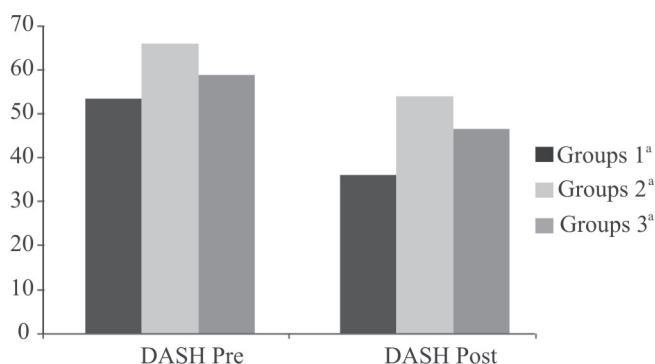
<sup>c</sup> $p<0.01$  Difference among groups in Post-treatment period.

Concerning the IR, the 3 groups presented significant improvement of ROM when compared the pre- and post-treatment periods ( $p<0.01$ ). Group 1 showed a gain of 6°, while Groups 2 and 3 presented a gain of 5°. Despite of that, no statistical differences were found among the groups in pre- and post-treatment periods.

For the ER, Groups 2 and 3 presented statistical differences when analyzed pre- and post-treatment periods

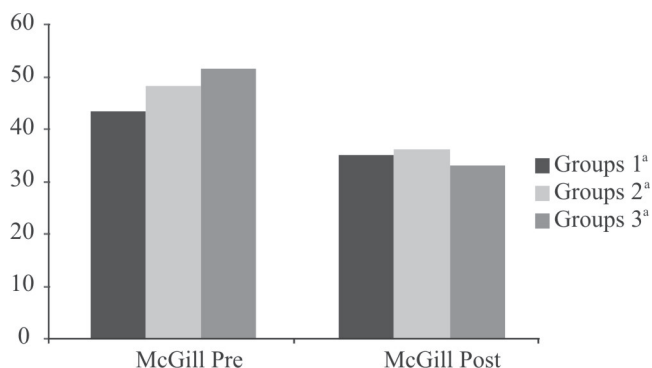
( $p<0.01$ ). Group 2 showed a gain of 11°, while Group 3 gained 13°.

Regarding DASH questionnaire, when compared the results obtained in the different protocols of treatment, all groups presented significant improvements ( $p<0.01$ ). However, compared to Groups 2 and 3, Group 1 presented a more significant improvement ( $p<0.01$ ) (Figure 1).



<sup>a</sup> $p<0.01$  Differences in DASH questionnaire in pre- and post-treatment periods.

(Group 1 Pre vs. Group 1 Post; Group 2 Pre vs. Group 2 Post; Group 3 Pre vs. Group 3 Post).



<sup>a</sup> $p<0.01$  Differences in McGill questionnaire in pre- and post-treatment periods.

(Group 1 Pre vs. Group 1 Post; Group 2 Pre vs. Group 2 Post; Group 3 Pre vs. Group 3 Post).

Figure 1 - Presentation of data related to DASH and McGill questionnaires of the 3 groups in the pre- and post-treatment periods. Ribeirão Preto-SP, 2011.

Regarding the McGill questionnaire, as well as the DASH, when the results obtained in the pre- and post-treatment periods are compared, all groups presented significant improvements ( $p<0.01$ ). Compared to Groups 1 and 2, Group 3 presented a more significant improvement ( $p<0.01$ ) (Figure 1).



## DISCUSSION

The supraspinatus tendinopathy, also known as “impingement syndrome”, is one of the most common causes of shoulder pain<sup>(16)</sup>. It occurs due to mechanical compression and abrasion of the subacromial structures, mainly the supraspinatus tendon against the anterior inferior surface of the acromion and coracoacromial ligament, especially during arm elevation<sup>(17,18)</sup>. The overwhelmed tendon tends to suffer microtears that ultimately induce neovascularization and a nervous proliferation, increasing its sensitivity<sup>(19)</sup>.

Currently, there are countless treatment options for tendinopathy, from the well-known ones, such as electrotherapy<sup>(20,21)</sup> and kinesiotherapy<sup>(18)</sup>, to the new therapeutic modalities, such as the therapy by extracorporeal shock waves (ESWT)<sup>(22)</sup> and platelet rich plasma (PRP)<sup>(23)</sup>. However, factors, such as variation in results and difficulty of access, may hinder the decision on which treatment modality should be adopted.

This study aimed to evaluate the effect of three therapeutic resources of easy application in patients diagnosed with supraspinatus tendinopathy. A study<sup>(20)</sup> evaluated the effects of low level laser therapy on the achilles tendinopathy, finding positive results in healing of tendons of rats<sup>(20)</sup>. Another research<sup>(21)</sup> also found positive effects in the use of electrotherapy and joint mobilization.

Like these works, the present investigation identified that the treatment performed with kinesiotherapy and conventional electrotherapy (low-level laser and therapeutic ultrasound) promoted an improvement in patients’ active ROM, a decrease in pain and better results in questionnaires.

Ultrasound is known to stimulate fibroblasts to produce collagen in vitro, as well as to improve the return of mechanical force during repair of acute injuries of the tendon<sup>(24,25)</sup>, while the laser has shown an increase in collagen production<sup>(26)</sup>. However, it is suggested<sup>(27)</sup> that the use of such therapies is based only on circumstantial evidence. Therefore, additional studies and research are needed to meet the best indication of each modality, since controversial results are also found<sup>(28)</sup>.

Thus, it is not possible to state that the benefits found in groups 1 and 2 of the present study have occurred only due to the application of electrotherapeutic resources, since both groups also conducted conventional kinesiotherapy exercises aiming to correct the biomechanical factors that were leading patients to compression of the supraspinatus tendon.

From the results of Group 3, which held different therapeutic exercises, involving eccentric exercise, neuromuscular control work and manual therapy, it was

noticeable that the benefits were higher in almost all parameters compared to the other groups. Similarly to other studies<sup>(28,29)</sup> that used primarily eccentric exercises and neuromuscular control work, great benefits were found in the rehabilitation of tendinopathy, this being considered a strong treatment option.

The eccentric exercises result in the strengthening of tendons by the stimulation of mechanoreceptors, accelerating the metabolism of tenocytes for the collagen production, reversing the cycle of tendinosis<sup>(30)</sup>.

The results of the present investigation show that the three therapeutic modalities used promote an improvement in the characteristic panel of tendinopathy. However, as a limitation of this study, it is not possible to say that the electrotherapy alone provides an improvement of tendinopathy, since, in this work, a therapy with exercises was performed.

Despite all the therapeutic modalities provide a good improvement in the patient’s symptoms, the benefits found with kinesiotherapy were just as good as with conventional electrotherapy, or even better, showing that a therapy based on strengthening exercises, when well done, correcting the major changes in each patient, can promote a significant improvement.

## CONCLUSION

According to the results, it was possible to establish that the different treatment modalities used promote a significant improvement in the clinical features of tendinopathy.

Although considered simple, the group that performed a more specific exercise therapy showed greater gain in ROM in the majority of the assessed parameters. Thus, it is concluded that, despite the various benefits brought by the electrotherapeutic resources, an approach involving only kinesiotherapy is able to promote a significant improvement in the supraspinatus tendinopathy, eliminating factors that cause injury and avoiding the risk of recurrence

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