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Research Article / Araştırma Makalesi

Effect of Low-Level Laser Treatment in de Quervain's Tenosynovitis Patients

De-Quervain's Tenosinovitli Hastalarda Düşük Düzeyli Laser Tedavisinin Etkisi

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Abstract

Abstract: The aim of the present study was to assess the efficacy of low level laser therapy (LLLT) combined with thumb support wirst splint in patients with de Quervain's tenosynovitis and to investigate whether the thumb support wirst splint combined with LLLT is superior to splint-alone. Thirty-five female patients with a positive Finkelstein test and radial styloid tenderness were included in this study. Patients were divided two group. Patients in group 1(n=18) were applied LLLT combined thumb support wirst splint and patients in group 2 (n=17) wore thumb support wirst splint-only. Patients were instructed to use one splint full time for a period of 3 weeks. LLLT was applied five times a week, for a total of 15 sessions. Visual analog scale (VAS), grip-strength, and global improvement as reported on a verbal scale (VSGI) were used for evaluations. Clinical evaluations were performed at baseline and at the end of the treatment. Before the treatment, clinical parameters were similar between the treatment groups. Posttreatment VAS significantly improved in both groups compared to the pretreatment values (group 1; p<0.001, group 2; p=0.016). Grip strength and VSGI only improved in group 1 after treatment (p=0.020, p<0.001). There was no posttreatment difference in any parameter when the groups were compared with each other (p> 0.05). As a result of this study, it is found that there is no difference between groups in the treatment of De Quervain's tenosynovitis. It has been thought that both treatment methods provide symptomatic relief.

Keywords: Low level laser, de Quervain's tenosynovitis, thumb support wirst splint

Özet

Bu çalışmanın amacı de Quervain tenosinoviti olan hastalarda başparmak destekli el bilek ateli ile birlikte düşük düzeyli laser tedavisinin (DDLT) etkinliğini değerlendirmek ve DDLT ile kombine edilen başparmak destekli el bilek atelinin tek başına atelden üstün olup olmadığını araştırmaktı. Pozitif Finkelstein testi ve radyal stiloid hassasiyeti olan 34 kadın hasta çalışmaya dahil edildi. Hastalar 2 gruba ayrıldı. Grup 1(n = 18) deki hastalara DDLT ile birlikte başparmak destekli el bilek splinti uygulandı. Grup 2 (n = 17) deki hastalar sadece başparmak destekli el bilek splinti giydi. Hastalara 3 haftalık bir süre boyunca tam bir splint kullanma talimatı verildi. DDLT, haftada beş kez, toplam 15 seans uygulandı. Değerlendirmeler için görsel analog skala (VAS), kavrama gücü ve hastanın sözel olarak ifade ettiği global iyileşme skoru (VSGI) kullanılmıştır. Klinik değerlendirmeler başlangıçta ve tedavi sonunda yapıldı. Tedaviden önce klinik parametreler tedavi grupları arasında benzerdi. Tedavi sonrası VAS, her iki grupta da tedavi öncesi değerlere göre anlamlı olarak iyileşti (grup 1; p<0.001, grup 2; p=0.016). Kavrama gücü ve VSGI sadece grup'de tedaviden sonra iyileşti (p=0.020, p<0.001). Gruplar birbirleriyle karşılaştırıldığında hiçbir parametrede tedavi sonrası fark yoktu (p> 0.05). Bu çalışmanın sonucunda De Quervain'in tenosinovitinin tedavisinde sadece başparmak desteği wirst ateli veya DDLT ile başparmak destekli el bilek ateli tedavileri arasında bir fark olmadığı düşünülmekle birlikte her iki tedavi yönteminin de semptomatik rahatlama sağladığı sonucuna varılmıştır.

Anahtar Kelimeler: Düşük düzeyli laser, de Quervain's tenosynovitis, başparmak destekli el bilek splinti

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1. Introduction

De Quervain's tenosynovitis is a stenosing tenosynovitis of the the extensor pollicis brevis and abductor pollicis longus tendons. The condition occurs in both genders, it is significantly more common in women. Prevalence is estimated at 0.5 % among men and 1.3% among women (1).

Patients with de Quervain's tenosynovitis typically present with swelling and pain over the dorsoradial side of the wrist. These symptoms are provoked by resisted movement of the thumb. It can cause disability and lead to job loss due to impaired functioning of the hand. Treatment of de Quervain's tenosynovitis is usually conservative, rarely is surgery (2).

The commonly used conservative treatments for de Quervain's tenosynovitis are nonsteroidal anti-inflammatory medications, icing, diathermy, transverse friction massage, corticosteroid injections activity modification, and splinting. The evidence supporting the effect of these treatments is insufficient (3-6).

Commonly, thumb support wirst splint is used to rest or prevent motions that aggravate symptoms in patients with de Quervain's tenosynovitis (7). Splints are used alone or in combination with other physical therapy options. When splinting is used alone, the success rate is about 14% to 19% of patients (8, 9).

LLLT, comprise a local application of a monochromatic light, coherent and of short wavelengths. The wavelength of the low-energy laser used in physical therapy is an electromagnetic energy form that appears in the electromagnetic spectrum or fits into the infra-red section. The three important features that distinguish the laser from ordinary light are the disintegration, monochromatism, and the rectifetion of light (10). Several studies has been shown that LLLT is beneficial in many musculoskeletal system diseases such as chronic degenerative osteoarthritis, rheumatoid arthritis, low back pain, neck pain or tendinopathies (especially of the Achilles tendon) , epicondylolpathies (11-14).

To the best of our knowledge, there is limited study about the use of LLLT in de Quervains syndrome. Therefore, in our study we purposed to evaluate the efficacy of LLLT in patients with de Quervain's tenosynovitis and to investigate whether the thumb support wirst splint combined with LLLT is superior to splint alone. Our hypothesis is that patients receiving LLLT therapy combined with the thumb support wirst splint have greater improvement in evaluation parameters.

2. Materials and Methods

The study was conducted at the Eskisehir Osmangazi University Hospital Department of Physical Medicine and Rehabilitation from July 2016 to January 2018. Thirty-five female patients who had to have pain and tenderness with palpation over the first extensor region, and a positive Finkelstein test were included the study. The test was considered positive if there is pain while the examiner passively deviated the wrist ulnarly (15).

Patients who had less pain in 30 days, recent history of taking non-steroidal anti-inflammatory drugs, fracture of the wirst, uncontrolled concomitant disease (such as diabetes mellitus, rheumatoid arthritis, gout, pseudo gout, pregnant or lactating mothers, hypertension) who applied injection or surgery, abnormal findings radiography of the wrist, and skin conditions making splint wear problematic and also were excluded from the study. All patients had unilateral de Quervain's tenosynovitis. The flow diaphragm of this study is shown in figure 1.

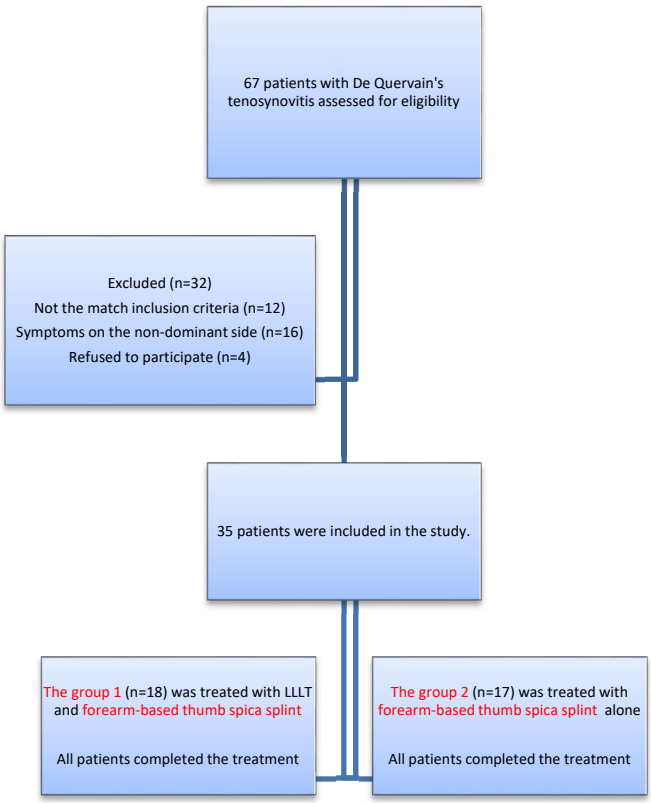

Figure 1. The flow diaphragm of this study

Study design

This study was planned as single blinded, randomized, and prospective study. The patients were informed about the study, and written consent was obtained from the patients. The Ethics Committee at our institution approved this study (date/no: 30-06-16/219)

Randomization

The closed envelope method was used to determine the treatment groups of 35 patients who met the inclusion criteria and accepted to participate in the study. Twenty of 40 envelopes

were labelled as group 1 and the other 20 envelopes were labelled as group 2. The patients were told to pick up an envelop from a box and they were randomly assigned to treatment groups according to the numbers in the envelops.

Thirty-five patients having inclusion criteria were included in this study. The patients were randomly divided into 2 groups with opaque closed envelope. The physician who evaluated the patients was blinded to the treatment they would receive. There were eighteen patients in the first group and seventeen patients in the second group. Patients were divided to LLLT combined thumb support wirst splint as group 1 (n=18) and thumb support wirst splint only as group 2 (n=17).

Treatment

For the LLLT, a Gal-Al-As diode laser appliance (Endolaser 476, Enraf–Nonius, Netherlands) was used with a power output of 100 mW and the wavelength of 830 nm. The diameter of the laser beam at treatment point was 1 mm. The laser was set to deliver continuous form of energy. The painful dorsa radial area across was irradiated with the laser probe. Laser therapy was applied with 0.60

joule per minute, the duration of treatment was 5 minute, and the accumulative dose for 15 laser treatments were 45 joules appliance

A thumb support wirst splint which is shown in figure 2 was applied in both groups. Patients were instructed to use the splint fulltime for a period of 3 weeks.

Treatment groups were not allowed to take any medicationt during the treatment. They were recommended to avoid activities that might provoke pain.

Figure 2. A thumb support wirst splint

Clinical assessment

The two groups were assessed before and post treatment. The severity of pain was assessed by visual analog scale (VAS) consisted of 10-cm horizontal lines, with anchor points of 0 (no pain) and 10 (maximum pain) (16).

Verbal Scale of Global Evaluation (VSGI): This score was used for assessing the well-being of the patient (great recover:1 moderate recovery:2, slight recovery:3, no recovery:4, worsening:5) (17).

Grip strength was assessed by hydraulic hand dynamometer while the forearm pronated and elbow full extended. The patients were seated in a comfortable position and asked to squeeze the dynamometer until the pain was felt. The measurements were repeated 3 times and a resting time of 2 minutes was provided between each measurement. The average of these measurements was calculated and recorded.

Statistics

The normality distribution was assessed by the Shapiro-wilk test. Age, disease duration, height, weight and body mass index were compared between groups using independent samples Student's t test. The comparisons of VAS, grip strength, and VSGI between groups and within pre-treatment and post-treatment were analyzed using general linear model for repeated measures ANOVA. The interaction between pre-post treatment and groups was assessed using multivariate tests which are Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root. Pairwise multiple comparisons were evaluated by Sidak Test. P-value less than 0.05 was considered to statistically significant difference. The SPSS 21.0 version was used for statistical analysis.

3. Results

Based on the selection criteria, 35 patients with de Quervain' s tenosynovitis aged between 32 and 61 years (42.69 ± 1.25 years) were included in the trial, and all of them completed the study period. There were no differences between two groups in terms of age, weight, body mass index and duration of symptoms (Table 1).

Table 1. Baseline clinical and demographic characteristics of patients with De Quervain's tenosynovitis

	Group 1(n=18) mean ± SD	Group 2(n=17) mean ± SD	p-value*
Age (year)	42.72 ± 1.82	42.65 ± 1.75	0.976
Disease duration (month)	6.72 ± 0.69	7.25 ± 0.62	0.584
Height (cm)	158.22 ± 1.07	158.88 ± 0.98	0.653
Weight (kg)	62.22 ± 2.04	63.35 ± 1.61	0.669
Body mass index (kg/cm²)	24.86 ± 0.78	25.12 ± 0.68	0.809

Group 1: LLLT combined thumb support wirst splint, Group 2: thumb support wirst splint-only
**: Independent Samples Student's t Test, SD: Standard Deviation*

There were no difference between the two groups in terms of VAS scores at baseline. Significant improvement was observed in post treatment VAS in both groups (Group 1; p<0.001, Group 2; p<0.05, respectively) (Table 2, Table 3). The grip strengths measured at baseline were similar in all groups. Post treatment grip strength significantly improved in LLLT group (p>0.05) (Table 2, table 3). The patients in both groups had similar VSGI scores at the baseline. Significant improvement was detected in VSGI at the end of the treatment in only LLLT group (p<0.01) (Table 2, Table 3). There was no difference at the end of the treatment in any evaluated parameters when the groups were compared with each other (p<0.05) (Table 3). The differences within each group observed in VAS score, grip strength and VSGI were illustrated in Figures 3, 4 and 5, respectively.

Table 2. Clinical assessment parameters before and post treatment in both groups (Means were obtained from estimated marginal means)

	Group 1(n=18)		
	Pre-treatment mean ± SD	**Post-treatment mean ± SD**	**p-value***
VAS	71.50 ± 1.58	66.83 ± 1.73	< 0.001
Grip strength	0.39 ± 0.008	0.40 ± 0.009	0.020
VSGI	3.44 ± 0.17	2.78 ± 0.14	<0.001
	Group 2(n=17)		
	Pre-treatment mean ± SD	**Post-treatment mean ± SD**	**p-value***
VAS	71.77 ± 1.63	70.00 ± 1.78	0.016
Grip strength	0.38 ± 0.008	0.39 ± 0.009	0.456
VSGI	3.06 ± 0.18	2.94 ± 0.15	0.379

Group 1: LLLT combined thumb support wirst splint, Group 2: thumb support wirst splint-only
VAS: Visual Analog Scale VSGI: Verbal Scale of Global Evaluation
**: General Linear Model for Repeated Measures ANOVA, Adjustment for Multiple Comparisons by Sidak Test, SD: Standard Deviation*

Table 3. Comparison of pre-treatment and post-treatment clinical assessment parameters of groups (Means were obtained from estimated marginal means)

	Pre-treatment		
	Group 1 (n=18) mean ± SD	**Group 2 (n=17) mean ± SD**	**p-value***
VAS	71.50 ± 1.58	71.77 ± 1.63	0.908
Grip strength	0.39 ± 0.008	0.38 ± 0.008	0.695
VSGI	3.44 ± 0.17	3.06 ± 0.18	0.126
	Post-treatment		

	Group 1 (n=18) mean ± SD	Group 2 (n=17) mean ± SD	p-value*
VAS	66.83 ± 1.73	70.00 ± 1.78	0.211
Grip strength	0.40 ± 0.009	0.39 ± 0.009	0.213
VSGI	2.78 ± 0.14	2.94 ± 0.15	0.430

Group 1: LLLT combined thumb support wirst splint, Group 2: thumb support wirst splint-only
VAS: Visual Analog Scale VSGI: Verbal Scale of Global Evaluation
**: General Linear Model for Repeated Measures ANOVA, Adjustment for Multiple Comparisons by Sidak Test, SD: Standard Deviation*

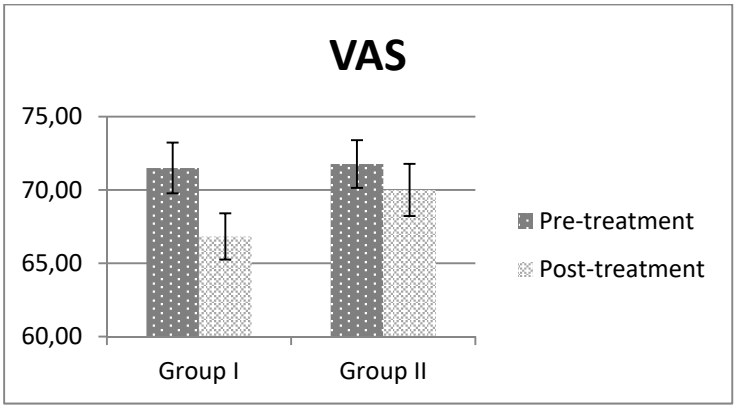

Figure 3. The differences within each group observed in VAS score.

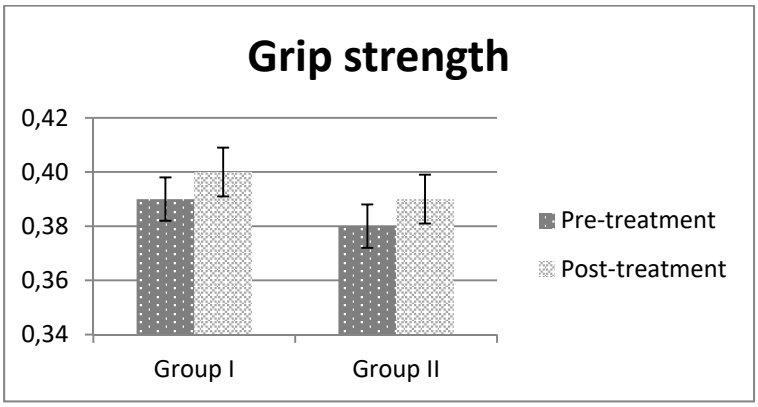

Figure 4. The differences within each group observed in grip strength

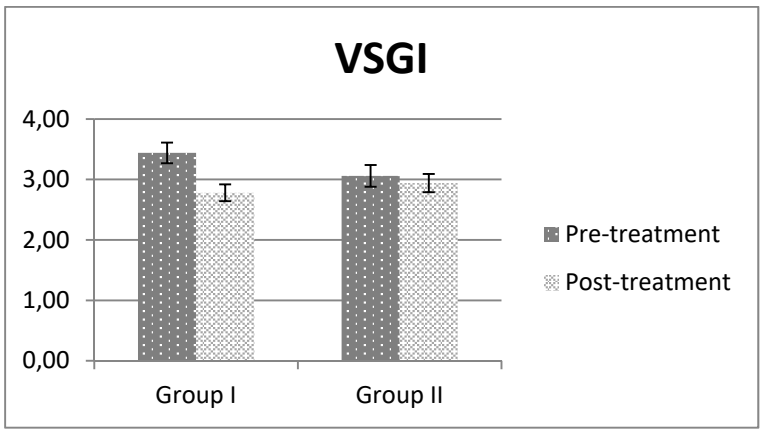

Figure 5. The differences within each group observed in VSGI

Posterior Power Analysis

After the all statistical analyses, we performed posterior power analysis for General Linear Model of Repeated Measures ANOVA. For the comparisons of the interaction between pre-post treatment and groups, we use partial eta squares, effect sizes and the correlation coefficients between pre-post treatment measurements for VAS, grip strength and VSGI. According to the posterior power analysis, the powers for the comparisons of VAS, grip strength and VSGI were found as 1.000, 0.799, and 0.999 at the total sample size 35, respectively.

4. Discussion

Our aimed of this study was to evaluate whether the thumb support wirst splint combined with LLLT is superior to splint alone in patients who had de Quervain's tenosynovitis. The results of our study showed that combined technique of LLLT and thumb support wirst splint were not superior to only thumb support wirst splint. However, the combined use of LLLT and thumb support wirst splint found more effective in improving clinical parameters in patients with de Quervain's tenosynovitis than with only thumb support wirst splint

Although there are many modalities for de Quervain's tenosynovitis treatment, splint immobilization is the most common recommended treatment (15). There is no consensus about the best protocol for splint administration in such patients. Forearm based thumb spica is often used to reduce mechanical friction of the EPB and APL tendons. Some authors suggest full time splinting for three to six weeks (18,19).

In our study, it is found that the patients who used only full time thumb support wirst splint a pain relief was also found. A systematic study involving seven observational studies by Richie and Eriner was conducted and the treatment modalities of the 459 wrists were examined. In conclusions, only 14% of patients treated with splint therapy had improvement (8). Although there is no significant statistical difference between the groups, the results of our study showed that combined technique of LLLT and thumb support wirst splint were partly more effective ($p<0.01$) than single thumb support wirst splint ($p<0.05$) in patients with de Quervain's tenosynovitis

LLLT involves the local application of a monochromatic beam of consistent, short wave lengths. LLLT has gained increasing popularity in the management of tendinopathy and arthritis (10). It has been used since 1960 and the popularity of laser treatment for tendonitis and arthritis has increased years. In various studies, LLLT has been shown to be useful in in the treatment of tendon injuries. It is especially effective in the treatment of Achilles tendonitis (19,20). Unfortunately, the number of studies evaluating the efficacy of LLLT in de Quervain's tenosynovitis is very limited. For this reason, we aimed to evaluate whether combined thumb support wirst splint therapy with LLLT provides additional benefit to the clinical manifestations of patients with de Quervain's tenosynovitis when compared to splint therapy alone. The results that we obtained in the study suggest that LLLT is an efficient treatment modality for the clinical symptoms of de Quervain’s tenosynovitis.

In a double-blind placebo controlled study, Ga-As Al infrared laser wavelength 830 nm was used and an optimum dose of 2–4 joules/cm^2 continuous output of 100% were given. The results showed a significant improvement in grip strength, tenderness (Ritchie's tenderness scale), and VAS (21). In another study, LLLT and ultrasonic therapy were compared in the de Quervain's tenosynovitis patients. Ga-As Al infrared laser wavelength 830 nm was used, and an optimum dose of 3 joules/cm^2 continuous output of 100% was given. Post treatment, significant improvements were seen in both groups in the Ritchie's tenderness scale, grip strength and VAS (22). In our study, we also applied 3 J / cm low level laser and at the end of treatment, similar improvements were observed in clinical parameters such as VAS, grip strength and general healing.

The mechanisms of action of laser therapy are not fully understood. Anti-inflammatory

and analgesc effects were shown in different experimental studies. According to thesre experimental studies, LLLT decreases the edema and fibrinogen levels, and reduces the amount of inflammatory cells (23,24). The reduction of the inflammatory process is thought to provide analgesia. Throughout the inflammatory process, in addition to an increase in endorphin synthesis, LLLT modifies chemical mediators, vasodilation, and increases the synthesis of protein and cortisol (24-27).

On the other hand, in de Quervain's tenosynovitis, inflammation occurs in the wrist and thumb due to a repetitive strain injury or a cumulative trauma. As a result, a degenerative thickening develops in the retinaculum of the extensor covering of the first extensor compartment. Ultrasonographic measurements have shown that laser treatment reduces this degenerative thickening (22). In addition, there is recent evidence that LLLT may have a preventive capacity which enhance muscle strength and accelerate muscle regeneration (11).

The results we have obtained on clinical parameters may be related to the treatment mechanisms of laser therapy on pain, inflammation, muscle regeneration and degenerative thickening.We think that our study was useful in attracting attention to laser therapy in patients with de Quervain's tenosynovitis. The limitation of our study was that the changes in the tendon sheath could not be measured with imaging methods.The presence of a small number of patients and the absence of our placebo group due to ethical constraints are other limitations of our study.

As a result of this study, it is found that there is no difference between only thumb support wrist splint or LLLT and thumb supported wrist splint treatments in the treatment of De Quervain's tenosynovitis. It has been thought that both treatment methods provide symptomatic relief. Currently, the choice of laser type, laser modality, dose and wavelength used in musculoskeletal disorders show differences. We think that further research is required to evaluate the different LLLT applicationslications, other dosages and the long-term efficacy. More inclusive studies are needed to prove the effectiveness of laser therapy and to compare it with other established treatment modalities.

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