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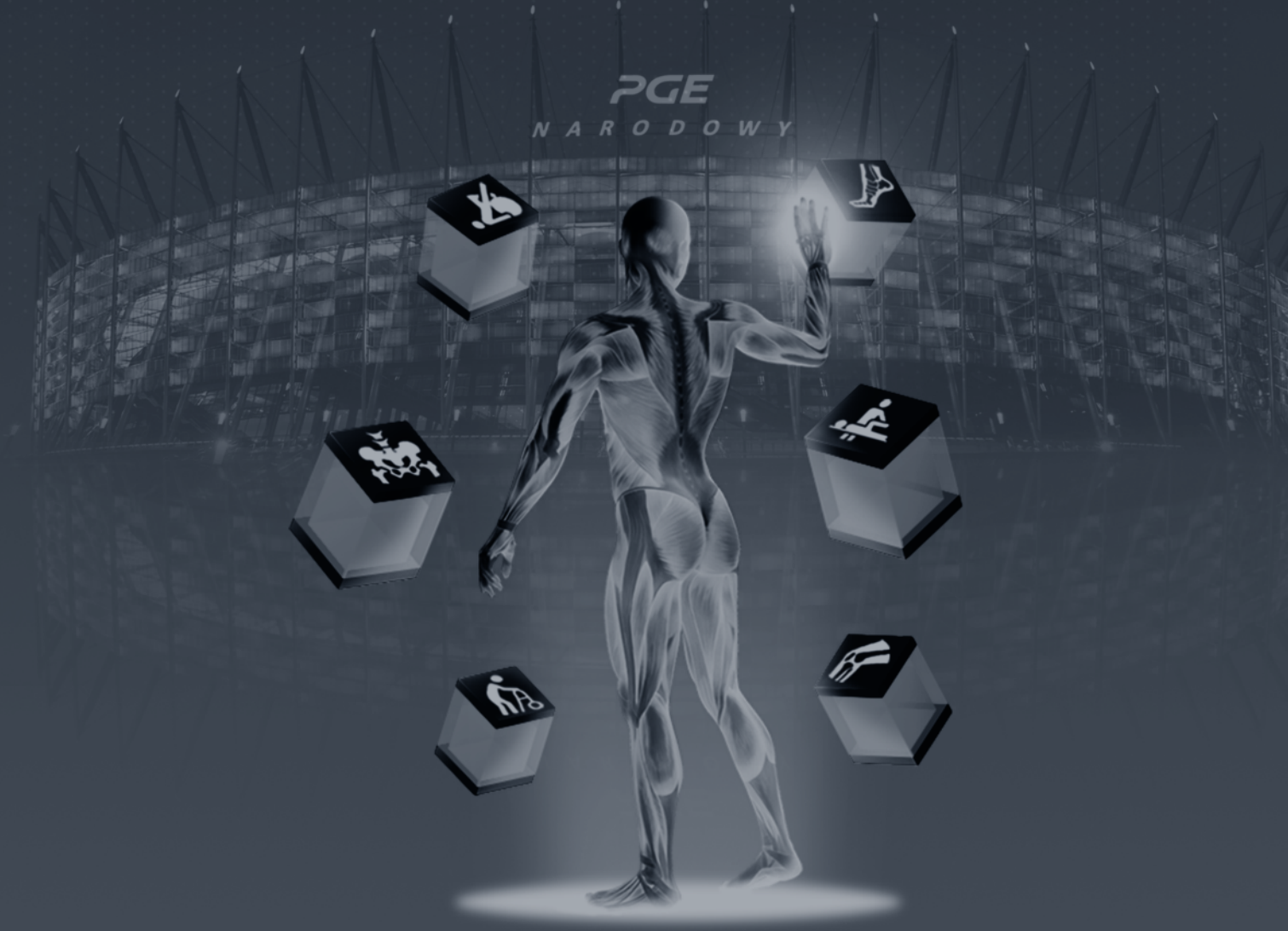

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Comparing the Effect of Low-Level Laser Therapy Versus Therapeutic Ultrasound After Distal End of Radius

Porównanie efektów laseroterapii niskopoziomowej i terapii ultradźwiękowej po złamaniu dalszego końca kości promieniowej

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Abstract

Background. The Distal end of radius fracture is the most common fracture site in the upper extremity; it causes functional problems and can result in some disabling complications. Objective. The purpose of this study was to investigate the effect of Low-level laser therapy versus therapeutic ultrasound after the distal end of radius fracture fixation. Method. Forty patients were assigned randomly into two groups (Group A and Group B) with ages ranged from 18-45 ys. Group A consisted of fifteen female patients and five male patients, and received Low-level laser therapy, group B consisted of fifteen female patients and five male patients, and therapeutic ultrasound for 3 times per week for 4 weeks. Patients were evaluated pre and post-treatment for the function of the wrist joint, grip strength, and wrist joint's ROM. Results. When comparing patients in group (A) who received LASER therapy, and patients in group B who received Therapeutic ultrasound, we observed clinical difference but it was only statistically significant in favor of group (A) patients in terms of wrist extension, Radial deviation and Ulnar deviation but it was no statistically significant in favor of group (A) patients in terms of wrist flexion. Group (A) patients also had no statistical significance when assessing the wrist proprioception at 20° angle flexion and extension. Conclusion. It can be concluded that both Low-level laser therapy and therapeutic ultrasound after Distal end of radius fractures fixation improved wrist range of motion and proprioception. Both of similar degrees of improvement, however low-level laser therapy had more improvements than therapeutic ultrasound in the wrist ROM of extension, radial deviation, and ulnar deviation.

Key words:
The distal end of radius fracture, Low-level laser therapy, Therapeutic ultrasound

Streszczenie

Informacje wprowadzające. Najczęstszym miejscem złamania kończyny górnej jest dalszy koniec kości promieniowej; powoduje ono problemy funkcjonalne i może powodować pewne komplikacje powodujące niepełnosprawność. Cel. Celem pracy było zbadanie wpływu laseroterapii niskopoziomowej w porównaniu z terapią ultradźwiękową po zespoleniu dalszego końca kości promieniowej. Metoda. Czterdziestu pacjentów przydzielono losowo do dwóch grup (Grupa A i Grupa B) w wieku od 18 do 45 lat. Grupa A składała się z piętnastu pacjentek i pięciu mężczyzn, i była poddawana laseroterapii niskopoziomowej; grupa B składała się z piętnastu pacjentek i pięciu pacjentów, i była poddawana terapii ultradźwiękowej 3 razy w tygodniu przez 4 tygodnie. Pacjenci byli oceniani przed i po leczeniu pod kątem funkcji stawu nadgarstkowego, siły chwytu i zakresu ruchu stawu nadgarstkowego. Wyniki. Porównując pacjentów z grupy (A), poddawanych laseroterapii, i pacjentów z grupy B, poddawanych terapii ultradźwiękowej, zaobserwowaliśmy kliniczną różnicę, ale była ona statystycznie istotna tylko na korzyść pacjentów z grupy (A) pod względem wyprostu nadgarstka, odchylenia promieniowego i odchylenia łokciowego, jednak nie była istotna statystycznie na korzyść pacjentów z grupy (A) w zakresie zgięcia nadgarstka. W przypadku pacjentów z grupy (A) również nie zaobserwowano istotności statystycznej w ocenie propriocepcji nadgarstka przy zgięciu i wyproście pod kątem 20°. Wniosek. Można stwierdzić, że zarówno laseroterapia niskopoziomowa, jak i terapia ultradźwiękowa po zespoleniu dalszego końca kości promieniowej poprawiły zakres ruchu nadgarstka i propriocepcję. Obie osiągnęły podobne stopnie poprawy, jednak laseroterapia niskopoziomowa przyniosła większą poprawę niż terapia ultradźwiękowa w kwestii zakresu ruchu nadgarstka pod względem wyprostu, odchylenia promieniowego i odchylenia łokciowego.

Słowa kluczowe:
złamanie dalszego końca kości promieniowej, laseroterapia niskopoziomowa, terapia ultradźwiękowa

Introduction

The Distal end of radius fracture is at the particular distal radius and commonly the lower radial and is dorsally and side to side angulated along with a rotating deformity in supination [1]. This is a very typical extra-articular fracture that arises as to the results of the fall on an outstretched hand. It is typically seen in all age groups and demographics, particularly increased in osteoporotic individuals [2].

This fracture may result in some difficulties as persistent pain in addition to the loss of motion combined with moderate swelling of the particular distal radius. Increased angulation of the distal radius may lead to an incapability to grasp objects following a plaster cast [3]. Impairment throughout the range of motion in addition to strength after distal radius fractures may result in difficulty along with the functional task [4].

Physiotherapy in many cases is included in the rehabilitation involving patients with these accidental injuries. The activities and tasks of these professionals usually overlap. Rehabilitation interventions simply by physiotherapists focus on protecting against complications associated with the particular fracture and/or treatment and even on optimizing movement in addition to the physical function of the patient [5].

The particular goal for rehabilitation following wrist fractures is to be able to achieve complete and fast recovery of ROM, strength, and performance involving the wrist and Hands [6]. Hence, for the development of functional outcomes, one has to pay focus on the postoperative therapy period [7]. A patient would likely need a more effective treatment procedure without really stressing the bone which may prevent the unfavorable side effects as effectively as the central reorganization that takes place as a result of immobilization. This may lead to being able to a temporary forgetting regarding the function of the particular affected limb [8], and even results in the ineffectiveness of the central management of movements. Immobilization seemed to be shown to result quite rapidly in changes involving motor and sensory diagrams in the brain involving peripheral organs such as a finger, arm [9, 10].

For instance, Langer et al. [9] showed some sort of decrease in cortical in the left motor and somatosensory region as well as a decrease in the gray matter in the corticospinal tract after at least 2 weeks of arm or leg immobilization.

Physiotherapy rehabilitation can be effective exercises (under control over the particular patient) and passive (usually performed by the specialist while the patient is still 'passive') mobilization exercises, passive motion devices, conditioning exercises, heat treatment, in addition to massage [5].

Ultrasound is utilized to manage the three most common impairments of the distal end of radius fracture |and they are generally soft tissue inflammation, tissue extensibility, and scar tissue remodeling [11]. Ultrasound (US) has been traditionally used as an adjunct modality for the particular management of many musculoskeletal conditions. Therapeutic ultrasound may be the use of alternating compression and rarefaction of reasonable waves for therapeutic. When ultrasonic energy is induced into an attenuating material such as tissues, the amplitude of the particular wave decreases the distance. This attenuation was due to either absorption or the spreading of sound waves [12].

Low-Level Laser Therapy (LLLT) sometimes known as Low-Level Light Therapy or Photobiomodulation (PBM) is a low-intensity light therapy. The effect is photochemical, not thermal. The light triggers biochemical changes within cells and can be compared to the process of photosynthesis in plants, where the photons are absorbed by cellular photoreceptors and trigger chemical changes [13].

It hypothesized that there was no significant difference between Low-Level Laser and Therapeutic ultrasound on the wrist joint range of motion, and wrist proprioception at 20° wrist flexion and extension.

Material and Methods

Design

The study was designed as a prospective, randomized, controlled trial. It was carried out between January 2019 to October 2020. It followed the Guidelines of Declaration of Helsinki on the conduct of human research.

Participants

Forty patients (30 females and 10 males) were recruited from the orthopedic outpatient clinic of Sohag General Hospital who has suffered The Distal end of radius fracture and treated with a plaster cast. The participants' age was ranged from 18-40 years old, Patients with limited wrist ROM, Patients group with radiological diagnosis of post distal end of radius fractures after 6 weeks of the cast. The exclusion criteria were Patient with Neuromuscular injuries, the wrist or forearm motion deficits were presented before the wrist injury to the degree that it affected the patient's daily activity, Osteopenia and patient with both radius and ulna fractures.

Randomization method

Each participant was assigned a unique number. These numbers were written on a piece of paper. The pieces of paper were mixed in a container and then the numbers were selected by another physical therapist. Finally, the assigned number put in a closed envelope and delivered to the researcher at beginning of treatment. Patients were randomly allocated to one of two groups equal in number, group (A) low-level laser therapy (n = 20) and group (B) therapeutic ultrasound (n = 20).

Intervention

All patients have received sixteen treatment sessions.

Group A

Patients who received low-level laser therapy with a treatment program in which 830 nm LLLT [average power 60 mW, peak power 8 W, 10 Hz, 10 minutes, and 9.7 J/cm] will be administered three times per week for 4 weeks.

Group B

Patients who received therapeutic ultrasound with an intensity of 1.5 w/cm^2 and a frequency of 3 MHz for 5 minutes were administered three times per week for 4 weeks.

Outcome measures post radial fracture

The researcher chose outcome measures that can be easily understood and administered and have consistent reliability and validity over a wide array of demographic groups [14].

The Myrin OB goniometer is used as an alternate instrument to the universal goniometer for assessing the range of motion at some joints. It consists of a fluid-filled rotatable container mounted on a plate. The container has a compass needle that reacts to the earth's magnetic field, an inclination needle that is influenced by the force of gravity, and a scale on the container floor marked in 2º increments [one minor unit = 2º and one major unit = 10º]. The compass needle measures movements in the horizontal plane; the inclination needle measures movements in the frontal and sagittal planes. Two straps with Velcro fastenings are supplied to attach the goniometer to the body segment, and two plastic extension plates are also supplied to position the goniometer for certain joint measurements [15].

Wrist and hand sensory dysfunction is important due to its influence on optimal joint neuromuscular control and stability during functional tasks. It can be tested via the joint position sense JPS method which tests the ability to accurately reproduce a specific joint angle while vision is blocked. [16]. It can be quantified by using a goniometer and measure the absolute difference between the target and the matching joint position sense accuracy [17]. It is reported that repositioning tests performed for the upper extremities gave better results when the eyes of the subjects were open than when they were closed [18].

Data Analysis

The Independent variables were Low-Level Laser Therapy and Therapeutic Ultrasound and the dependent variable was wrist ROM and wrist proprioception. Analyses were performed using the SPSS statistical software package. Paired't' test was used for the measurement of pre-test and post-test values of groups A and B. Unpaired 't' tests were used to compare the post-test values of Group A and B. p-values ≤ 0.05 were considered significant. Ethical approval was obtained by the Research Ethics Committee of the National Institute of laser enhanced science, Cairo University, Egypt.

Results

In this study 30 female and 10 male patients were assigned randomly into 2 groups; Group A (n = 20) their mean age was 30.8 ± 8.98 years old. Group B (n = 20) their mean age was 29.6 ± 7.63 years old.

The results at the end of the treatment program revealed that group A that received Low-Level Laser showed no statistically significant difference than Group B at wrist range of motion flexion and a statistically significant difference than Group B at extension, radial deviation, and ulnar deviation group A was 37.9 ± 5.77 and the mean value of group (B) was 46.6 ± 8.53 with t test = 1.886 and p value = 0.096, group A was 40 ± 12.24 and the mean value of group B was 47.8 ± 7.69 with t test = 1.206 and p value = 0.262, group A was 12.6 ± 5.80 and the mean value of group B was 14.2 ± 5.84 with t test = 0.432 and p value = 0.677, group A was 18.8 ± 6.6 and the mean value of group B was 20 ± 9.0 with t test = 0.238 and p value = 0.818 table [1].

At 20° wrist flexion proprioception after treatment revealed no statistically significant difference between the mean value of group A was 2.6 ± 2.46 and the mean value of group B 5.3 ± 3.39 with t test = 1.530 and p value = 0.152 and at wrist 20° extension, group A was 3.3 ± 2.95 and the mean value of group B was 3.9 ± 2.46 with t test = 0.420 and p value = 0.683 table [1].

Table 1. Comparison between group A and B at wrist ROM and Wrist Proprioception

Parameters	Group A	Group B	t-value	p-value
Wrist Flexion ROM [degree]	40 ± 6.32	28 ± 11.66	2.216	0.050 [NS]
Wrist Extension ROM [degree]	48.33 ± 14.71	29 ± 9.69	1.687	0.023 **
Wrist Radial deviation ROM [degree]	20.5 ± 5.09	11.5 ± 3	3.726	0.004 ***
Wrist Ulnar deviation ROM [degree]	17.5 ± 2.25	9.5 ± 2.91	5.314	0.000 ***
At 20˚ wrist flexion proprioception	5.3 ± 3.39	2.6 ± 2.46	1.530	0.152 [NS]
At 20˚ wrist flexion proprioception	3.9 ± 2.46	3.3 ± 2.95	0.420	0.683 [NS]

Data are expressed as mean ± SD; [NS] None significant difference at α > 0.05;
**** High significant difference at α < 0.004; ** significant difference at α < 0.023*

Discussion

This study investigated the effects of Laser therapy versus therapeutic ultrasound in the rehabilitation after stable The distal end of radius fracture. This study used different outcome measures to assess the effects of the treatments on the wrist ROM and wrist proprioception. The researcher chose a sample of youth who sustained a relatively high energy fall which is one of the common causes of The distal end of radius fracture [19]. Although postmenopausal women have nearly five times more likely than men, [20].

LASER therapy of wrist joint

When comparing patients in group [A] who received LASER therapy, and patients in group B who received Therapeutic ultrasound, we observed clinical difference but it was only statistically significant in favor of group [A] patients in terms of

wrist range of motion and proprioception. Group [A] had a better score in wrist range of motion of extension, radial deviation, and ulnar deviation but it was statistically significant, also had a better score in wrist range of motion of flexion but it was not statistically significant, also had a better score in wrist proprioception but it was not statistically significant.
This study confirms the previous report that LLLT and Therapeutic ultrasound early intervention helps to improve pain, range of motion, grip strength, and reduce disability. Chang et al. [21] employed a diode laser with a wavelength of 830 nm, an energy density of 9.7 J/cm2, and average power of 60mW a diode laser [9.7 J/cm2] was used to treat closed bone fractures in wrists and hands, and the experimental results indicated that the treatment provided effective pain relief and improved the muscle strength and functional ability of patients. This study revealed that the pain of acute fractures was significantly reduced after LLLT. A significant difference in the VAS scores was observed in both the laser and placebo groups after treatment and at the follow-up, compared with those at the baseline. However, only the laser group demonstrated significant improvement in the Quick DASH results and hand and finger grip strength measures after treatment.
Bjordal et al. [22] suggested that a laser wavelength of 830 nm and dosages between 6 and 10 J, can deeply penetrate tissue, and that satisfactory absorption can be achieved, thereby inducing anti-inflammatory effects to treat orthopedic diseases
This is following our results that Schindl et al. [23] reported that LLLT has shown some medical benefits. Some of these include increasing ROM, increasing blood flow, increasing tissue regeneration, decreasing inflammation, and decreasing pain. Skin circulation has also been reported to increase in diabetic patients due to LLLT.

Therapeutic ultrasound of wrist joint

Draper [24] and Kaltenborn [25], stated that thermal ultrasound used in concert with joint mobilizations was effective in restoring ROM in hypo-mobile wrists post-injury or when immobilized after surgery. Ultrasound also increased patient comfort during the treatment and minimized posttreatment soreness.

Basso and pike [26] stated that if the distal radius heals in a satisfactory position, functional prognosis tends to be good. Nevertheless, recovery may be delayed by the onset of soft tissue complications such as edema and pain, peritendinous adhesions, and algodystrophy, which require further physiotherapy. In this study, US treatment failed to change clinical outcomes since, although there were fewer physiotherapy referrals, this finding was not statistically significant.
Morishita et al. [27] reported no physiological effects on skin stretch temperature on the tissue; thus, the clinical implication of tissue cooling is not considered to be important. On the other hand, the ultrasound group showed significant influences, such as favorable results in the ROM and SP threshold during the 20 minutes after the intervention. This is clear evidence that ultrasound causes a direct mechanical effect on the skin and muscle due to a combined effect of thermal effects and mechanical effects in ultrasound.
This is consistent with Kamal et al. [28] who concluded that both Maitland's mobilization plus therapeutic ultrasound and closed kinetic chain exercises plus therapeutic ultrasound after Colles' fractures fixation improved patient hand function, grip strength, joint position sense, and range of motion. Both similar degrees of improvement, However Maitland's mobilization plus therapeutic ultrasound had more improvements than closed kinetic chain exercises in the wrist range of motion extension, radial deviation, and ulnar deviation.

Conclusion

It can be concluded that both Low-level laser therapy and therapeutic ultrasound after Distal end of radius fractures fixation improved wrist range of motion and proprioception. Both of similar degrees of improvement, however low-level laser therapy had more improvements than therapeutic ultrasound in the wrist ROM of extension, radial deviation, and ulnar deviation.

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