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Efficacy Comparison of Low Level Laser Treatment with Muscle Energy Procedure Among Diabetic Patients Suffering from Frozen Shoulder

Abdul Samad Qureshi[1*], Tanweer Hussain[2], Muhammad Zaib Tunio[3], Muhammad Arshad Aleem[2] and Zain-Ul-Abideen[4]

[1]Department of Orthopedic, Indus Medical College, Tando Muhammad Khan, Pakistan
[2]Department of Orthopedic, King Saud Hospital, Unaizah, Al Qasim, Saudi Arabia
[3]Department of Orthopedic, Chandka Medical College, Larkana, Pakistan
[4]Department of Orthopedic, Ghulam Muhammad Mahar Medical College, Sukkur, Pakistan

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***Corresponding Author:**
Abdul Samad Qureshi
Department of Orthopedic, Indus Medical College, Tando Muhammad Khan, Pakistan
asqureshi855@hotmail.com

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ABSTRACT

Frozen shoulder incidence in diabetic patient is twice as high as normal controls. There are various conventional as well as electrotherapies for its treatment within which low-level laser therapy versus muscle energy technique are well debated for efficacy in diabetic patients frozen shoulder. **Objective:** Comparative analysis of effectiveness of low-level laser therapy and muscle energy technique among diabetic patients with frozen shoulder. The study design was comparative study. The Place and Duration of Study was Department of Orthopaedic, Indus Medical College, Tando Muhammad Khan from 1st January 2023 to 30th June 2023. **Methods:** One hundred and twenty patients who were having diabetes mellitus (type 1 and type 2) and suffering from frozen shoulders were enrolled. The conventional therapeutic exercise included exercises like pendulum, arm overhead, finger wall ladder, twisting arm outwards, overhead pulley, cross-body reach exercises, hand behind-back exercise and outward rotation exercise. Muscle energy technique was administered in cases where restriction in shoulder flexion, as well as abduction, external rotation was observed. **Results:** There were 59% females and 41% males with majority being within the age group of 45-65 years. It was observed that there was a significant variance between pain scores at pretreatment and post treatment stages with highest value decrease observed in muscle energy technique group II. The ROM was least improved in control group only treated through conventional protocol. **Conclusions:** The Muscle energy technique is slightly more effective than low-level laser therapy technique in terms of pain, inflammation reduction and angular movements.

INTRODUCTION

Diabetes Mellitus is a global challenge with an advanced number of cases in twenty first century. It is related with genetic and lifestyle predisposition causing a critical public health concerns [1, 2]. According to an estimate around 537 million worldwide are suffering from diabetes mellitus wherein the number is expected to intensify up to 643million globally by year 2030 and 783 million by 2045 [2]. Low-income countries are at a higher risk than other parts of the world. In this context around 4.2 million people were found to have type 2 diabetic in the Sub-Sahara Africa region. The pr4e4velance of undiagnosed cases of diabetes mellitus type 2 in African countries is considered up to 67% which is almost twofold than other developed countries having a prevalence of 37% respectively. This increased number of diabetes cases builds the risk of mortality and complicative morbidities among this region at the higher than other part of the world [3]. Diabetic patients having uncontrolled glycemia are at higher risk of complications and additional morbidities including neuropathy, retinopathy, cardiovascular disease, and

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paralysis leading to increased health cost and care [4, 5]. Microvascular and macrovascular complications are highly significant in diabetes. Beside this, musculoskeletal concerns have also been highlighted in the Diabetes mellitus patients [5, 6]. Recent studies have identified the fact the incidence of musculoskeletal issues in diabetes patients is 1.7 to 2.1 times higher than in non-diabetic patients [7, 8]. However, due to non-life-threatening conditions the issue is many times overlooked. The complications associated with musculoskeletal disease result in organ complication as well as complications related with internal organs and chronic low-grade inflammation [9-12]. Frozen shoulders are a major concern with painful and disabling fibro proliferative disorders [13, 14]. It features gradual onset of pain and limitation of movement only up to a glenohumeral range. This can resist routine activities without bringing any radiological evidence while diagnosis [15, 16]. The average frequency of frozen shoulders in diabetic patients is about 13.4% higher than non-diabetic patients [17]. The life impact of frozen shoulders is not only related to physiological effects but also related with psychological variances with a high tendency of anxiety and depression as well as sleep deprivation among patient [18]. There are various methods introduced for treating frozen shoulders and easing the patient's life either suffering from diabetes mellitus or not. Conventional therapeutic exercises as well as electro therapy methods including Low-Level Laser Therapy (LLLT) has emerged with promising sensory system for the frozen shoulder treatment of frozen. The LLLT has bio stimulating, analgesic and anti-inflammatory effects [19]. One hand physiotherapist however prefers using another technique recognized as Muscle Energy Technique (MET) which applies gentle manipulations on lengthen-shortened spasmatic muscles resulting in reduction of edema and pain [20]. The present study was designed to compare the LLLT and MET for the treatment of frozen shoulders in diabetic patients. The results of the study have presented assuring data for opting the most efficient method of frozen shoulder treatment.

METHODS

The present study was designed as a comparative analysis which was conducted at Department of Orthopaedic, Indus Medical College, Tando Muhammad Khan from 1st January 2023 to 30th June 2023. A total number of 120 patients who were having diabetes mellitus (type 1 and type 2) and suffering from frozen shoulders were enrolled in this study. Patients with declined active-glenohumeral ROM at least of ≥20 degree for last 3 months in least 3 movements, as flexion less than 144°, abduction less than 120° and external rotation as less than 72°.Thoses patients which were suffering from bilateral/unilateral shoulder-symptoms were also included in the study. A written informed consent was taken from each enrolled patient while the study was priorly approved by ethical committee through institutional review board (IRB No. Ltr/IMCH2022/0000196). Both gender patients within the age group of 18-65 years and having clinical symptoms of diabetes as well as frozen shoulder was included in this study. Those patients who were already diagnosed with neuropathy, stroke, Parkinson's disease, brachial plexus injury, injury to cervical-spine with/without radiculopathy as well as those having injury/surgery of their shoulder, malignancy, tumor, shoulder arthritis were excluded from the research. The samples size was generated from available sample size calculation with open EPI using prevalence of frozen shoulder in diabetic patients as 13.4% and using 95% CI, 80% power of test and 5% margin of error [13]. The patients were divided into three groups. Each group had 40 patients in it. Group I was treated for frozen shoulder through LLLT and Conventional Therapeutic Exercise (CET) while Group II were treated with MET and CET. Group III were controls to mitigate the risk of placebo and only received CET. Each treatment plan was conducted as double-blind strategy where each group patient was given a specific treatment for 8 months (LLLT or MET) while group III was given only CET treatment. The CET included exercises like pendulum, arm overhead, finger wall ladder, twisting arm outwards, overhead pulley, cross-body reach exercises, hand behind-back exercise and outward rotation exercise. LLLT was performed through 3B laser therapy unit having 810m wavelength, output power as 60 Mw and the spot size as 0.5 cm2. Painful shoulder regions were irradiated through5.4 j/cm2 power density 50% duty cycle of 50%. The laser was performed for 30 seconds per region. To reduce the skin and probe reflection the region under treatment was cleaned by methylated spirit. MET was administered in cases where restriction in shoulder flexion, as well as abduction, external rotation was observed. The details of treatment have been previously described in literature [21]. The outcomes of the research were measured in terms of primary and secondary outcomes. The primary outcomes were measured in terms of Shoulder Pain and Disability Index (SPADI) and Visual Analog Score (VAS). The SPADI comprised of thirteen items which are further divided into 2 subscales (5: shoulder pain, 8: shoulder disability). Each element scoring is performed on zero (best score) to ten (worst score) rating scale. The higher the score, the greater the pain. The secondary outcome comprised of pain intensity, shoulder ROM, depression, IL-6 and anxiety. The shoulder pain intensity was valued through Numerical Pain Rating Scale (NPRS) having 11-point Likert scale, with zero as representing "no pain" while ten meant "worst imaginable pain". A 3cc blood was withdrawn from each or patient for measuring the IL 6 levels in the patients. The plasma was stored for the purpose in -80 degree freezer until analysis was performed. A well-structured

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questionnaire was used for compiling all the extracted data. The outcomes were compared and measured through SPSS version 26.0. T test and two-way ANOVA was used for interpreting of data. P value < 0.05 was considered as significant.

RESULTS

There were 59% females and 41% males in the present research with majority being within the age group of 45-65 years. This was followed by the age group 36-45 years. The mean age of the group I, II and III was 47.8 ± 2.5, 47.7 ± 2.7 and 49.5 ± 3.1 years respectively (Figure 1).

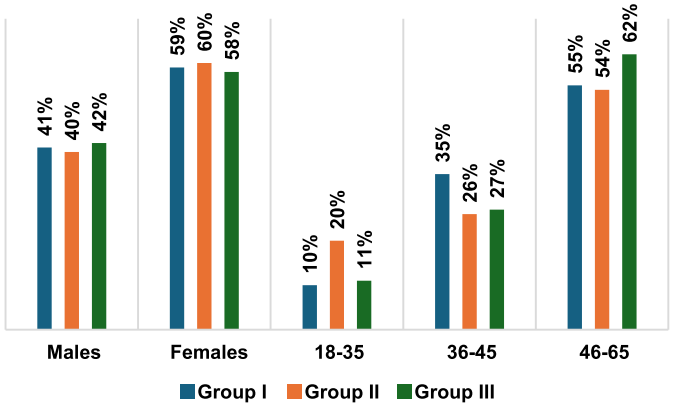

Figure 1: Comparison of Demographic Characteristic within Groups

The patients' pain was scored through VAS pain scoring and compared within the initial, 8 weeks' time and post treatment as an outcome among various groups. It was observed that there was a significant variance between pain scores at pretreatment and post treatment stages with highest value decrease observed in MET group II (Table 1).

Table 1: Comparison of VAS Score Pre and Post Treatment within Groups

VAS Score	Group I (Mean ± SD)	Group II (Mean ± SD)	Group III (Mean ± SD)	P-Value
VAS Pre-Treatment	8.83 ± 1.63	9.11 ± 0.97	10.23 ± 1.5	<0.005
VAS Post Treatment	3.39 ± 0.89	2.59 ± 0.67	6.55 ± 0.99	<0.005

The Shoulder Pain and Disability Index (SPADI) was compared within groups and it was observed that there was a significant decrease in SPADI in LLLT (group I) followed by MET (Group II). However, there was a least decrease between pre and post treatment disability value in control group (Table 2).

Table 2: Comparison of Shoulder Pain and Disability Index (SPADI) within Groups

SPADI	Group I (Mean ± SD)	Group II (Mean ± SD)	Group III (Mean ± SD)	P-Value
Pre-Treatment	85.81 ± 10.56	84.65 ± 2.2	86.71 ± 10.11	<0.005
Post-Treatment	28.81 ± 10.25	28.32 ± 15.9	67.32 ± 10.05	<0.005

The numerical pain rating score presented the highest significant decrease in pain rating scale in group I followed by Group II and least decrease from pre to post treatment in Group III (Figure 2).

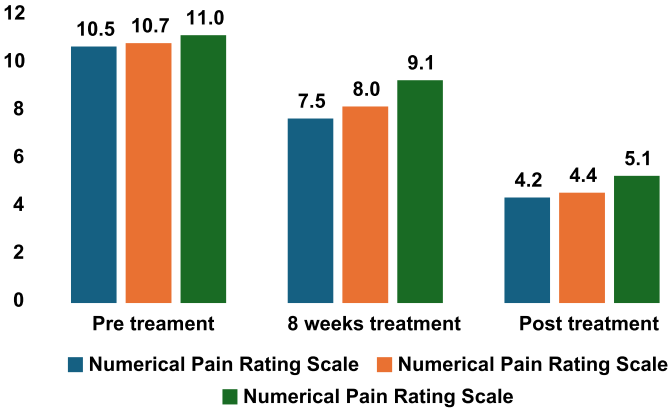

Figure 2: Comparison of Numerical Pain rating scale within groups

The blood plasma value of interleukin 6 showed the highest significant decrease in group II followed by group I with minimal variance among groups. The inflammatory marker presented the substantial decrease in inflammation in cases where LLLT or MET treatment was accompanied with conventional treatment methods (Table 3).

Table 3: Interleukin 6 Values Alteration from Pre to Post Treatment among Groups (n=120)

Variables	Interleukin- 6 Value in pg/mL		
	Group I (Mean ± SD)	Group II (Mean ± SD)	Group III (Mean ± SD)
Pretreatment	11.54 ± 1.12	11.55 ± 1.13	11.89 ± 1.9
8 Weeks Treatment	11.26 ± 0.77	11.25 ± 0.65	11.65 ± 0.95
Post Treatment	11.02 ± 0.67	11.01 ± 0.66	11.32 ± 0.81

P<0.05

The normal Range of Motion (ROM) of the shoulder is considered as an active movement within 180° flexion and abduction and 90° for external rotation according to the American Academy of Orthopedic Surgeons (AAOS). However in frozen shoulder the mean ROM was found as 3.43 ± 0.33º. Post treatment with LLLT and MET lead into a significant improvement as 115.8 ± 1.1º and 116.1 ± 0.7º in group I and group II respectively. The ROM was least improved in control group only treated through conventional protocol (Table 4).

Table 4: Comparison of Range of Motion (ROM) Pre and Post Treatment among Three Groups

Variables	Mean ± ROM Angle		
	Group I	Group II	Group III
Pretreatment	3.2 ± 0.4°	4.1 ± 0.3°	3.1 ± 0.4°
8 Weeks Treatment	61.5 ± 0.5°	61.2 ± 0.6°	60.4 ± 0.8°
Post Treatment	115.8 ± 1.1°	116.1 ± 0.7°	110.1 ± 0.2°

P<0.05

DISCUSSION

The comparative effectiveness of low-level laser therapy versus muscle energy technique in treating frozen

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shoulder, particularly among diabetic patients, is a pertinent topic in physiotherapy and rehabilitation. Adhesive capsulitis or frozen shoulder is a common condition characterized by pain and restricted shoulder movement. Diabetic patients are at an additional higher risk of developing frozen shoulder, making effective treatment strategies essential [21]. There were 59% females and 41% males in the present research with majority being within the age group of 45-65 years. This was followed by the age group 36-45 years. The mean age of the group I, II and III was 47.8 ± 2.5, 47.7 ± 2.7 and 49.5 ± 3.1 years respectively. In a previous study conducted by Venturin D *et al*, majority 57% were females and mean age of the presented cases was 46.9 years. These findings were in line with our studies.[13] Another study presented comparable results to our findings in which average age of the cases was 48.17 years.[19] The LLLT and MET can significantly reduce pain and improve function in patients with musculoskeletal conditions, including frozen shoulder [22, 23]. Present study was particularly designed for the comparison of LLLT and MET in context to frozen shoulder among diabetic patients. In the present study, both groups display significant changes in terms of pain reduction and angular movements. For better authentication of the results and efficacy analysis three various pain analyzing scores were applied in the present research. Previous study conducted by Hassan Hl *et al*, also supports the application of combination of pain scores for better comparatives results interpretation [8]. The patients' VAS pain scoring were compared within the initial, 8 weeks' time and post treatment as an outcome among various groups. It was observed among both study groups that there was a significant variance between pain scores at pretreatment and post treatment stages. Similarly, the Shoulder Pain and Disability Index (SPADI) was also significantly decrease in both study groups. In the present study result it was observed that both of the techniques are highly efficient with a slight higher efficacy of MET on LLLT. Although the MET superiority is not significantly recognizable. The present study results were in coordination with previously reported literature which has also reported similar findings and observed that pain scoring conducted through various pain scoring methods has efficient results in MET and LLLT group [8, 22, 24]. Alongside, the numerical pain rating score presented the highest significant decrease in pain rating scale in study participants and least decrease from pre to post treatment in control group. The inflammatory marker presented the substantial decrease in inflammation in cases where LLLT or MET treatment was accompanied with conventional treatment methods [20]. The normal range of motion was least improved in control group only treated through conventional protocol whereas it was significantly improved in other two groups of the study. Despite many physiotherapy interventions for frozen shoulder is available, there is still scarcity of data regarding superiority of one therapeutic intervention [25]. In current study the blood plasma value of interleukin 6 showed the highest significant decrease in group II followed by group I with minimal variance among groups. The inflammatory marker presented the substantial decrease in inflammation in cases where LLLT or MET treatment was accompanied with conventional treatment methods. Recent study conducted by Khalil R *et al* [20] presented same results in which, there was no difference between the groups when it came to the plasma levels of interleukin 6, however MET and CET had the greatest meaningful drop. In instances when LLLT or MET therapy was administered with traditional treatment approaches, the inflammatory marker demonstrated a significant reduction in inflammation. In frozen shoulder the mean ROM was found as 3.43 ± 0.33º. Post treatment with LLLT and MET lead into a significant improvement as 115.8 ± 1.1º and 116.1 ± 0.7º in group I and group II respectively. The ROM was least improved in control group only treated through conventional protocol. The results demonstrate that early range-of-motion exercises significantly enhance rehabilitation outcomes following surgical repair, including accelerated healing, reduced stiffness, and prevention of re-tears, in line with a previous research by Kjaer BH *et al.* [26]. Furthermore, neither tendon repair nor clinical results are improved by immobilization. Result of present study proved that both treatment showed substantial reduction in pain. The muscle energy technique is slightly more effective than low-level laser therapy as the former had slight improved reduction in pain observed than LLLT. Although the difference is not significant.

CONCLUSIONS

The low-level laser therapy as well as muscle energy technique among diabetic patients with frozen shoulder are highly effective techniques with both having a significant efficacy in treating the frozen shoulders of diabetic patients. The MET is slightly more effective than LLLT technique in terms of pain, inflammation reduction and angular movements as most of the pain test result presented slight more decrease in MET than LLLT. Although the difference is not significant.

Authors Contribution

Conceptualization: ASQ

Methodology: MZT, MAA, ZUA

Formal analysis: ASQ

Writing, review and editing: TH

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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