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Original Article

THE USAGE PATTERN OF PHONOPHORESIS IN THE MANAGEMENT OF MUSCULOSKELETAL PAIN BY PHYSIOTHERAPISTS IN TRIPOLI, LIBYA

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ABSTRACT

Phonophoresis is an acoustic therapy that delivers topical medication to the tissue via the skin's layers. Despite the widespread use of phonophoresis in Tripoli's Hospitals, scientific data supporting the practice is insufficient, particularly for skeletal muscle disorder. This exploratory study aimed to determine the usage pattern of phonophoresis by Libyan physiotherapists and their perceptions of its clinical significance in managing common musculoskeletal pain. A cross sectional survey conducted on 121 physiotherapists during the period November and December 2020. Data was collected using a questionnaire in three categories: demographics, phonophoresis application patterns and pain characteristics. The data was then analyzed using SPSS. According to the survey results all physiotherapists participating were using phonophoresis for managing common musculoskeletal disorders. The phonophoresis usage patterns in clinical practice among participants were thermal TUS with an intensity of >0.8 W/cm^2, a frequency of 3 Megahertz (MHz) and voltaren gel as the most preferred topical medication. The duration of applying phonophoresis was 5 minutes for 8-10 therapeutic sessions to control the pain. Low back pain was a common cause of pain, characterized by constant moderate spasms. Additionally, the physiotherapist agreed that phonophoresis has a beneficial impact over the medium term on the treatment line, and a very good influence on treatment outcomes. In conclusion, this study surveyed the opinions and experiences of various Libyan physiotherapists in the usage patterns of phonophoresis to manage common musculoskeletal disorders. The findings revealed an apparent pattern of medicine administration along with pain severity, causes and types. Further researches is advised to upgrade these clinical findings.

KEY WORDS; Phonophoresis, Therapeutic Ultrasound , Physiotherapists, Musculoskeletal pain, Topical medications.

INTRODUCTION

Therapeutic ultrasound (TUS) is used for the treatment of musculoskeletal disorders; Phonophoresis (PP) is a non-invasive procedure that is used in the treatment of inflammation in a muscle or other soft tissue. It involves the use of ultrasound combined with a drug (1). Medications commonly used in PP include hydrocortisone gel, dexamethasone gel, and lidocaine gel,

ultrasound wave frequencies deliver the medication through the skin into the tissue beneath it. This technique shows an efficient method of applying medication through the ultrasound waves rather than taking it orally or in parenteral form (2).

Musculoskeletal pain is a broad term that refers to any pain affecting the bones, muscles, tendons, ligaments and nerves. The pain can be acute, coming on suddenly with severe symptoms, or chronic, and it can be localized in one area of the body, or widespread. It can be caused by overuse (3).

It is been overviewed that PP as the therapeutic effect from overlapping medication through ultrasound waves depends on rate, amount, drug penetration through the depth of the skin (4). Despite the previous surveys which investigated the usage patterns of TUS in physical therapy practice among physiotherapists in several countries Brazil(5), Canada(6) and India (7), where it discuss the frequency and pattern of ultrasound usage among physiotherapists (6,7).

Finding out the theoretical fundamentals and utilization criteria of TUS among PTs (5). There is a limitation to knowledge regarding the adopted criteria of PP application, the effectiveness of the technique on treatment protocol specifically in musculoskeletal pain. Especially in Libya that has a limited source of information regarding therapists knowledge and experiences.

AIM OF STUDY

The purpose of this study was to determine usage pattern of PP by Libyan physiotherapists and their perceptions of its clinical significance in managing common musculoskeletal pain.

METHODS

This exploratory study based on a cross-sectional survey, includes a questionnaire formulated into three parts. The study was carried out during the period; November to December of 2020, on sample consist of 121 physiotherapists, those who work in ten public hospitals and private clinics located in different areas within the city of Tripoli.

The questionnaire was prepared after critical literature review. To test the content validity, the questionnaire was piloted among 26 clinical and academic colleagues who were invited to fill out the survey and provide feedback on the questionnaire by passing the electronic link in the "Libyan Physiotherapists Specialist's Associations" site. Their feedback were taken into consideration.

Before starting to distribute the questionnaire to the participants and collect the required data, research team obtained the approval of the physiotherapy departments of the concerned hospitals. Participation was voluntary, and physiotherapists agreed to take part in the study. The questionnaire directly distributed to physiotherapists in hospitals that are in relation to the study.

The questionnaire organized and arranged its questions within three parts; demographic data, application patterns of PP and characteristics of pain. The first part of questionnaire aims to describe the PTS participating in the survey in terms of gender, qualification, work place and years of experience. The second part of the questionnaire high light the usage pattern of PP in clinical settings that the

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participants usually used in managements of the muscle skeleton pain in term of type, intensity, frequency of TUS, time, number of session , and topical medication that they used in therapeutic session. Finally, the third part aims to identify the characteristics of muscle skeleton pain from the therapist's point of view in terms of causes, frequency, type and severity of pain. In addition the current study was interested to determine the participants' opinion on the impact of using PP in treatment out come and the effectiveness of PP on treatment time line. For avoiding ambiguity in patients' answers, the questionnaire identified and directed the answers in terms that were easily understood by all respondents.

After collecting questionnaires and coordinate participant's answers the data were tabulated and entered for the programming of the statistical package for social science (SPSS version 26) for analysis, where all variables presented as descriptive statistics using frequencies and mean percentages. The correlation frequency used to test the relationship between pain severity and effectiveness of PP on treatment time line and drugs type used related to the effect of PP. The results are considered as statistically significant if p value excessed 0.05.

RESULTS

This study involved ten different public hospitals and private clinics in Tripoli. A survey was administered to a sample of 121 physiotherapists, who were fairly evenly distributed across workplace settings: 38% were employed in private clinics, 40.5% in public hospitals, and 21.5% worked in both private and public institutions. According to the data presented in table 1, the percentage of female participants in study were 59% while males were 41%. The therapists answers indicated that 28.1% of them had 1-3 years of work experience, 25.9% had 7-9 years and 28.9% had more than 9 years of experience in physiotherapy department. Furthermore, it was found that 53.7% of participants were holding BSc degree and 37.2% have Diploma qualification. While less than 9% were a MSc degree holders and only one participant has PHD qualification.

Table 1; Demographic data of participants

		No.	%
Sex	Female	71	58.7
	Male	50	41.3
Qualification	BSc	65	53.7
	Diploma	45	37.2
	MSc	10	8.3
	PHD	1	.8
Work place	Both of them	26	21.5
	Private	46	38.0
	Public	49	40.5
Years of experience	1-3 years	34	28.1
	4-6 years	15	12.4
	7-9 years	31	25.6
	Above 9 years	35	28.9
	< 1 year	6	5.0

Table 2, displays the data about the TUS parameters that were used in clinical practice as following; (55.4%) of therapists reported using "Thermal" US while (44.6%) using non-thermal type. Also (51.2%) of participants chose US intensity ">0.8W/cm^2", but (30.6%) used TUS intensity "0.8 W/cm^2" and the small percentage (18.2%) used TUS intensity "<0.8 W/cm^2". Furthermore TUS

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frequency "3 MHz" was mainly used, although 1.5 MHz is still applied by 24% of participants . For duration of applying TUS, (59.5%) of therapists said the time "5 minutes ", 35.3% chose “10 minutes”. About the number of sessions that the patient needs to control the pain (28.1 %) answered the use of PP must be continued for 5-8 sessions, while (33.9 %) reported 8-10 sessions take place and only (19.0%) chose 10-12 sessions.

Tablet (2); Ultrasound using patterns in clinical practice

TUS Parameters		No.	%
Frequency TUS	1 MHz	22	18.2
	1.5 MHz	29	24.0
	2 MHz	9	7.4
	2.5 MHz	12	9.9
	3 MH	49	40.5
Type TUS	Non-thermal	54	44.6
	Thermal	67	55.4
Intensity of TUS	<0.8 W/cm^2	22	18.2
	>0.8 W/cm^2	62	51.2
	0.8 W/cm^2	37	30.6
Session time	10 min	43	35.5
	5min	72	59.5
	3 min	6	5.0
Number of Sessions	1-3	3	2.5
	3-5	10	8.3
	5-8	34	28.1
	8-10	41	33.9
	10-12	23	19.0
	Above 12	10	8.3

According to data in table 3, the responding therapists` shows their answer's about the question, "what type of dugs do you use with TUS? Most of therapists` used "Voltaren gel "(37.2%), while "Lidocaine gel "(18.2%), "Hydrocortisone gel” (14.0%), Ketoprofen gel (13.2 %), followed by Dexamethasone gel (9.9 %) and lowest percentage used "Ibuprofen gel"(7.4 %).

Table 3, Type of TM used by participants in PP

Druge	Precipitant %
Voltaren gel	37.2
Lidocaine gel	18.2
Hydrocortisone gel	14.0
Ketoprofen gel,	13.2
Dexamethasone gel	9.9
Ibuprofen gel	7.4

The survey also contained questions about characteristics of MSP from therapists point of view in term of pain, type of pain, pain frequency and pain severity. Table 4, shows PP is widely used for managing low back pain (34.7%), knee osteoarthritis (19.0%) and frozen shoulder (14.0%). Although PP still applied for burning pain (12.4%) and ache pain (13.2%) most of the responders have used PP on pain related to spasm (54.5%). The (66%) and (23.1%) of respondents stated that moderate pain and sever pain (respectively) were treated probably using PP. Finally, 52.9% of participants reported the pain frequency where constant pain while 41.3% intermittent pain.

Furthermore this study was interested in knowing the opinion of the participants about the effect of using PP on MSP and the effectiveness of PP on treatment time line.

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Table 4; Response to the characteristic of pain

Characteristic of pain		No.	%
Causes of pain	Low Back Pain	43	35.5
	Carpal tunnel syndrome	11	9.1
	Cervical Spondylosis	15	12.4
	Knee Osteoarthritis	23	19.0
	Tendonitis	7	5.8
	Frozen Shoulder	16	13.2
	Tennis elbow	6	5.0
	Bursitis	0	0.0
Pain frequency	Constant	64	52.9
	Intermittent	50	41.3
	Both of them	7	5.8
Pain type	Burning	15	12.4
	Sharp	13	10.7
	Spasm	66	54.5
	Cramping	11	9.1
	Ache	16	13.2
Pain severity	Mild	13	10.8
	Moderate	80	66.1
	Severe	28	23.1

Whereas (49.6%) reported that PP has "very good" effects on pain treatment, while (36.4%) reported PP had "excellent" effects. Furthermore (74.4%) of participants confirmed the PP medium effects on treatment time line, as seen in table 5.

In addition, the relationship between pain severity and effectiveness of PP were analyzed. Table 6 presented a diverse range of answers to the question (what is the effectiveness of technique on treatment time line?). The majority of therapists (68%) had the same opinion on midterm effect of PP on moderate pain; while (12%) on sever pain. However, (14%) thought PP has long term effect on sever pain

Table 5: Physiotherapists opinions about PP.

Options		No.	%
What is the effect of PP on treatment outcomes?	excellent	44	36.4
	Good	17	14.0
	Slight	0	0.0
what is the effectiveness of PP on treatment time line?	Short term	9	7.4
	Medium term	90	74.4
	Long term	22	18.2

Table 6; Correlation between pain severity and effectiveness of PP on treatment time line

Pain severity	Long term %	Medium Term %	Short term %
Mild	3	10	0
Moderate	5	68	7
sever	14	12	2
Total	22	90	9

When data related to the correlation of drug type and PP treatment effect on pain were analyzed, a good relation was considered (rs=0.0151, P value). The data in figure 1 indicated that, 18% of respondents reported an excellent effect of voltaren drug, (17%) of respondents believes that Lidocaine 5% had a very good effect, where (10%) thought the same for Hydrocortisone. Similarly, almost (9%) ketoprofen gel and (6%) for Ibuprofen drug.

DISCUSSION:

This study aimed to determine usage patterns of PP by Libyan physiotherapists and their perception of its clinical significance in managing common musculoskeletal pain.

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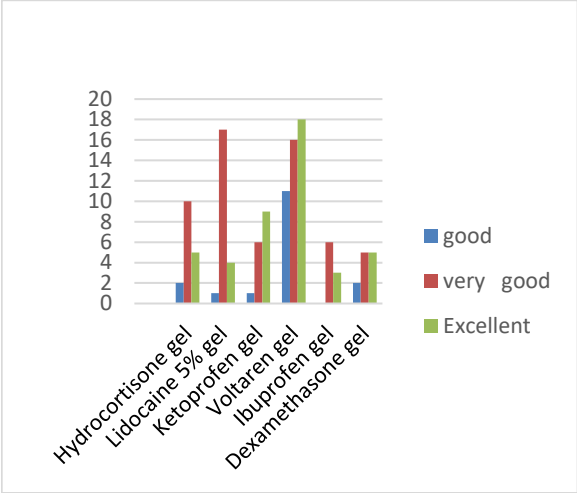

Figure 1; Correlations between effects of PP on pain and TM type

Participants in this study were physiotherapists, who had worked in both public and private institutions within Tripoli city, for more than seven years in the field of orthopedic physical therapy. The data refers to wide use of PP in this sample of physiotherapists. Although PP is frequently used in clinics practice as part of the treatment protocol for musculoskeletal disorders, there are no evidence or guidelines on the appropriate criteria used nowadays. It is worth mentioning that the PP action is overlapping of two components: therapeutic ultrasound and topical medication. From this perspective, we will compare the results of studies that focused on determining the appropriate criteria for using the ultrasound device in the treatment of musculoskeletal disorders, as well as the results of studies that focused on determining the best drugs to use with the PP, with the results of the current study.

In addition to studies that focused on the appropriate criteria for treating musculoskeletal disorders by PP. Results of this exploratory survey highlighted interesting usage patterns of ultrasound. The majority of therapists used "Thermal" US, with intensity ">0.8 W/cm2", frequency "3MHZ" and voltaren gel as a conductive medium. The duration of applied PP "5minutes", for "8-10" therapeutic sessions. This clinical finding is widely used to manage constant, moderate, and spasm pain. Wu et al. conducted an overview of ultrasound usage trends in orthopedic and sports physiotherapy (8). The respondents reported use of TUS in both continuous and pulsate modes. The continuous mode favors thermal effects, while non-thermal effects dominate in pulsate modes. According to the responding therapists, Pulsate TUS was found to be more effective for treating soft tissue inflammation and musculoskeletal and articular acute pain. While continuous mode treats musculoskeletal and articular chronic pain.

The intensity between (0.6-1.0 W/cm^2) and frequency of 1.0 MHz was the most used regardless of the depth of the tissue and injury phase. Period of TUS application ranges between 2-4 minutes. Other studies, preferred non-thermal effects TUS intensities between 0.3-0.5 W/cm^2 for treating soft tissue inflammation [9,10]. While thermal TUS at intensities 0.8 - 1.0 W/cm^2 was recommended for treating chronic

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injury symptoms and to relieve pain. (11,12).

PP is considered to enhance healing, speed up functional recovery and reduce pain by delivering different drugs directly to inflamed subcutaneous tissues (13). The heat effects of the ultrasound waves dilate sites of entrance, enhance circulation, increase capillary permeability, and disrupt the structured lipids in the stratum corneum. While Ultrasound waves non-thermal impacts will affect the permeability of both ionized and unionized molecules, as well as increases cell membrane permeability. These effects are most likely due to cavitation induced by ultrasonic waves, which generates mechanical stress, temperature rise, and increased chemical reactivity, all of which may impact topical medication distribution (14). On the other hand, Nussbaum (15) suggested that the size of cavitation is determined by ultrasonic properties and bubble generation is limited by low-intensity, high-frequency, and pulsed ultrasound.

Regarding to medication used in phontophoresis. Participants in this study reported using voltaren gel with PP to manage pain. Voltaren is non-steroidal anti-inflammatory drugs that relief the symptoms of pain and inflammation. PP increase the ability of the voltaren gel to penetrate more deeply into inflamed areas.Thus, the drug efficacy accelerated, and produce more localized effects (16). This may have an additional effect on the treatment protocol, more over it avoids the systemic side effects of medication administrated orally especially in elderly patients. The results agree with a systematic review carried out by Fu-An Yang et al (17) to investigate the effect of PP when various gel types were used. They found significant differences in WOMAC function scores when PP was used with corticosteroid gel and significant differences in pain scores when PP was used with NSAID gel.

According to the participants' opinions on the efficacy of PP on treatment MSP and the efficacy of PP on treatment timeline. Half of the respond said the PP had very good results, and 36.4% said PP had excellent effects for managing MSP. The current study included a number of MS disorder, such as low back pain, carpal tunnel syndrome, cervical spondylosis, knee osteoarthritis, tendinitis, frozen shoulder, tennis elbow, and bursitis. The data revealed that the therapists employed PP for all types of MSP except bursitis; nonetheless, back pain received the greatest proportion, followed by knee osteoarthritis. Based on the evidence, the characteristics of MKP is spasm in type, moderate in severity and constant in frequency. The criteria for identifying the pain severity was based on VAS scores (1-3 mild, 4-7 moderate and 7-10) sever. The efficacy of PP with a topical medium in treating MSP has been demonstrated previously. It has been reported that PP may improve outcomes in the treatment of MSP (14,18,19) and it is best considered as adjuncts to exercise (20). Kim and Kaminski (14), in their systemic review conducted on assessing the effectiveness of PP on Chronic Injuries.

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The studies reviewed were using ultrasound intensity ranged between 0.75-1.5W/cm^2, frequencies 1-3 MHz, duration of sessions 5-8 minutes for three times a week and the improvement in pain and function scores were reported. Besides different types of drug used such as NSAID and cortisone. However, the authors did not confirmed whether the using of ultrasound and phonophersis where superior than others or which sitting parameters is more effected on managing chronic injury.

Furthermore the current study, compared the association between the variables "pain severity" and "treatment time line," as well as the variables "the effects of topical medication type" and "the effect of PP on treatment MSP." The findings revealed a significant correlation, and the PP produced extremely good effects in pain control over the medium term. Moreover, Voltaren had very good results in treating MSP, followed by lidocaine 5%.

Our data demonstrated satisfactory knowledge of using PP for managing musculoskeletal pain by Libyan physiotherapists. However, this study has some limitations regarding lack of knowledge on the effects of using different ultrasound parameters. Moreover, it wasn't taken into consideration evaluating the relation of the cause and type of musculoskeletal pain along with treatment time line. More research is needed to determine the parameters (duty cycle, intensity, and frequency) that are more effective in medication transport, and more specific for musculoskeletal diseases.

CONCLUSION

In conclusion , this study surveyed the opinions and experiences of Libyan physiotherapists in the usage patterns of PP to manage common musculoskeletal disorders. The findings revealed an apparent pattern of medicine administration along with pain severity, causes and types. further researches is advised to upgrade these clinical findings.

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