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Effect of Reflexology on Pain and Disability in Patients with Diabetic Adhesive Capsulitis

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ABSTRACT

Background: Worldwide attention for diabetic adhesive capsulitis is due to its growing negative impact either economic or reported physical dysfunction. Potential evidence regarding reflexology as an alternative therapy, and well-known manipulation with movement for their therapeutic benefits on diabetic adhesive capsulitis.

Purpose: To distinguish effect of reflexology on disability and pain in diabetic adhesive capsulitis patients.

Patients and Method: Fifty diabetic participants with adhesive capsulitis from Out-patient Clinic of Physical Therapy in Al-Kasr Al-Ainy Hospital, Cairo, Egypt, with age ranged 45-60 years old; were randomly divided into equal two groups; **Group A** received foot reflexology, and mobilization with movement, three session/week for four weeks; and **Group B** received mobilization with movement, only three session/week for four weeks. Baseline evaluation involving shoulder mobility using smartphone inclinometer and shoulder pain and disability using shoulder pain and disability index, as well as shoulder muscular strength using hand-held dynamometer.

Result: No significant difference was revealed at baseline analysis. Both groups had revealed a significant raise in shoulder mobility posttreatment with favor for group A, also a significant decrease in shoulder pain and disability post treatment was found with no superiority for any group. While there were significant differences in shoulder rotators strength of group A post treatment.

Conclusion: Foot reflexology and mobilization with movement are effective with favor for foot reflexology in terms of shoulder mobility and muscular strength. Therefore, foot reflexology could be recommended in diabetic adhesive capsulitis management.

Keywords: Diabetic adhesive capsulitis, Foot reflexology, Handheld dynamometer, Smartphone inclinometer application.

INTRODUCTION

Moderate evidence suggested that poorly understood painful diabetic adhesive capsulitis with 10-36% incidence, is defined as a disability leading issue with remarkable socioeconomic impacts that consumed huge healthcare costs [(1,2)].

Current estimated prevalence of diabetic adhesive capsulitis of 10.3% in type I diabetes mellitus (DM), and 22.4% in type II DM, which have worse functional outcomes compared to their nondiabetic counterparts, particular among poorly controlled glycemic status along an extended duration [(3)].

Often adhesive capsulitis (AC) has a pathophysiological process with well-defined four distinctive stages 'inflammatory, freezing, frozen, and thawing'; as well AC is classified into primary idiopathic sort that occur spontaneously without any particular inciting event, or secondary adhesive capsulitis that may represented with severe manifestations [(4)]. Recent identified evidence estimated that 70% of AC sufferers were females, despite males did not respond well in the same manner as women [(5)]. Almost diabetic populations have a repeated complains recognized clinically as D-AC, which overload those who were exhausted with multiple co-morbidities [(6)].

The exact etiology for AC remains unknown, unless AC dense intraarticular adhesions, capsular thickness addressed for progressive mobility restrictions may triggered by growth factors release [(7)].

Current guidelines stated that early AC mobilization beyond painful limits is advised, unless therapeutic program parameters remain controversial [(8)]. Numerous complementary therapeutic modalities have been addressed i.e., acupuncture, dry needling, and reflexology since earlier centuries. Reflexology involves gentle manipulation or application of pressure to specific points on the feet and hands, that addressed to relieve the body from any stress in daily living activities [(9)].

As well, mobilization with movement reveals multiple therapeutic benefits could be explained the analysis and correction of any minor positional fault. Also, mobilization with movement realign joints positional faults by applying a manually specific oriented glide while adjusting force intensity, and also restoration of the interstitial fluid to near normal levels, while patient actively performs joint movement, so immediately relieved and the makeovers improve pain and movement [(10)].

In addition, multimodal interventions provide a practical view of care have potential benefits such as relieving pain and improving associated disabilities mainly among diabetic adhesive capsulitis sufferers. Furthermore, conservative treatments including oral medications, corticosteroid injections, electrotherapy modalities, and also various manual approaches

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combinations were recommended [11]. Yet, great attention for reducing associated complications of diabetic adhesive capsulitis, plus gaining better prognosis [12].

Therefore, current study aim was to investigate effect of reflexology to improve disability and pain on diabetic adhesive capsulitis that in line to minimize healthcare overload, and also to provide clinicians with valuable conclusion, which assists them in clinical decision making.

PATIENTS AND METHODS

A Pre/ Post treatment, random clinical trial conducted at Physical Therapy Faculty, Cairo University, Egypt. G*POWER statistical software ensured the study sample size with assistant of paper of **Balci *et al.*** [13], via t-test, with assumption of a two-sided 5% type I error, and 80% power, plus 0.458 effect size. Thus, the required sample size was 25 diabetic patients with adhesive capsulitis in each group.

Group A: received reflexology and mobilization with movement therapy; 3 sessions/week for 4 consecutive weeks.

Group B: received mobilization with movement therapy, only; 3 sessions/week for 4 consecutive weeks.

Participants: Fifty overweight participants suffering from adhesive capsulitis, were randomly allocated into equal two groups (twenty-five participants each), with age range 45-60 years old. They were randomly recruited from Out-patient Clinic of Physical Therapy in Al-Kasr Al-Ainy Hospital, Cairo, Egypt, from January to June 2023. Groups were randomized by a computer-generated randomized table using SPSS program "SPSS Inc., Chicago, Illinois, USA".

Inclusion Criteria: Participants` age ranged 45-60 years old, of both genders. Each participant had 5-10 years diagnosed as type II-DM, with 3-9 months earlier adhesive capsulitis, and has held a written referral.

Exclusion Criteria: All participants with signs of acute infection, inflammation, serious diseases i.e., tumors, thrombosis, perforated ulcers, enlarged axillary lymph nodes, aneurysm or cardiac disorders, also who underwent shoulder surgeries, or had other associated disorders such as mastectomy, or with serious orthopedic diseases, pre-existing neuromuscular diseases i.e., myasthenia gravis, as well as those who had open fractures, or fractures associated with nerve or vascular compromise were excluded.

Instruments Assessment Instrument:

Smartphone inclinometer application: developed by plain code application and used for objective shoulder mobility evaluation. Valid and reliable follow-up for determining effectiveness of therapeutic interventions [14].

Shoulder pain and disability index (SPADI): a 13 self-report questionnaire, widely utilized for pain severity and daily activities` difficulties requiring usage of upper extremities evaluation tool. SPADI was concluded as a valid and reliable self-reported questionnaire, with total score expressed as a percentage [15].

Handheld dynamometer (HHD): 01165 model, Lafayette Company, Indiana, USA. Objective strength assessment for shoulder rotators. It is a reliable apparatus with a light weight, and easy portable features [16].

Evaluating Procedures:

Initially: medical and physical details were recorded at the baseline of current study then recorded.

Shoulder mobility measurement: it was assessed via smartphone inclinometer application; well-supported in adequate clothes participant with straight erected back, also armband attached to distal part of targeted arm. Smartphone device was positioned with screen facing away for the researcher. Researcher conducted shoulder flexion, abduction and external rotation evaluation, where his assistant recorded measured values [14].

Shoulder pain severity and disability levels measurement: Each patient used SPADI self-report questionnaire before starting the program and after four weeks at the end of the treating program [15].

Shoulder internal and external rotators` strength measurement: Manual muscular testing was conducted for objective obtaining normative strength of external and internal shoulder rotators values through the basic calculation. Each participant was positioned in prone with targeted shoulder 90° abducted, in neutral 'no rotation', with elbow flexed to right angle. The researcher stabilized distal of humerus against stretcher, and HHD was placed prior to styloid process of ulna for external rotators, while placed anteriorly for internal rotators, where his assistant recorded measured values [16].

Therapeutic procedures:

Mobilization with movement therapy (Groups A and B): Adequate counselling for each participant regarding procedures, then relaxed in supine with relaxed shoulders. Researcher placed his left hand and grasped targeted shoulder firmly. Researcher right hand-held humerus and moved his left hand laterally to distract patients` humerus in a glide, spin and distraction in a combined movement that sustained for few seconds. Researcher began with short duration at relatively pain free 'grade 1 and 2 antero-posterior oscillation, then moved to restricted range point, to gain maximal available range; while oscillation for a total 30 seconds per set for 10 minutes for 5-6 set repetitions, with 10 seconds rest between each set. [8,10]

Reflexology therapy (Group A only): Initially, therapeutic program was explained then participant was asked to relax in supine, and each session was ≈10 minutes using reflexology chart to demonstrate area affects pain 'just below the pinky toe, ipsilateral' on patient`s sole to each participant. Then reflexology technique was applied over relevant zone in relevant feet along ten minutes per set, then reassessed [9].

Ethical approval:

The Ethics Committee of Cairo University's Faculty of Physical Therapy granted the study approval No. (P.T.REC/012/004014). All participants signed an informing consent after a thorough explanation of the goals of the study. The Helsinki Declaration was followed throughout the study's conduct.

Statistical Analysis

We used SPSS version 25 for statistical analysis, where descriptive statistics were calculated as mean and standard deviation (SD). Paired T- test was used for comparing pre and post-test values in the same group and independent T- test was used to compare between both groups. The significance level was settled at 0.05.

RESULTS

Participants characteristics No significant differences in terms of age, weight, height, and BMI were found, table (1).

Table (1): Participants` features.

Measured variable	Group A (N=25) Mean ±SD	Group B (N=25) Mean ±SD	t-value	p-value
Age (years)	56.85 ± 3.66	58.3 ± 3.19	-1.33	0.19
Weight (kg)	74.4 ± 12.88	73.9 ± 15.74	0.11	0.91
Height (cm)	168.05 ± 5.46	167.25 ± 6.55	0.41	0.67
BMI (kg/m^2)	26.26 ± 3.98	26.31 ± 5.06	-0.03	0.97

Effect of treatment on shoulder mobility, pain and disability levels and shoulder rotators strength: a remarkable interaction therapeutic gain on timeline (P 0.001). A therapeutic gain on timeline (P 0.001). remarkable therapeutic gains (P 0.006).

Therapeutic gains on Shoulder mobility: table (2).
Comparing within group: A statistical rise was found in shoulder mobility 'flexion, abduction and external rotation' of both groups post treatment compared with baseline evaluation.

Comparing between groups: No remarkable differences were found in shoulder ROM 'flexion, abduction, and external rotation' between both groups baseline evaluation.
Also, obvious differences were found between groups post treatment in 'flexion, abduction and external rotation.

Therapeutic gains on shoulder pain severity and disability levels: table (2).
Comparing within group: A statistical improvement was found in SPADI values of both groups post treatment compared with baseline evaluation.

Comparing between groups: No remarkable difference in SPADI values was found between groups either pre or post treatment.

Therapeutic gains on shoulder` internal, and external rotators strength: table (2).

Comparing within group: A statistical rise was found in both internal and external rotators strength of both groups post treatment compared with baseline evaluation.

Comparing between groups: No remarkable differences in internal and external rotators strength was found between both groups at baseline time. While there were obvious differences between group A compared with group B post treatment.

Table (2): Outcome measures statistical analysis.

Outcome measures		Pretreatment Mean ±SD	Posttreatment Mean ±SD	MD	P-value
Group A	Flexion	72.04 ± 11.59	171.08 ± 70.32	-99.04	0.001
	Abduction	56.2 ± 15.43	111 ± 16.27	-54.8	
	Ext rotation	37.80 ± 4.87	63.80 ± 8.32	-26	
	SPADI	91.44 ± 10.14	18.52 ± 9.61	72.92	
	Int rotators	6.83 ± 0.65	9.09 ± 0.93	-2.26	
	Ext rotators	9.21 ± 0.92	12.67 ± 0.90	-3.46	
Group B	Flexion	69.68 ± 16.48	156.8 ± 7.05	-87.12	
	Abduction	52.60 ± 15.22	92.80 ± 13.77	-40.2	
	Ext rotation	40.48 ± 6.51	49.60 ± 7.05	-9.12	
	SPADI	95.8 ± 11.18	21.44 ± 8.67	77.62	
	Int rotators	6.80 ± 0.66	8.52 ± 0.63	-1.72	
	Ext rotators	9.50 ± 0.86	10.99 ± 0.96	-1.49	
MD	Flexion	2.36	14.28		
	Abduction	3.6	18.2		
	Ext rotation	-2.68	14.2		
	SPADI	-4.36	-2.92		
	Int rotators	0.03	0.57		
	Ext rotators	-0.29	1.68		
P-value	Flexion	0.56	0.001		
	Abduction	0.41			
	Ext rotation	0.11			
	SPADI	0.15			
	Int rotators	0.76			
	Ext rotators	0.41			

DISCUSSION

Current clinical diabetic adhesive capsulitis features incidence is estimated around 2-3% worldwide population, thus there is an actual need to determine an efficient approach for management of AC that maximize rehabilitation response to facilitate adequate life quality [(17)].

Therefore, current study aim was to investigate effect of reflexology to improve pain intensity, and disability in patients with diabetic adhesive capsulitis through physical examination and the most clinically valid and reliable outcome measures.

Our results revealed improved shoulder mobility 'flexion, abduction and external rotation (P 0.001) with favor to reflexology group. In addition, could explain increase in shoulder mobility based on previously stated mobilization with movement therapeutic benefits, which maximized through well-known reflexology analgesic benefits that permits additional gains of mobilization with movement therapy, mainly at restriction points within functional restricted shoulder mobility. As well, reflexology was thought to improve shoulder mobility through noninvasive specific zone stimuli targeting particular organ to normalize across hormonal activities or pathways [(17)].

Present study findings agreed with **Soliman *et al.*** [(18)] who had ensured the distinctive benefits of combining of reflexology as a traditional therapy approach with mobilization with movement to improvement of adhesive capsulitis range of motion, and reduce frozen shoulder severity among those who have no specific pathological etiologies.

Recent clinical trial by **Ramadan *et al.*** [(19)] stated that a significant improvement in shoulder mobility among diabetic patients is mainly due to connective shoulder structures elongation, and capsular fibers realignment that enhance adhesions breaking down. Recent clinical trial by **Sathe *et al.*** [(10)] has reported that restoration on interstitial shoulder joint fluids through frictional resistance could be gained by mobilization with movement or Maitland approaches. As well, **Kouser *et al.*** [(20)] has examined therapeutic benefits of mobilization 'Kaltenborn' around external range among diabetic adhesive capsulitis patients and had revealed it is more efficacious therapeutically.

Current result findings regarding shoulder pain severity and disability revealed a significant decrease in SPADI values at post treatment compared with baseline evaluation (0.001). No obvious difference was revealed between groups.

Could explain current study findings because SPADI values reflect in a feasible mirror for actual difficulties faced across daily activities. Both applied modalities have a good correlation with inflammatory reduction, also pain modulation through changing prostaglandin E2 concentrations, as well removal of

algogenic substances through significant increase in regional microcirculation and improving corresponding abnormal functional status [12,21,22].

Present study findings came in line with **Do Moon *et al.*** [12] who stated that keeping scapula fixed throughout daily functional activities is still one of most important items to permit conducting painless daily function activities.

According to current compelling evidence presented by **Artioli *et al.*** [22] had offered a valuable advice regarding periodic evaluation to monitor functional dysfunction for those with diabetic adhesive capsulitis that came in line with current physiological explanations for our findings focusing on focused on improving glenohumeral periarticular capacity that permits better active shoulder articulations` mobility aiming to gain effective rehabilitation for optimal functional outcomes.

Finally, regarding shoulder rotators strength, our findings revealed significant differences in both internal and external rotators strength between groups baseline evaluation ($p = 0.001$). Clinical explanation of current findings is based on that reflexology provides a painless status that facilitates exerting active muscular exertion, which are manifested through limited functional capabilities. Where the painful nature of adhesive capsulitis is modulated by reflexology, as well mobilization with movement thus facilitates conducting activities of daily living, as well progressive improvement in musculoskeletal strength, as supported by numerous clinical trials [5, 23].

Recent clinical trial conducted by **AbdElhamed *et al.*** [24] has concluded that therapeutic strengthening exercise training among adhesive capsulitis patients permits better improvements of their shoulder musculatures. Traditional rehabilitation protocols for adhesive capsulitis enhance adding strengthening training for multidisciplinary protocol for ensuring stimulation of regional shoulder mechanoreceptors with inhibiting pain proprioception thus which in turn facilitates regaining desired functional activities` capabilities near prior affection status came in line with current study findings [25,26].

In addition, foot reflexology is a safe potentially non-invasive and economic management modality that is widely accepted with remarkable relaxing nature, and mainly works on specific organ function correction through reaching homeostasis status. It also improves micro-circulatory supply with oxygen and nutrients to targeted organ/body region thus, accelerates healing process, and could up on that understand why shoulders` rotators could exerts near normal power that permit easier to regain normal strength [27].

On contrary, recent clinical study by **Alsubheen *et al.*** [28] had stated that multidisciplinary approach for management of diabetic adhesive capsulitis is the main maneuver for regaining optimal shoulder performance.

Limited strength evidence pertained to chronic persistent painful nature of diabetic adhesive capsulitis, hardened building up clear therapeutic guidelines for usage of complementary medicine i.e., foot reflexology as a unique therapeutic modality [29]. The clinical guidelines ensured that no single therapeutic consensus modality could gain optimum management, therefore no doubt, it is a must to conduct combinations of treatment modalities to accelerate optimum diabetic adhesive capsulitis management [30, 31].

CONCLUSION

Foot reflexology provided additional analgesia that allows other therapeutic modalities i.e., active range of motion exercise training to be conducted comfortably, thus facilitates regaining shoulder musculatures` strength and minimizing of functional limitations. Therefore, foot reflexology seemed to be more effective in management of diabetic adhesive capsulitis.

Limitation of this study:

Small population sample restricted to diabetic adhesive capsulitis. Therefore, it is recommended to involve other disorders for extended follow up, thus could determine therapeutic benefits of reflexology on extended follow up period.

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