Original Article

Efficacy of Dynamic VS Closed Kinematic Exercise Combined with Stretching in Adhesive Capsulitis- a double blinded randomized controlled trial.

Rajalaxmi.V[1], S.Vasanthi[2], S.Sathya[3], K.Kirupa[4], S.M.Divya Mary[5], Vani Aravind[6], N.Muthukumaran[7]

Abstract:

Objective*:** To compare the efficacy of Dynamic exercise and Closed kinematic exercise combined with stretching in adhesive capsulitis. ***Background of the study: Adhesive capsulitis is a condition characterized by stiffness and pain in the shoulder joint. It is a painful and disabling disorder of unclear cause in which the shoulder capsule, the connective tissue surrounding the shoulder becomes inflamed and stiff, restricting ROM and causing chronic pain. ***Methodology:*** This was an experimental study design with Pre-Post test. 30 samples were selected from 45 volunteers based on the inclusion criteria. Group A-Dynamic exercise with stretching, Group B-Closed kinematic exercise with stretching, SWD is commonly given to the patients for 1 week. ***Results*:** The result concludes both the groups showed improvement while group A received Dynamic exercise with stretching was comparatively better than the Group B received Closed kinematic exercise with stretching

Keywords: Adhesive capsulitis; Dynamic exercise; closed kinematic exercise; stretching; visual analogue scale; Shoulder pain disability index

Bangladesh Journal of Medical Science Vol. 20 No. 02 April'21. Page : 368-373
DOI: https://doi.org/10.3329/bjms.v20i2.51550

Introduction

Adhesive capsulitis is a self-limiting condition characterized by painful, active and passive range of motions are limited of >25% in at least two actions.[1,2] Naviaser (1983) referred the term as adhesive capsulitis after the open surgery for affected shoulder.[3] The aetiology depends on primary or secondary, Primary if the onset is idiopathic, Secondary from surgical event[4].There are three subcategories of the secondary frozen shoulder include systemic, Extrinsic and Intrinsic factors.[2]

Adhesive capsulitis is more prevalent in women & common in 40 - 65 years old with general population 2 -5 %[5,6] and the diabetic populations 10 - 20 %. [7,8] Individuals having adhesive capsulitis 5 - 34 % on the contra lateral shoulder at some point. Approximately 14 % of cases has bilateral involvement.[2]Therisk factors include trauma, prolonged immobilization, thyroid disease, stroke, myocardial infarcts, and presence of autoimmune disease. [5,7]

The clinical presentation of the adhesive capsulitis patient's report an insidious onset with a progressive increase in pain and gradual decrease in range of motion. [2,9]. Sometimes symptoms may never fully subside in many patients. [10][11]The three clinical phases are the Acute, Adhesive capsulitis / Frozen /

1. Rajalaxmi.V, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University.
2. S.Vasanthi, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University.
3. S.Sathya, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University.
4. K.Kirupa, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University.
5. S.M.Divya Mary, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University.
6. Vani Aravind, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University.
7. N.Muthukumaran, Faculty of health & sports science MAHASA University, Malaysia.

Correspondence to: V. RAJALAXMI**,** Vice Principal, Faculty of Physiotherapy, Dr. M.G.R. Educational & Research Institute University, Velappanchavadi, Chennai - 600 077, Tamil Nadu, India.
Email:rajalaxmi.physio@drmrgdu.ac.in

Stiffening phase, Resolution / Thawing [12]

Adhesive capsulitis can be treated with physical therapy and anti - inflammatory measures[3], these outcomes are not always superior to other interventions.[2]Injury or surgery to the shoulder may cause blood flow damage reducing recovery, reported after breast and lung surgery. [13]

Short wave diathermy (SWD) is a deep tissue electrotherapeutic modality, produce electromagnetic field[14] This modality produces electromagnetic energy that is used to generate heat in body tissue [15,16]. It is used in continuous mode or pulsed mode.[17]Stretching is a form of physical exercise in which a specific muscle group is deliberately stretched to improve muscle elasticity. [18] Stretching is also used therapeutically to alleviate cramps.[19]It is used to variety of clinical conditions, like musculoskeletal, sports medicine, neuro Rehabilitation as well as prosthetic and orthotics. [20] The definition of the CKC exercise is when the distal Segment meets "considerable "external resistance that prohibits free movement. [21,22]

The shoulder pain and disability index (SPADI) is a self-administered questionnaire to measure the pain and disability associated with shoulder pathology[23]The pain VAS is a one-dimensional measure of pain intensity[24,25]. The visual analogue scale is a valid and reliable chronic pain intensity[26,27]. The scale is most commonly anchored by "no pain" (score of 0) and "pain as bad as in could be "or worst imaginable pain". [28,29]

Procedure

This was an experimental study design with Pre- Post-test, was conducted in the outpatient Physiotherapy department of ACS Medical college &hospital &took nearly 3 months to complete the study (Jan 2018-April 2018). 30 samples were selected from 45 volunteers based on the inclusion criteria both genders are included in this study, subjects below 45 years and above 65 years patients, unilateral adhesive capsulitis, VAS pain score is above 4 and below 7, SPADI score is above 3 and below 8 & excludes those with systemic illness and connective tissue disorders, pregnancy, spinal pain or upper limp fracture in the past one year, cervical pain at rest, diabetic patients.

Once the study get approved from IRB (IRB REF NO: IV C- 050/ PHYSIO/ IRB/2017-2018) The samples were divided into two groups by lottery methods where even will be categorized in group A & odd in group B. The sample will be full explained about the study & the questionnaires to be filled. They were then asked to fill the consent form in acceptance to participate in study, which duly signed by the samples &Therapist. Initially demographic details like, age, sex, height, weight, were collected assuring confidentiality of the same.

Flow diagram is the progress through the phase of a parallel randomized trial of two groups that is, enrolment, intervention, allocation, follow –up and data analysis.30,31

Group A (Dynamic exercise with stretching) 15 subjects received Dynamic exercise with Stretching for 30 minutes per day for 5 days in a week, for 8 weeks.Dynamic exercises, kneeling thoracic rotation,Dynamic hug exercise, Squats push ups, Wringing out the towel.

Group B (Closed kinematic exercise with stretching)15 subjects received Wall Push up's, Cat and camel exercise, Single arm hold opposite arm resisted multi angel motions, Single arm Stability, opposite arm reaches in multiple angles.

Common intervention -Anterior shoulder stretch, Posterior shoulder stretch, Supraspinatus stretch. Both groups were given short wave diathermy for 1 week 15 minutes /day. The exercise protocol is given to the patients for 8 weeks, 5 repetitions for first 4 weeks one session /day than progressed to 10 repetitions for next 4 weeks two sessions /day.

Ethical Considerations: The manuscript is approved by the Institutional Review board of faculty of physiotherapy(IRB REF NO: IV C- 050/ PHYSIO/ IRB/2017-2018). All the procedures were performed in accordance with the ethical standards of the responsible ethics committee both (Institutional and national) on human experimentation and the Helsinki Declaration of 1964 (as revised in 2008).

Results

On comparing the Mean values of Group A & Group B on VAS Score, it shows significant decrease in the post test Mean values but (Group A - Dynamic exercise with stretching) shows **(1.43)** which has the Lower Mean value is more effective than (Group B - Closed Kinematic Exercise with stretching) (**3.88)** at $\mathbf{P \leq 0.001}$.

On comparing the Mean values of Group A & Group B on Shoulder Pain and Disability Index(SPADI), it shows significant decrease in the post test Mean

Table-1: **comparison of vas score between Group – A and Group - B**

#VAS	#GROUP - A		#GROUP - B		t - TEST	df	SIGNIFI CANCE
	MEAN	S.D	MEAN	S.D			
PRE TEST	6.02	.786	5.97	.688	.198	28	.845*
POST TEST	1.43	.457	3.88	.470	-14.43	28	.000***

Table – 2: Comparison of shoulder pain and disability index(SPADI) between Group – A and Group - B

#SPADI	#GROUP - A		#GROUP - B		t - TEST	df	SIGNIFI CANCE
	MEAN	S.D	MEAN	S.D			
PRE TEST	75.11	14.80	75.20	16.72	-.017	28	.987*
POST TEST	23.11	7.02	34.58	14.56	-2.74	28	.000***

Table – 3: **Comparison of vas within Group – A & Group – B between pre & post test values**

#VAS	PRE TEST		POST TEST		t - TEST	SIGNIFI CANCE
	MEAN	S.D	MEAN	S.D		
GROUP-A	6.02	.786	1.43	.457	19.93	.000***
GROUP-B	5.97	.688	3.88	.470	11.96	.000***

Table – 4: **Comparison of shoulder pain and disability index (SPADI) within Group – A & Group – B between pre & post test values**

#SPADI	PRE TEST		POST TEST		t - TEST	SIGNI FICANCE
	MEAN	S.D	MEAN	S.D		
GROUP-A	75.11	14.80	23.11	7.02	22.45	.000***
GROUP-B	75.20	16.72	34.58	14.56	13.94	.000***

values but (Group A - Dynamic exercise with stretching) shows **(23.11)** which has the Lower Mean value is more effective than (Group B - Closed Kinematic Exercise with stretching) (34.58) at $P \leq 0.001$.On comparing Pre-test and Post-test within Group A & Group B on VAS & SPADI shows highly significant difference in Mean values at $P \leq 0.001$

Discussion

The purpose of the study was to compare the efficacy of stretching with closed kinematic exercise and dynamic exercise with stretching in the management of subjects with adhesive capsulitis. This is also supported by Prentice, William E. (2003) Group A showed significant changes may be due to the application of dynamic exercise with stretching is improved functional ability. In this study it was found that adhesive capsulitis was reported to be more common in women, especially between the age group of 40 to 60 years. This is in accordance to the study done by Neviaser RJ; Neviaser TJ in which they concluded the condition is more prevalent in women.[3]

Fukadaetal. found a significant decrease in pain scores in the PSWD treatment group compared to a placebo and a control group[32]. Atamaz et al .did not find a significant change in pain scores in the SWD group as compared to a sham SWD group[33]. Further, during incremental dynamic exercise Ap En increased from the start to the end with and without parasympathetic blockade, indicating that non- vagal influents contribute to changes in ApEn. [34,35]

The findings indicate that CKC exercise can improve balance in chronic stroke patients, and this improvement may carry over into an improvement in functional performance[37]This study concluded that CKC exercise appears to be more effective at improving dynamic balance ability than OKC exercise within a six-week training period[38]. The results indicated that a 60-second stretch was more effective in increasing knee extension ROM than a 15- or 30-second stretch within this elderly group. These results differ from those of Bandy and Irion39 who reported that a 30-second stretch was as effective as a 60-second static stretch of the hamstring muscles. More recently, Bandy et al16 reported that there was no difference between stretching once or repeating the stretch 3 times using either a 30- or 60-second static stretch. Stretching exercises: effect on passive extensibility and stiffness in short hamstrings of healthy subjects. [40]

The subjects showed significant pain relief within Group A and Group B respectively. It was also noted that Group A showed better pain relief as compared to Group B. The disability was assessed using shoulder pain and disability index (SPADI). Here the subjects showed less disability score in both the group A and Group B. Group A showed less disability as compared to Group B score. When Group A and Group B were compared, Group A showed better results than Group B. Our data supported alternate hypothesis there is some significant difference between dynamic exercises with stretching is more effective than closed kinematic exercise with

stretching. One of the study concluded that Active release technique has yielded significant reduction in pain and improvement in range of motion in subjects with adhesive capsulitis[41].Another findings study suggest that closed kinematic exercises if added to conventional physiotherapy in the treatment of knee osteoarthritis is more beneficial[42]. The study concluded that a short term intervention of kinesio-taping yielded significant reduction of pain and improvement in functional abilities and also the shoulder range of motion in subjects with shoulder impingement syndrome[43]OtagoExercise Program is effective and can be used as a supplemental programme to regular supervised exercise classes. The OEP can be beneficial for elderly patients with weakness and chronic lower back pain[44]. Obese person tend to have a higher prevalence of adhesive capsulitis and one study shows that there was significant differences exist in the walking time and the FVC, FEV1/FVC values between Obese and Non obese individuals[45].

Conclusion

In this study concluded that Group A (dynamic exercise with stretching) is more effective in reducing pain and disability than the Group B(closed kinematic exercise with stretching) in adhesive capsulitis.

Conflict of Interest: 'Conflicts of interest: none'

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed

Source of Funding: Nil, This is a self-funded study

Acknowledgement: I would like to thank the authorities of Dr. MGR Educational and Research Institute, University and the Principal Faculty of Physiotherapy for providing me with facilities required to conduct the study.

Authors' contribution: All authors have contributed equally

Data gathering and idea owner of this study: V. RAJALAXMI

Study design: VaniAravind, K.Kirupa

Data gathering: S.Vasanthi**,S.**Sathya

Writing and submitting manuscript:S.M.Divya Mary**,** VaniAravind**,** N. Muthukumaran

Editing and approval of final draft: V. RAJALAXMI, N. Muthukumaran

Reference:

1. Dias R, Cutts S, Massoud S. Frozen shoulder. *BMJ* 2005; **331**:1453-6. https://doi.org/10.1136/bmj.331.7530.1453
2. 2. Kelley M, Mcclure P, Leggin B. Frozen shoulder: Evidence and a proposed model guiding rehabilitation. *J Orthop Sports PhysTher* 2009;**39**:135-148. https://doi.org/10.2519/jospt.2009.2916
3. Sunil G. hasulkar, keerthiRio; Chandra Iyar; khatri S. M. Effectiveness Gong's mobilization on shoulder abduction in Adhesive capsulitis, *Indian journal of Basic &Applied Medical Research.* 2013.**8** (2):984.
4. Walmsley S, Rivett DA, Osmotherly PG. Adhesive capsulitis: Establishing consensus on clinical identifiers for stage 1 using the delphi technique. *Phys Ther* 2009;**89**:906-917. https://doi.org/10.2522/ptj.20080341
5. Bal A, Eskioglu E, Gulec B, Aydog E, Gurcay E, Cakci A. Effectiveness of corticosteroid injection in adhesive capsulitis. *Clinical Rehabilitation* 2008; **22**:503-512. https://doi.org/10.1177/0269215508086179
6. Bussieres AE, Peterson C, Taylor JA. Diagnostic imaging guideline for musculoskeletal complaints in adults - an evidence based approach: Part 2 - upper extremity disorders. *J Manipulative PhysiolTher* 2008;**31**:2-32. https://doi.org/10.1016/j.jmpt.2007.11.002
7. Gaspar P, Willis B. Adhesive capsulitis and dynamic splinting: a controlled, cohort study. *BMC Musculoskeletal Disorders* 2009;**10**:111.https://doi.org/10.1186/1471-2474-10-111
8. Boyles RE, Flynn TW, Whitman JM. Manipulation following regional intrascalene anesthetic block for shoulder adhesive capsulitis: A case series. *Man Ther* 2005:**10**;164-171. https://doi.org/10.1016/j.math.2004.08.002
9. Jewell DV, Riddle DL, Thacker LR. Interventions associated with an increased or decreased likelihood of pain reduction and improved function in patients with adhesive capsulitis: A retrospective cohort study. *PhysTher* 2009;**89:**419-429.https://doi.org/10.2522/ptj.20080250
10. Yang JI, Chang C, Chen S, Wang S, Lin J. Mobilization techniques in subjects with frozen shoulder syndrome: Randomized multiple-treatment trial. *PhysTher* 2007;**87**:1307-1315. https://doi.org/10.2522/ptj.20060295
11. Hollmann L, Halaki M, Haber M, Herbert R, Dalton S, Ginn K. Determining the contribution of active stiffness to reduced range of motion in frozen shoulder. *Physiotherapy* 2015;**101:**e585. https://doi.org/10.1016/j.physio.2015.03.3409
12. Blanchard V, Barr S, Cerisola FL. The effectivemess of corticosteroid injections compared with physiotherapeutic interventions for adhesive capsulitits: A systematic review. *Physiotherapy* 2010; **96**: 95-107.https://doi.org/10.1016/j.physio.2009.09.003
13. Yang .JL, Chang, CW, Chen, SY, Wang, SF Lin. JJ Mobilization techniques in subjects with frozen shoulder syndrome; randomized multiple -treatment trial. *PhysTher.* 2007,**88:**1307-1315.https://doi.org/10.2522/ptj.20060295
14. Curette S. Adhesive capsulitis. Research advances frozen in time. *J. Rhumatol* 2000.**27**,1329-1331.
15. Prentice, William E. Therapeutic Modalities for Sports Medicine and Athletic Training 5th ed. New York :McGraw Hill, 2003.
16. The American Heritage Stedman's Medical Dictionary. 2002 ed. Houghton Muffin company.
17. Y, Later, Ziberman R, and Potatoes R, "Effects of pulsed short -wave -diathermy on pain and knee function of subjects with Osteoarthritis of the knee :a placebo -controlled double -blind clinical trial. "*Clinical Rehabilitation* 2005:255-263.https://doi.org/10.1191/0269215505cr864oa
18. Weerapong, Pornratshanee; Hume, Patria A; Kilt, Gregory S. (2004)"stretching. Mechanisms and Benefits for sports performance and injury Pretension ".*Physical therapy Reviews*. **9**(4):189-206.https://doi.org/10.1179/108331904225007078
19. Dagenais,Marc Indian society for strength training,(December 2011)
20. 20). N, Vargas OO. Kinetic chains: a review of the concept and its clinical applications. *PM and R.* 2011 Aug 31;**3**(8):739-45.https://doi.org/10.1016/j.pmrj.2011.02.021
21. Ellenbecker TS, Davies GJ. Closed kinetic chain exercise: a comprehensive guide to multiple joint exercise. Human Kinetics; 2001.
22. Rivera JE. Open versus closed kinetic chain rehabilitation of the lower extremity: a functional and biomechanical analysis. *JSR*. 2010 Apr **21**;3(2).https://doi.org/10.1123/jsr.3.2.154
23. Roach KE, Budiman-Mak E, Songsiridej N, Lertratanakul Y. Development of a shoulder pain and disability index. *Arthritis Care Res*. 1991;**4**(4):143-149. https://doi.org/10.1002/art.1790040403
24. Mc Cormack HM, Horne DJ, Sheather S. Clinical applications of visual analogue scales: a critical review. *Psychol Med* 1988;**18**:1007-19.https://doi.org/10.1017/S0033291700009934
25. Huskisson EC. Measurement of pain. *Lancet* 1974;**2**:1127-31. https://doi.org/10.1016/S0140-6736(74)90884-8
26. Downie WW, Leatham PA, Rhind VM, Wright V, Branco JA, Anderson JA. Studies with pain rating scales. *Ann Rheum Dis* 1978;**37**:378-81.https://doi.org/10.1136/ard.37.4.378
27. Gaston-Johansson F. Measurement of pain: the psychometric properties of the Pain-O-Meter, a simple,

inexpensive pain assessment tool that could change health care practices. *J Pain Symptom Manage.* 1996; **12**:172-81.https://doi.org/10.1016/0885-3924(96)00128-5

28. Todd KH, Funk KG, Funk JP, Bonacci R. Clinical significance of reported changes in pain severity. *Ann Emerg Med*.1996**; 4**:485-9.
29. Libman M, Berkoff D, Lahn M, Bijur P, Gallagher EJ. Independent validation of the minimum clinically important change in pain scores as measured by visual analog scale [abstracts]. *AcadEmerg Med*. 2000; **7**:550 https://doi.org/10.1016/S0196-0644(96)70238-X
30. Moher D, Schulz KF, Altman DG. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomized trials. *Ann Intern Med* 2001;**134**:657-62.https://doi.org/10.7326/0003-4819-134-8-200104170-00011
31. Moher D, Schulz KF, Altman D. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomized trials. *JAMA* 2001;**285**:1987-91.https://doi.org/10.1001/jama.285.15.1987
32. Atamaz FC, Durmaz B, Baydar M, Demircioglu OY, L YIYAPICI A,Kuran B, Oncel S, Sendur OF. Comparison of the efficacy of transcutaneous electrical stimulation, interferential currents, and short wave diathermy in knee osteoarthritis : a double -blind randomized controlled, multicentestudy. *Archives of physical Medicine and Rehabilitation*.2012;**93**(5)748-756. https://doi.org/10.1016/j.apmr.2011.11.037
33. Fukuda TY, Alves da cunha R Fukuda VO, Rienzo FA, Cazarini C jrCarvalho NAA, Centini AA Pulsed short wave treatment in women with knee osteoarthritis: a multicenter , randomized, placebo-controlled clinical trail. *Physical Therapy* : 2011; **91**(7):1007-1017. https://doi.org/10.2522/ptj.20100306
34. Tulpp0 MP, Makikallioth, Takala TE, SeppanenT,Huikuri HV (1996) Quantitative beat -to -beat analysis of heart rate dynamics during exercise. *Am J Physio1* 271:H244-H252. https://doi.org/10.1152/ajpheart.1996.271.1.H244
35. Tulppo MP, Hughson RL, Makikallio TH, AiraksinenKEJ,Seppanen T et al. (2001) Effects of exercise and passive head-up tilt on fractal and complexith properties of heart rate dynamics. *Am J Physio1 Heart Circ Physiol* **280** :H1081-H1087. https://doi.org/10.1152/ajpheart.2001.280.3.H1081
36. Kwon OK, Shin WS: Effects of closed and open kinetic chain exercises on knee extensor strength and balance in patients with early stroke. *J Korean Soc Phys Med,* 2014, **9**: 223-231. https://doi.org/10.13066/kspm.2014.9.2.223
37. Lee NK, Kwon JW, Son SM, et al. : The effects of closed and open kinetic chain exercises on lower limb muscle activity and balance in stroke survivors. *Neuro Rehabilitation*, 2013, **33**: 177-183.https://doi.org/10.3233/NRE-130943
38. Kwon YJ, Park SJ, Jefferson J, et al. : The effect of open and closed kinetic chain exercises on dynamic balance ability of normal healthy adults. *J PhysTher Sci*, 2013, **25**: 671-674. https://doi.org/10.1589/jpts.25.671
39. Bandy WD, Irion JM. The effect of time on static stretch on the flexibility of the hamstring muscles. *PhysTher* .1994; **74**:845-850.https://doi.org/10.1093/ptj/74.9.845
40. Jan PK Halbertsma, Ludwig NH. *GöekenArchives of physical medicine and rehabilitation* **75** (9), 976-981, 1994.https://doi.org/10.1016/0003-9993(94)90675-0
41. Rajalaxmi V et al (2017) Immediate Effects of Active Release Technique (Art) in Patients with Adhesive Capsulitis, *International Journal of Current Advanced Research*, **06**(07), pp. 4972-4974
42. V. Rajalaxmi, G. Mohan Kumar, K. Fousiyathaslim& M. Manju, a comparative study on the effectiveness of open kinematic exercises and closed kinematic exercises in patient s with osteoarthiritis of the knee joint. *TJPRC: International Journal of Physiotherapy& Occupational Therapy (TJPRC: IJPOT)* Vol. **2**, Issue 1, Jun 2016, 1-8
43. V. Rajalaxmi, G. Sperjan& G. Yuvarani, to compare the effectiveness of kinesio taping and exercise in patients with shoulder impingment syndrome, TJPRC: *Journal of Physiotherapy & Occupational Therapy (TJPRC:JPOT)* Vol. **1**, Issue 1, Jun 2015, 35-42
44. Rabilal, M., Maharaj, S. S., & Kaka, B. (2020). Efficacy of the Otago exercise programme as a supplementary intervention to exercise classes: On falls, balance, physical function and mobility in a patient with chronic lower back pain: A case report. *Bangladesh Journal of Medical Science*, **19**(2), 339-342. https://doi.org/10.3329/bjms.v19i2.45020
45. Yen, J. K., Bharathi, M., & B, A. (2018). Comparative study on differences in lung parameter between the obese and non obese collegiate sedentary students. *Bangladesh Journal of Medical Science*, **17**(3), 351-354. https://doi.org/10.3329/bjms.v17i3.36988