ORIGINAL RESEARCH

Effectiveness of finger fanning technique in K CAT concept, to improve the shoulder mobility by enhancing scapular dyskinesia

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ABSTRACT
Shoulder pain is a common and disabling complaint. The reported annual incidence of shoulder pain in primary care is 14.7 per 1000 patients per year with a lifetime prevalence of up to 70%.Fascial Manipulation technique are effective in reducing pain in chronic shoulder dysfunctions. The anatomical substratum of the myofascial continuity has been documented by dissections and the biomechanical models. Hence, this study focussed on understanding the effectiveness of finger fanning technique of K CATconcept, to improve the shoulder mobility by enhancing scapular dyskinesia.Pre- Post experimentaldesign and random sampling method adopted and sample size estimated to be 50, and 50 patients recruited for this interventional study.Pain, Shoulder Range of Motion (ROM) and morphometric width assessed at baseline and post intervention by, Visual Analogue Scale (VAS),Goniometer and ultrasonogram.Though classical anatomy still relegates muscular fascia to a role of contention. This study proves thatactivation of this resilient tissue and modulation of finger fanning of KCAT reduces shoulder pain. Coracoid process- Lesser tubercle width is increased and scapular dyskinesia is controlled which in turn facilitates improved shoulder ROM with a single session of finger fanning technique of K CAT concept.

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BACKGROUND

Shoulder pain is a common and disabling complaint. The reported annual incidence of shoulder pain in primary care is 14.7 per 1000 patients per year with a lifetime prevalence of up to 70%[1]. Recovery from shoulder pain can be slow and recurrence rates are high with 25% of those affected by shoulder pain reporting previous episodes, and 40 to 50% reporting persisting pain or recurrence at 12-month follow-up.[2,3]

However, the pathophysiological mechanisms underlying shoulder pain and dysfunction are yet to be clearly defined. Although subacromial impingement is suggested to be a potential source of shoulder pain solid evidence is not presented[4]. In fact, calcifications, acromion spurs, subacromial fluid, or signs of tendon degeneration are equally prevalent in healthy subjects and in patients with shoulder pain[5]. Furthermore, physical examination tests of subacromial impingement are not reliable. Lack of universally accepted diagnostic classification criteria and poor specificity of many physical examination tests hamper confidence in classification systems that use clinical test criteria alone[2]. Shoulder instability represents a spectrum of disorders resulting in shoulder dysfunction, including subluxation, dislocation, and symptomatic laxity[6]. Instability is classified as either unidirectional or multidirectional. Scapular dyskinesis is the term used to describe loss of normal scapular physiology, biomechanics, and kinetics. This may be secondary to a painful condition of the shoulder; however, it does not necessarily mean a pathological condition, but, rather, a previously asymptomatic condition in the shoulder girdle or muscle imbalance.[7,8] Shoulder instability events are characterized in terms of type (subluxation, dislocation), laterality (right, left), and direction (anterior, posterior, inferior, multidirectional) based on

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history, physical examination, and medical imaging. By definition, subluxations are instability events that do not require a reduction manoeuvre, while dislocations are instability events that necessitate manual reduction by Physiotherapist or Orthopaedic specialist. Unidirectional instability (UDI) typically results from shoulder subluxation/dislocation. Multidirectional instability (MDI) results from atraumatic laxity of the anterior capsule and glenohumeral (GH) ligaments.[9] In MDI the ratio of elastin in capsular tissues is increased leading to a redundant capsule and increasing glenohumeral joint volume.[10,11]

Scapular dyskinesias can be subdivided into a posterior displacement from the posterior thorax of the inferior medial angle (type I), a posterior displacement from the posterior thorax of the entire medial border of the scapula (type II) and an early scapular elevation or excessive/insufficient scapular upward rotation (dysrhythmia) during dynamic observation (type III).[12]

There are six categories of causative factors contributing to scapular dyskinesis.[13] Surgical intervention may be considered for the bone and joint factors prior to beginning rehabilitation treatment.[14]

- Nerve damage: long thoracic or spinal accessory nerve palsy
- Inflexibility factors: glenohumeral internal rotation deficit (GIRD), total range of motion deficit or tightness of pectoralis minor or levator scapula
- Muscular issues: weakness of lower trapezius, rhomboids or serratus anterior, hyperactivity of upper trapezius, and detachment of peri-scapular muscles
- Kinetic chain problems: weakness of hip/leg and core muscles
- Bone factors: excessive anterior scapular tilt, thoracic kyphosis, clavicular fracture and scapular fracture, prior subluxation event with glenoid bone loss
- Joint factors: acromioclavicular separation or arthritis, GH instability (capsular laxity), biceps tendinitis and labral damage

MDI reportedly occurs more often in gymnasts and swimmers but is also seen in other overhead athletes such as throwers and volleyball players. Scapular dyskinesis occurs in overhead athletes and is associated with posterior capsular tightness, GIRD, and serratus anterior/lower trapezius weakness.[13]

The GH joint has little inherent bony stability. During shoulder abduction, the humeral head rolls superiorly, simultaneously sliding inferiorly to prevent impingement.[15] GH joint stability depends on both static and dynamic restraints. Static restraints include the interface of the humeral head, glenoid fossa, GH ligaments, and glenoid labrum.[16] Dynamic stability is achieved primarily through the eccentric action of the rotator cuff, keeping the humeral head “seated” within the glenoid fossa during motion.[15,16]

Scapulohumeral rhythm is the coordinated movement of the scapulothoracic and GH joints. Below 30 degrees of abduction, the majority of motion occurs at the GH joint. Beyond 30 degrees of abduction, the ratio of glenohumeral to scapulothoracic movement generally occurs at a ratio of 5:4. Scapular movement includes upward/downward rotation, anterior/posterior tilt, and internal/external rotation. Scapular retraction is the coupling of external rotation, posterior tilt, upward rotation, and medial translation.[16]

The normal kinematic pattern of the scapula during arm elevation is upward rotation, posterior tilt, and external rotation. This allows the humeral head to clear the acromion during upward rotation. The scapula has an important function in the proximal-to-distal sequencing of shoulder movements. The body segments and muscles are coordinated to transfer forces to the terminal link (i.e., hand) through the shoulder, which is known as kinetic chain.[17]

In MDI, current treatment guidelines recommend an initial course of non-operative management with a structured rehabilitation program. A surgical referral may be considered for an identified anatomic lesion and failure of the rehabilitation program. According to a recent review article, the surgical intervention revealed 14% of unsatisfactory result due to persistent instability or pain.[18]

In order to decrease the failure rate, a well-designed and structured rehabilitation program should be provided to the patients. Focus should be on kinetic chain deficits, scapular stabilizer strengthening, appropriate shoulder girdle flexibility, and scapulothoracic mechanics. Maximal rotator cuff strengthening requires a stabilized, retracted scapula and should occur only after scapular control is achieved.[13,19,20]

In the last two decades, scapular stabilization has become a key component of shoulder rehabilitation. Inclusion of scapular exercises as part of a rehabilitation program achieves better results and higher patient-rated outcomes.[21] The systemic review of MDI indicates arthroscopic capsular plication and open capsular shift as the best surgical procedures after rehabilitative treatment failure.[12] Short term rigid or Kinesio taping was shown to improve scapular dyskinesis in a study examining asymptomatic athletes, however high level evidence from clinical trials is still needed. Scapular dyskinesis was also noted to improve based on the scapular dyskinesis test.[22]Classical anatomy still relegates muscular fascia to a role of contention. Nonetheless, different hypotheses concerning the function of this resilient tissue have led to the formulation of numerous soft tissue techniques for the treatment of musculoskeletal pain. Fascial Manipulation technique are effective in reducing pain in chronic shoulder dysfunctions. [23]The anatomical substratum of the myofascial continuity has been documented by dissections and the biomechanical models. Hence, this study focussed on understanding

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the effectiveness of finger fanning K CAT technique, to improve the shoulder mobility by enhancing scapular dyskinesia.

Does finger fanning technique in K CAT Concept improve the shoulder mobility by enhancing scapular dyskinesia among patients with limited shoulder mobility?

To study the effectiveness of finger fanning technique in K CAT concept, to improve the shoulder mobility by enhancing scapular dyskinesia.

METHODOLOGY

PARTICIPANTS & STUDY SETTING

Individuals attending the routine rural medical camp organised by Pacific Medical College were screened for shoulder pain, and patients recruited based on the inclusion criteria; patientsaged between 21 and above with limited shoulder mobility due to scapular dyskinesia or shoulder dysfunction, Shoulder impingement syndrome, or pain or bursitis limiting shoulder mobility or adhesive capsulitis. Patients were excluded from this study if they had any recent fracture of upper limb, oron treatment or treated for; cancer,Rheumatoid Arthritis, Severe osteoporosis, Acute neurological conditions with weakness, deemed unfit for exercises.;or hadglenoid labyranthile tear; or withShoulder subluxation grade 2 + and with Reflex sympathetic atrophy. Random sampling method adopted and sample size estimation done to be 50.Pacific Medical University,Institute's ethical approval obtained dated01/09/2021, PMU/ PMCH/IEC/2021/186A/8. All participants completed information and consent form at recruitment.

STUDY DESIGN

Pre- Post experimental design.

MEASURES

Patients socio economic details and clinical characteristics were collected in a self-designed data sheet. Patients were assessed for their pain, shoulder ROM and corocoid -Lesser tubercle distance at baseline andimmediately after intervention.

Variable	Tool Used
Shoulder Range of Motion	Goniometer
Pain	VAS-Pain
Coracoid -Greater tubercle width	Morphometric study using Sonographic device.

INTERVENTION DETAILS WITH STANDARDIZATION PROCEDURES

K CAT Concept: The Fascial force transmission or controlling method, by root cause analysis. It is influenced by either detension or tension of fascia and integrating the functional movement of normal facial chain of the moving bodyin unison. In which the principles of K CAT is used in terms of biotensegrity model of fascia, and it helps to restore the movement in terms of efficiency and optimization in both quantity of mobility and motility.

Finger Fanning Technique: Therapist manoeurve'sthe patient with his palms encapsulating patient palm,and instructs the patients to do finger fanning technique (spreading and approximating the web spaces without detaching the fingers and wrist from the contact surface like monitor lizard holding the surface). During the fanning the resistance offered by the therapist to the patients is distributed evenly across all the fingers, and this manoeuvre aids in improved proximal joint mobility due to the resistance or isotonic resisted working of fingers. The proximal work isometrically, hence results in change in length tension relationship of entire myofascial force transmission system anterolateral & posteromedial get activated.

Starting position: Patient should be in relax sitting position with both feet in contact with ground (closed kinematic position of lower limb) with extended elbow and flexed shoulder around 45-50 Degree of flexion which should be fully supported on the table.

Process: Ask the patient for finger fanningtechnique the palmar surface resting on the table with good contact with the below surface, if required pillow can be used for better contact.

Physiotherapists: PT, seat in front of the patient and delivers finger fanning techniques.

Statistical Analysis: Demographic & Clinical characteristics were analysed using descriptive statistics such as median and range.Paired't'test was used toanalyze the pre and post assessment in shoulder ROM, Pain and corocoid–Lesser Tubercle width,Chi Square to analyze the correlation.

RESULTS

The data analysis included descriptive and inferential statistics. The demographic and clinical details of the study participants were summarised as frequencies and percentages. Of the 54 patients reported with shoulder pain and dysfunction, 50 were included in the study. As per exclusion criteria 4 patients were excluded. 2 had glenoid labrynthal tear, 1 patient had rheumatoid arthritis, and 1 was treated for colle's fracture 2 months back with POP.

Table 1: Demographic and clinical characteristics

Variable		Frequency	Percentage
Age (in years)	20-30	5	10%
	30-40	8	16%

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	40-50	7	14%
	50-60	16	32%
	60-70	11	22%
	70-80	3	6%
Gender	Male	29	58%
	Female	21	42%
Disease / Dysfunction Post diabetic adhesive capsulitis/soft tissue injuries and dysfunction	YES	24	48%
	NO	26	52%
Injury Sprain, strain, unspecify soft tissue injury	YES	9	18%
	NO	41	82%
Scar Post traumatic/surgical lesion	PRESENT	8	16%
	ABSENT	42	84%
Duration of Symptoms	1 week	10	20%
	2 week	1	2%
	1month	4	8%
	2month	6	12%
	3 Months and above	29	58%

The mean age of the patients was 50.70(13.94) years with 74 % of them being above 40 years of age. 58% of the study population were male.Most of the patients had the symptoms for 3 months and above (n=29;58%).

Table2: Shoulder ROM, Pain and Ultrasonographic Assessment Pre & Post KCAT with finger fanning technique.

	Assessment	**MEAN ±SD**	**'t' value**	**P 'value**
Shoulder Flex	PRE	50.80 ± 8.10	24.04	<0.001
	POST	79.50 ± 7.16		
Shoulder ABD	PRE	40.50 ± 8.22	27.00	<0.001
	POST	83.60 ± 9.80		
USG	PRE	0.57 ± 0.09	20.9	<0.001
	POST	0.72 ± 0.11		
Pain VAS	PRE	2.5 ± 1.16	8.57	<0.001
	POST	1.3 ± 0.79		

The mean score of the shoulder abduction improved, from 40.50 ± 8.22 before intervention to 83.60 ± 9.80 after intervention, and the pain score reduced from 2.5 ± 1.16 to 1.3 ± 0.79 post intervention.

Table 3: Correlation between USG(coracoid process-lesser tubercle width),Pain, Shoulder Range of Movement

	PRE USG	***POST USG***	***Pre PAIN VAS***	***Post PAIN VAS***	***PRE SHOULDER FLEXION***	***POST SHOULDER FLEXION***	***PRE SHOULDER ABDUCTION***	***POST SHOULER ABDUCTION***
PRE USG	1							
POST USG	0.903**	1						
Pre PAIN VAS	-0.048	-0.101	1					
Post PAIN VAS	-0.114	-0.211	0.544**	1				
PRE SHOULDER FLEXION	-0.295*	-0.259*	0.010	0.073	1			
POSTSHOULDER FLEXION	0.081	0.122	0.103	0.171	0.393**	1		
PRE SHOULDER ABDUCTION	0.077	0.018	0.282*	0.102	0.261*	0.246*	1	
POST SHOULDER ABDUCTION	-0.341**	-0.180	0.071	-0.010	0.303**	0.091	0.224*	1

***p<0.05 (S); **p<0.001 (HS)**

DISCUSSION

The purpose of this study was to evaluate the effect of finger fanning technique in K CAT concept to improve shoulder mobility and to demonstrate the effectiveness by morphometric analysis using sonographic device, in improving the distance between coracoid process and Lesser Tubercle of humerus among patients with limited shoulder mobility. This study finding shows

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that there is significant improvement in shoulder ROM, both abduction and flexion post intervention, there is also a significant improvement in the width between the bony prominence of coracoid process and greater tubercle by ultrasonographic marking.

This study findings were in line with an impacted systemic review to understand the effectiveness of KCAT, that emphasises on the role of Kinetic Chain activation during shoulder rehabilitation might increase axioscapular muscle recruitment, produce lower trapezius muscle ratios and reduce the demands on the rotator cuff. [24] This study finding is analogous to the study by Dorienetal,which states that Incorporating the kinetic chain during shoulder elevation exercises influenced scapular muscle activity and ratios. In particular, incorporating the lower limb resulted in more upper trapezius activity, whereas the open-hand position increased middle trapezius and Lower trapezius activity,[25] as in our finger fanning technique.

The findings of this study support the John & Timothy report about KCAT and that the exercises in this approach areconsistent with biomechanical models, apply biomechanicaland motor control theory, and work toward sport specificity.These exercises are designed to stimulate weakened tissue bymotion and force production in the adjacent kinetic link segments.

The clinical utility of ultrasonography forrotator cuff disease, shoulder impingement syndromeand subacromial bursitis were specified by Mark S Awerbuch[26], and thisstudy had a statistically significant improvement incoracoid-Greater tubercle space by USG after KCAT by finger fanning technique. Similar finding was reported from studiesusing dynamic sonography evaluation of shoulder impingement syndrome.[27][28]

Evidential studies states that Kinetic chain shoulder rehabilitation incorporates the kinetic link biomechanical model and proximal-to distal motor-activation patterns with proprioceptive neuromuscular facilitation and closed kinetic chain exercise techniques.[23][29]This approach focuses on movement patterns rather than isolated muscle exercises. Patterns sequentially use the leg, trunk, and scapular musculature to activate weakened shoulder musculature, gain active range of motion, and increase strength. The paradigm of kinetic chain shoulder rehabilitation suggests that functional movement patterns and closed kinetic chain exercises should be incorporated throughout the rehabilitation process. The exercises are designed to stimulate weakened tissue by motion and force production in the adjacent kinetic link segments.[30] The finding of this study is similar to the study by Arsalan Ghorbanpour'sreport that fascia treatment decreases shoulder pain and improves range of motion of shoulder joint [31].An Indian Randomized study reported a significant improvement in shoulder range of motion and reduction of pain among patients with shoulder pain syndrome[32].Similarly another study by Neelam states that , Open kinematic chain exercises are effective for treating asymptomatic overhead athletes with SICK scapula.[33]Research studies from LephartSm& Henry TJ emphasizes that, K CATof upper extremity function is due to the numerous shoulder positions and the great velocities with which the shoulder can move. Classifying exercises for rehabilitation of the upper extremity is very difficult due to the complexity of the joint. Many definitions and classification systems have been proposed; however, none of these entirely encompass rehabilitation of the upper extremitysystem has been designed to restore functional shoulder stability, which is dependent upon proper scapulothoracic and glenohumeral stability, and humeral control; all of these are in part mediated by neuromuscular mechanisms.[34]Various anatomical studies have shown the existence of myofascial chains linked by deep fascia along the upper extremity.

CONCLUSION

In the last two decades, scapular stabilization has become a key component of shoulder rehabilitation. Inclusion of scapular exercises as part of a rehabilitation program achieved better results and higher patient-rated outcomes. Though classical anatomy still relegates muscular fascia to a role of contention. This study proves thatactivation of this resilient tissue and modulation of finger fanning of KCATreduces shoulder pain. Coracoid process- Lesser tubercle width is increased and scapular dyskinesia is controlled which in turn facilitates improved shoulder ROM with a single session of finger fanning technique of K CAT concept.

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