Section A-Research paper

Effect of kinetic chain activation technique in shoulder impairment: A review

[1]Dr. KM Annamalai, [2]Dr. Kapil Vyas, [3]Dr. Jafar Khan, , [4] Dr. Parneet Kaur Bedi, [5]Dr. M.S.Satish, [6]Dr. Kapil Aggarwal

[1](PI)Ph.D. Scholar Pacific Medical University, Udaipur, Rajasthan, India
[2]Senior Professor and HOD, Department of Radiology, Pacific Medical University, Udaipur, Rajasthan, India
[3]Dean and HOD Pacific College of Physiotherapy, Udaipur, Rajasthan, India
[4]Assistant Professor, Pacific College of Physiotherapy, Udaipur, Rajasthan, India
[5]Chief Physiotherapist, Cancer Institute (WIA), Chennai, Tamil Nadu, India
[6]Assistant Professor Department of Radiology, Pacific Medical College & Hospital, Udaipur, Rajasthan, India

Corresponding Author: Dr. KM Annamalai
Email: annamalai2k@gmail.com

Abstract

Shoulder pain is a common and disabling complaint with increasing incidence and prevalence rate. Shoulder pain being very common problem in human population and many reasons affected the shoulder mobility, and having different ideology of treatment by individual specialty. Major thought in shoulder rehabilitation were, in patients having limited shoulder range of motion (ROM), there is always an underlying structural problem near shoulder or associated to shoulder joint. The true statement is we do maximum movement of holding through distal and distal is most neglected during the treatment of proximal, and need to explore that proximal is major culprit and enhancer, responsible for proximal dyskinesia.

Evidence states that integrating the Kinetic Chain activation Technique (K CAT) during shoulder rehabilitation may increase axioscapular muscle recruitment, produce lower trapezius muscle ratios and reduce the demands on the rotator cuff. Although 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. The anatomical substratum of the myofascial continuity has been documented by dissections and the biomechanical models. These myofascial chains and their mechanical relevance were explicit in stating that K CAT of distal chain to facilitate the reactivation of proximal chain is evident. But from the review it is evident that, while we treat proximal through distal it is easier and faster communicating to entire system, till distal to proximal and change muscle movement physiology which alter the bony anatomy which causing dissociation may result in proximal joint ROM gain.

Keywords: : K-CAT, Kinetic Chain Activation Techniques, Myo fascial chain, Physiotherapy

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Introduction

The concept of the Kinetic chain has been carved and amalgamated with the field of engineering in order to describe human movement. It is frequently used in several clinical conditions which may include musculoskeletal, sports rehabilitation, and neurorehabilitation among other conditions. Since then, the concept of the kinetic chain has advanced in different forms for clinical requirements. It has been also challenged to be merely a kinetic chain and it's more important to take it as a chain reaction where one particular movement triggers other areas. Fascia is not only an inert force transmitter. It modulates mechanical stress by absorbing, storing, and dissipating kinetic energy. Fascia also plays a significant role in venous return in the lower limb. The concept of kinetic chain argues that the joints and segments have an effect on one another while moving. When a person moves, a chain of events occurs that creates an effect on the movement of neighbouring joints and segments. An integrated biomechanical task produced by sequential physiologic muscle activations in the upper and lower extremities is known as a kinetic chain.

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 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].

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, Glenohumeral Internal Rotation Deficit (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 prescribed 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]. Functional impingement may be associated with muscle imbalance; therefore, careful examination of flexibility and strength of important muscles about the shoulder complex is vital to understanding the root cause of impingement and prescribing effective treatment. Janda's approach to muscle imbalance suggests a possible neuromuscular component to functional impingement due to the predisposition of certain muscles to be concentrically or eccentrically locked, which would alter the

length tension relationship affecting the functional outcome. The literature substantiates that imbalance in the glenohumeral and scapulothoracic musculature are present in patients with subacromial impingement. Shoulder pain is very common problem in human population and have many reasons affected the shoulder mobility and having different ideology of treatment by individual specialty.

Major thought in shoulder rehabilitation were, in patients having limited Range of Motion (ROM) there is always an underlying structural problem near shoulder or associated to shoulder joint. The true statement is we do maximum movement of holding through distal and distal is most neglected during the treatment of proximal. It is imperative to explore that distal modulation can enhance proximal joints outcome, similarly distal fascia distortion is responsible for proximal dyskinesia of scapula in shoulder joint.

Discussion

A functional shoulder is a pre-requisite for good upper arm functioning, as it places, operates and controls the forearm. Without the active and significant contribution of the human shoulder, many daily living activities like hair combing and reaching the back cannot be performed successfully. It is evident that proximal range and function of shoulder is not dependent only on the proximal synergy, but it is greatly dependent on distal chain functioning.

Eleanor Richardson: This review found evidence that integrating the Kinetic Chain activation technique (KCAT) during shoulder rehabilitation may increase axioscapular muscle recruitment, produce lower trapezius muscle ratios and reduce the demands on the rotator cuff [21].

Aaron Sciasca: Sequenced physiologic muscle activations in the upper and lower extremity result in an integrated biomechanical task. This sequencing is known as the kinetic chain, and, in upper extremity dominant tasks, the energy development and output follows a proximal to distal sequencing. Impairment of one or more kinetic chain links can create dysfunctional biomechanical output leading to pain and/or injury. When deficits exist in the preceding links, they can negatively affect the shoulder. Rehabilitation of shoulder injuries should involve evaluation for and restoration of all kinetic chain deficits that may hinder kinetic chain function [22].

Dorien: Scapular rehabilitation exercises should focus on selective activation of weaker muscles and minimal activation of hyperactive muscles. 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 [23].

John Mccullen: 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. 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 [24].

Kamkar: Shoulder pain secondary to impingement of the rotator cuff tendons underneath the coracoacromial arch is a common problem seen in athletes who perform repetitive overhead activities. Shoulder impingement has been classified into primary and secondary types. Several factors contribute to impingement, including rotator cuff weakness, posterior capsule tightness, and subacromial crowding. Recently, it has been proposed that scapulothoracic muscle weakness could be a factor that contributes to impingement. Traditional rehabilitation protocols for shoulder impingement syndrome stress individualized rotator cuff strengthening. The finding suggests that individualized scapulothoracic muscle strengthening should be a part of any protocol for nonoperative treatment of secondary shoulder impingement syndrome [25].

Arsalan Ghorbanpour reports that fascia treatment decreases shoulder pain and improves range of motion of shoulder joint in a patient diagnosed with frozen shoulder [26].

An Indian Randomized study reported a significant improvement in shoulder range of motion and reduction of pain among patients with shoulder pain syndrome [27].

A study by Neelam states that, Open kinematic chain exercises are effective for treating asymptomatic overhead athletes with SICK scapula [28].

Lephart Sm & Henry TJ underlines that, the confusion between the terms *open kinetic chain* and *closed kinetic chain* becomes even greater with application to the upper extremity. Upper extremity function is very difficult to define, 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 extremity. system 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 [29].

Day JA and Stecco C states that, Classical anatomy still consigns muscular fascia to a role of contention as there is a dearth in focussed studies based on functional anatomy. 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. Various anatomical studies have shown the existence of myofascial chains linked by deep fascia along the upper extremity. Any alterations in these deep fasciae could be a source of shoulder pain [30].

It was postulated that alterations in distal movement due to any injury in proximal is going to change the entire range of movement which more alter and changing the muscle movement physiology which may lead secondary dissociation in proximal, along with it create a cascade effect on entire stability and mobility which contributing in entire ROM for shoulder joint as we scapula is one of major component in stability along with partly mobility.

But from the review it is evident that, while we treat proximal through distal it is easier and faster communicating to entire system, till distal to proximal and change muscle movement physiology which alter the bony anatomy which causing dissociation may result in proximal joint ROM gain.

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 achieves better results and higher patient-rated outcomes. The systemic review of MDI indicates arthroscopic capsular plication and open capsular shift as the best surgical procedures after rehabilitative treatment failure. 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. 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. The anatomical substratum of the myofascial continuity has been documented by dissections and the biomechanical models. Myofascial chains and their mechanical relevance were explicit in stating that K CAT of distal chain to facilitate the reactivation of proximal chain is evident. Hence, we suggest that future studies need to explore K CAT to improve the shoulder mobility by combating scapular dyskinesia across all age group and ethnicity.

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