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Original Article

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Effect of Training in Mechanism-Based Classification on Clinical Decision-Making of Pain by Physical Therapy Post-Graduate Students - A Qualitative Study

Nisha Rani Jamwal*, Senthil P. Kumar, Ketaki C. Joshi*****

Abstract

Mechanism-based clinical reasoning was shown to be the recommended strategy for clinical decision making for physical therapy management of musculoskeletal pain. The five mechanisms proposed were central sensitization, peripheral sensitization, and sympathetically mediated pain, cognitive-affective and nociceptive. Earlier study found that there was prevalence of all mechanisms among patients with MSK pain. The objective of this study was to assess the immediate effects of a 2-weeks training session on the clinical decision-making among post-graduate physical therapy students. The training session comprised of two contact lecture sessions, online study material for duration of two weeks. Pre and post assessment was done qualitatively using a pre-provided case example and objective structured evaluation. Additionally, the participants also answered seven-point Likert scaling for their attitudes and opinions towards the mechanism-based clinical reasoning of pain. Overall, the responses were favorable and there were observable changes recorded post-training compared to pre-training. Thus training on mechanism-based classification of pain improved clinical decision-making skills of post-graduate physical therapy students.

Keywords: Education; Training; Pain Sciences; Clinical Reasoning.

Introduction

Musculoskeletal (MSK) pain ranked as the second common complaint next only to common cold among patients visiting a general medical practitioner [1]. Non-pharmacological treatments for MSK pain such as physical therapy have its range of treatment options whose effects not only involve symptom control but also towards improving quality of life in patients receiving pain rehabilitation and palliative care [27]. Various pain models like the ' Medical/ disease model' and classification systems proposed by World Health Organization (WHO) and International Classification of Diseases (ICD) were developed for treating pain but were lacking in explaining various clinical presentations of pain. The main cause of treatment failure of pain was attributable to difficulties in identifying the pain mechanisms. It is important to differentiate etiological factors or diseases/causative factors from pain mechanisms as etiological factors. The pain mechanisms are responsible for producing the pain symptoms. Thus, mechanism based classification was proposed. Mechanism-based classification also known as 'pain analysis'refers to the classification of pain according to the underlying neurophysiological mechanisms responsible for its generation and/or maintenance. Mechanism-based classification was originally put forth by Clifford J Wolf and explained by Mark A Jone, in his hypothetico- deductive model of clinical reasoning. Mechanism-based classifications may facilitate effective decision making by directing the therapeutic intervention towards the predominant pain mechanism 1. Recent studies by Smart and Doody [3] and Smart and Doody [4] using qualitative methodology found that expert musculoskeletal physiotherapists used mechanism-based classification in their clinical reasoning process of

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evaluation of pain in their patients. Mechanism-based treatments for MSK pain are most likely to succeed compared to symptomatic treatments or diagnosis-based treatments.

Various methods of mechanism based classification were proposed but were lacking in description of reliable and empirically validated clinical criteria to distinguish the different categories of pain mechanism from each other. Smart et al [5] thus proposed MBC which was later profoundly explained by Kumar and Saha [6]. It involved five mechanisms that operate to initiate, process and produce the 'pain' as a combination of stimulus-response inter-relationship, experience and its associated emotional expression. The five mechanisms were as follows:

Central sensitization/ central neurogenic mechanism/ central nociceptive mechanism

Peripheral sensitization/ peripheral neurogenic mechanism

Peripheral nociceptive mechanism

Sympathetically maintained pain/ sympathetically dependent pain mechanism

Cognitive-affective (psychosocial) mechanism

The readers are referred to the earlier article by Kumar [8] for an overview of these mechanisms. Single symptom may be produced by different mechanisms or single mechanism can elicit different symptoms. Kumar [8] found that patients with MSK pain exhibited a combination of all mechanisms in their clinical presentation. A list of clinical indicators of 'nociceptive', 'peripheral neuropathic', and 'central' mechanisms of musculoskeletal pain was derived to provide some indication of criteria upon which clinicians may base such mechanistic classifications. Further, preliminary discriminative validity was identified for 'nociceptive', 'peripheral neuropathic', and 'central' mechanisms of musculoskeletal pain. Improved understanding of the mechanisms would thus enhance clinical interpretation of patient symptoms in clinical practice. Previous study by Kumar et al [9] found positive benefits on knowledge, attitudes, beliefs and experiences among under-graduate physical therapy students following a palliative care training program. The objective of this paper was to study the effectiveness of an educational session on mechanism-based classification on clinical decision-making of musculoskeletal pain by post-graduate physical therapy students and to evaluate their attitudes and experiences with using the MBC on assessing pain amongst patients with muscloskeletal pain..

Materials and Methods

Study design

A pre-post single-group quasi-experimental study using a focus group methodology, under a qualitative (grounded theory) approach.

Sample size

Six post-graduate physical therapy students specializing in Musculoskeletal Physical Therapy, Dept of Physiotherapy, Kasturba Medical College (Manipal University), Mangalore participated in this study.

Procedure

The instructor obtained written informed consent from the participants and then performed the pre-participation evaluation using a structured form as shown in appendix-1. The evaluation form consisted of an illustrative case example [10], with clinical decision-making queries, followed by participant's rating of the usefulness of the example and their level of interest to learn mechanism-based classification (MBC).

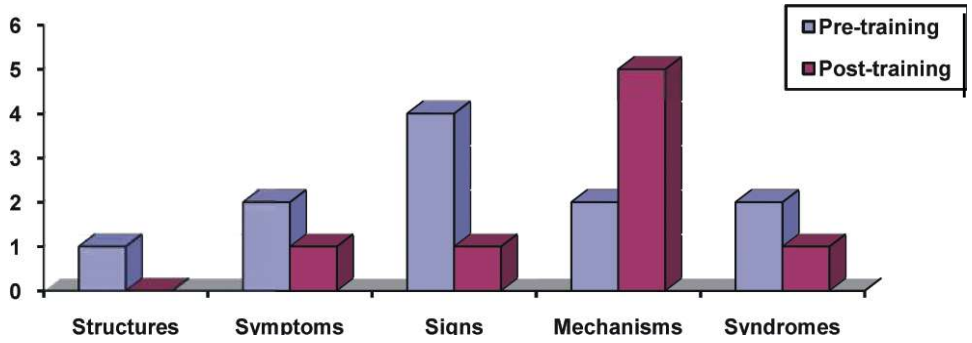
The training period was for two-week duration that included an initial lecture session for two hours, and relevant articles were e-mailed to the participants as leisure-time study material. During this period, the participants were also provided with evaluation forms which they were instructed to classify five cases of their interest. The post-participation evaluation involved the one similar to the pre-evaluation, with the same case example and questions. In addition, the post-participation evaluation included questions on participants' feedback on their experiences with using this classification on patients with musculoskeletal pain and their attitudes and beliefs henceforth towards MBC. The later part allowed an in-depth program evaluation from the participants' perspective.

Data Analysis and Results

Descriptive analysis was done for all the findings of comparison between pre- and post-participation evaluation response categories. The following

categories were used operationally for summarizing participant responses: causes for patient symptoms, problem list, therapeutic goals, treatment selection, treatment techniques, opinion about recovery, and predicted duration of recovery. Categories related to the case example were overall impression, similarity with routine clinical practice, overall learning experience and rating of study material provided. Post-instruction evaluation included positive and negative experiences, attitudes towards positive, neutral and negative statements associated with MBC.

Fig.1: Pre-post comparison of clinical reasoning for cause of patient symptoms

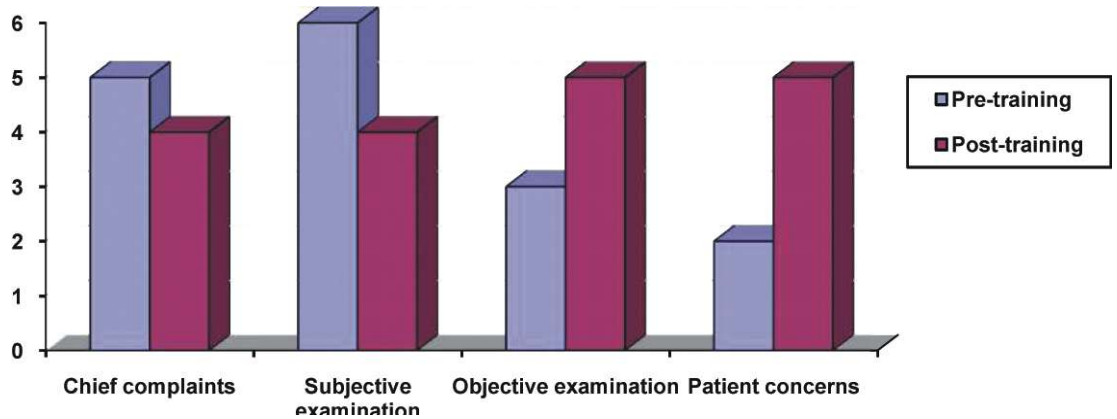


Results

The perceived cause for patient symptoms was initially based upon structural and symptoms and signs, and later it was based on mechanisms of pain (figure-1).

Causes for symptoms

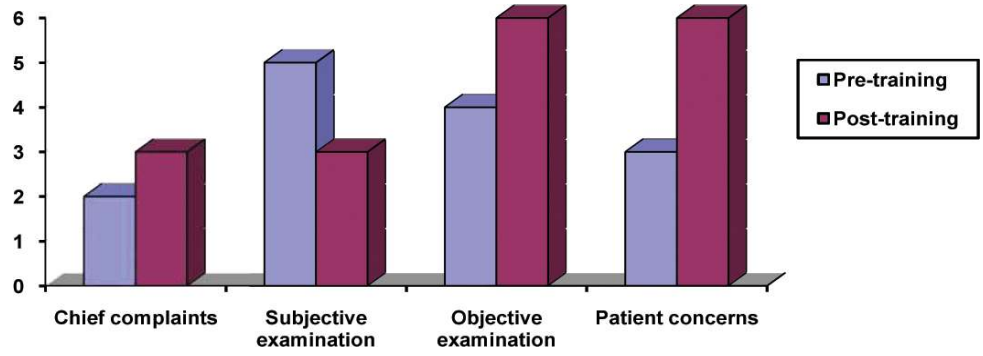
Fig. 2: Pre-post comparison of clinical reasoning for problem list of patient



The participants framed the patient's problem list based upon chief complaints and subjective examination pre-training when compared to based

Problem-listing

Fig. 3: Pre-post comparison of clinical reasoning for setting therapeutic goals.

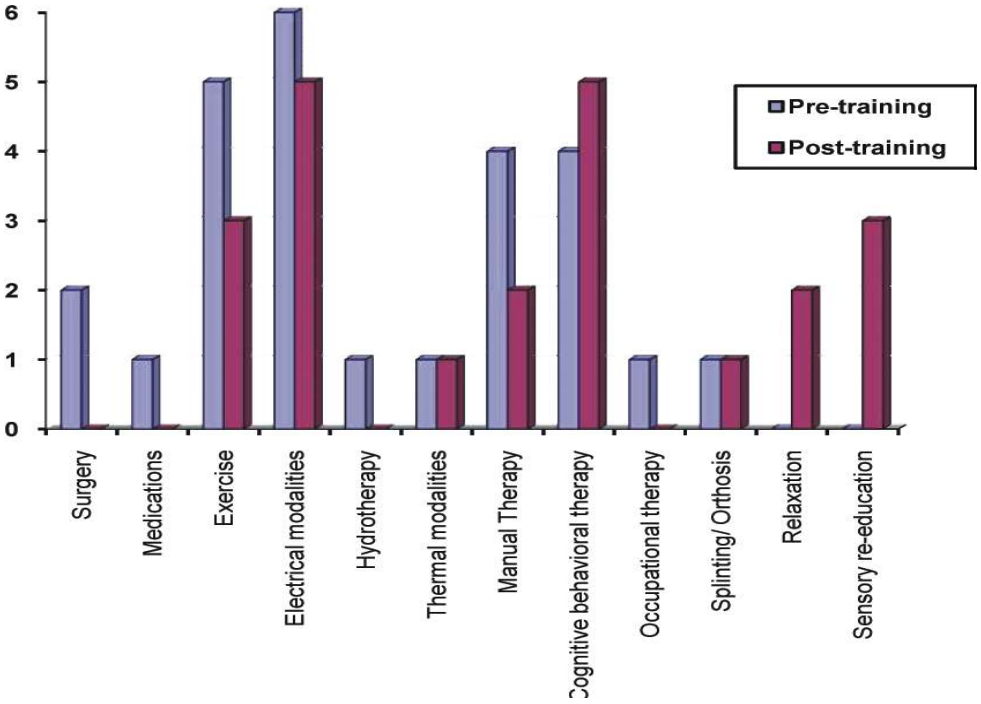


upon objective examination and patient concerns post-training (figure-2).

Therapeutic goal setting

The participants decided their therapeutic goals based upon subjective examination and based upon objective examination and patient concerns post-training (figure-3).

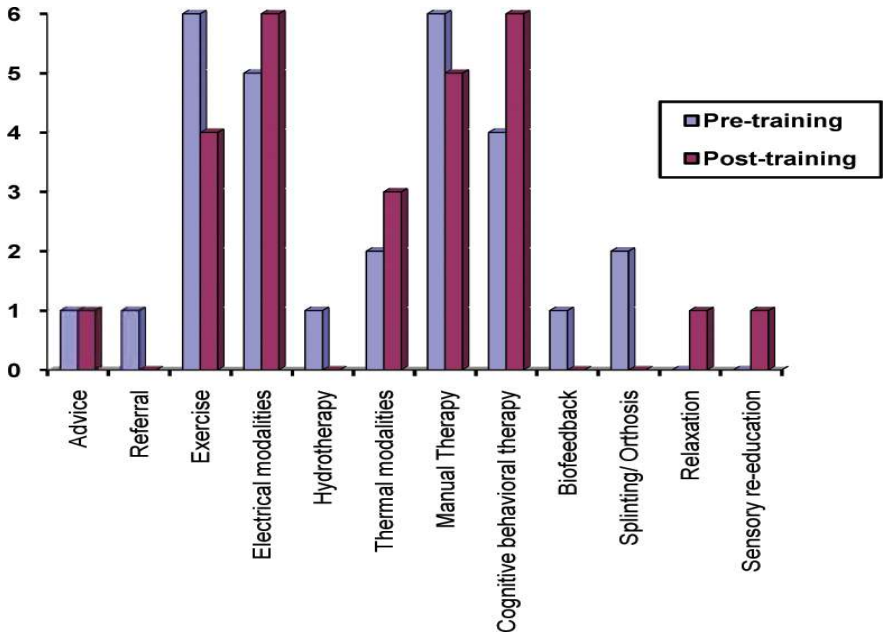
Fig. 4: Pre-post comparison of clinical reasoning for therapeutic selection.



Most of the responses pre-training were towards selection of exercises, electrical modalities and

Therapeutic selection

Fig. 5: Pre-post comparison of clinical reasoning for therapeutic techniques.



manual therapy while post-training responses were more towards cognitive-behavioral therapy, relaxation and sensory re-education (figure-4).

Therapeutic techniques

The participants' chosen therapeutic techniques were exercises and manual therapy pre-training and electrical modalities and cognitive-behavioral therapy post-training (figure-5).

Fig.6: Pre-post comparison of clinical reasoning for opinion on positive prognosis.

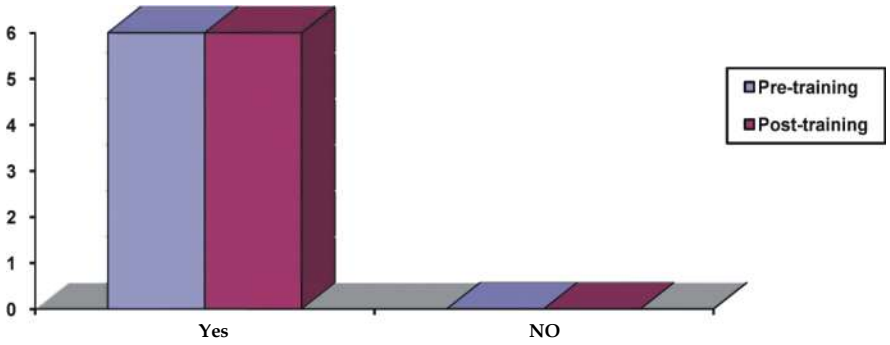
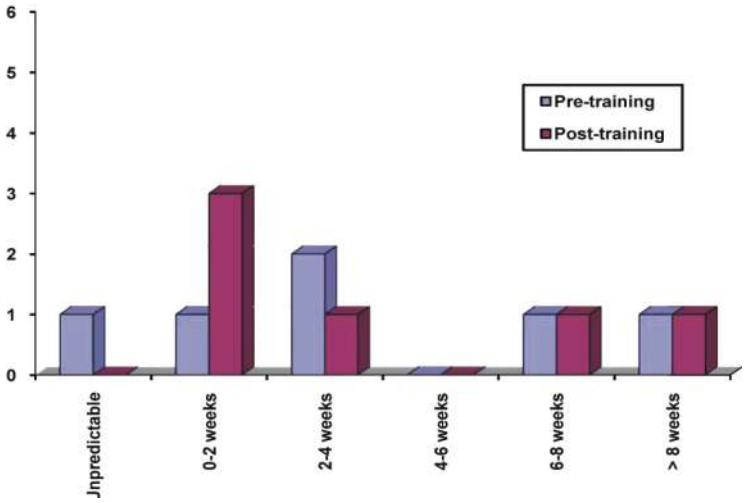


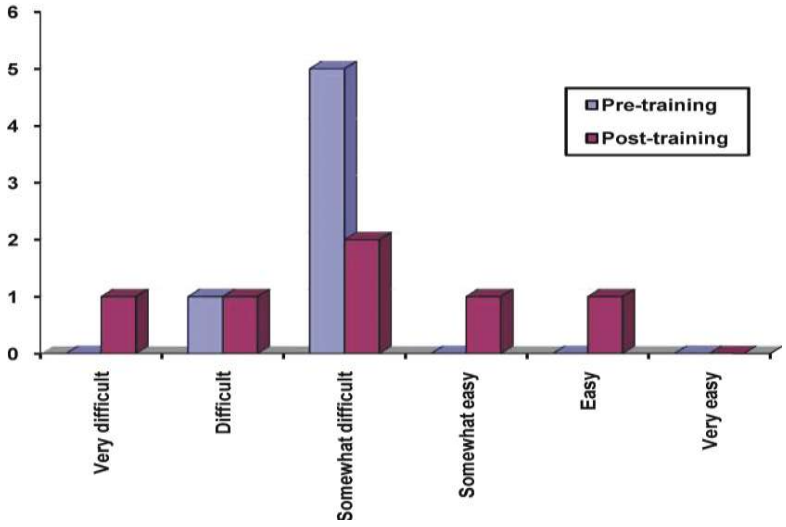
Fig.7: Pre-post comparison of participant responses for duration of patient recovery.



Opinion about recovery

There was not such an observable change in the participants' opinion about recovery when compared

Fig. 8: Pre-post comparison for overall impression about training / case example.



pre-post training (figure-6).

Predicted duration of recovery

The participants reported shorter duration of recovery in the patient post-training compared to pre-training (figure-7).

Fig. 9: Pre-post training comparison for opinion of frequency of similar case exposure in clinical practice.

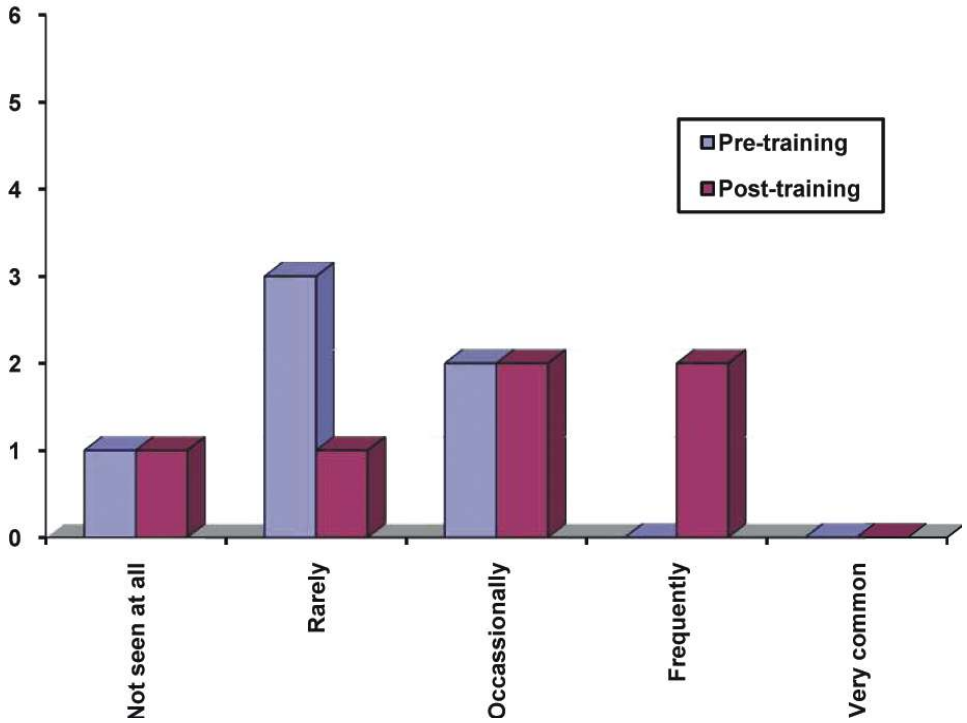
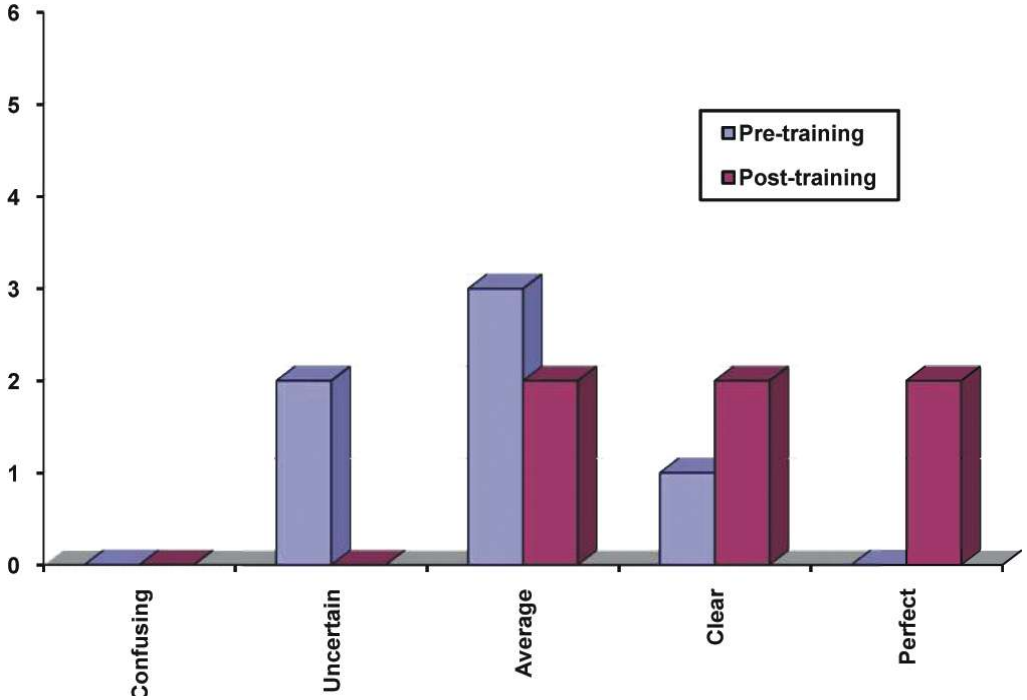


Fig. 10: Comparison of pre-post training participants' opinion about case example.



Overall impression

Majority of participants said 'somewhat difficult' pre-training and post-training, about half of the participants felt 'somewhat easy' or 'easy' (figure-8).

Frequency of similar case exposure

Fig. 11: Pre-post comparison of participants' rating of overall learning experience from the case example.

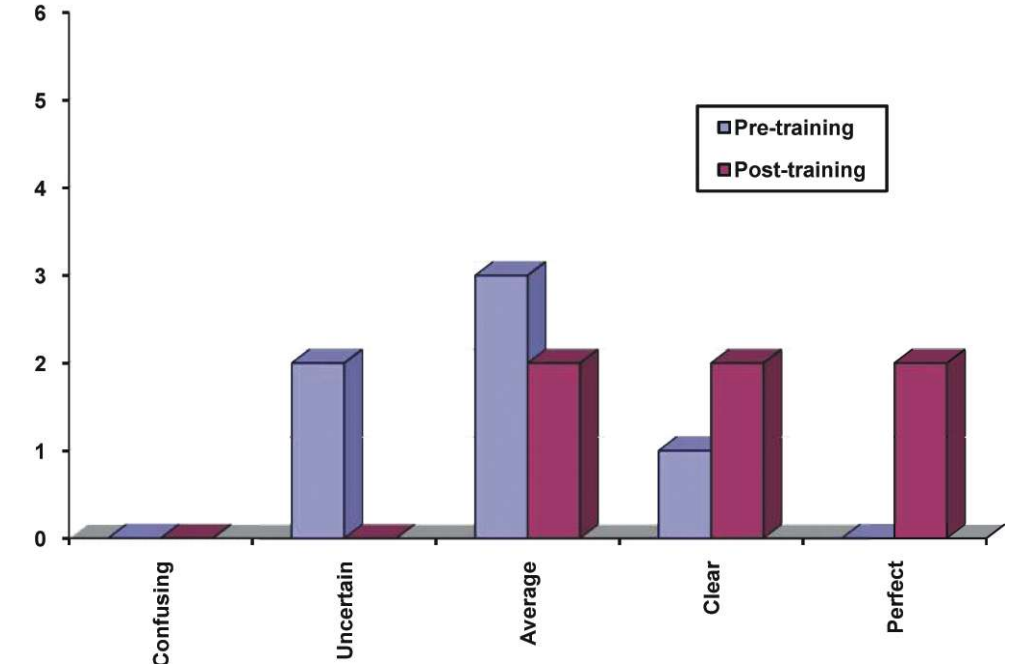
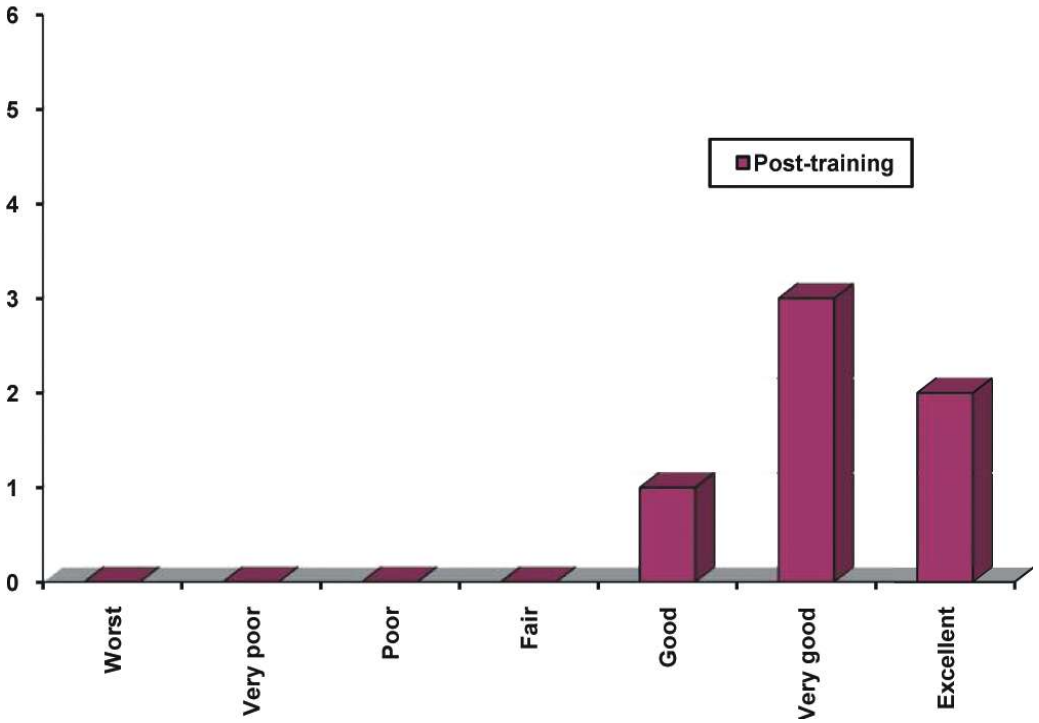


Fig. 12: Participants' overall rating of study material.



The participants started recognizing similar case situations in their routine practice, which was evident in their post-training responses (figure-9).

Overall rating of simulated case example

Majority of the participants rated the case example as 'clear' and 'perfect' following training (figure-10).

Overall learning experience from case example

All the participants rated their overall learning experience from the case example as 'good', 'very good' and 'excellent' (figure-11).

Fig. 13: Participants' rating for positive statements about MBC.

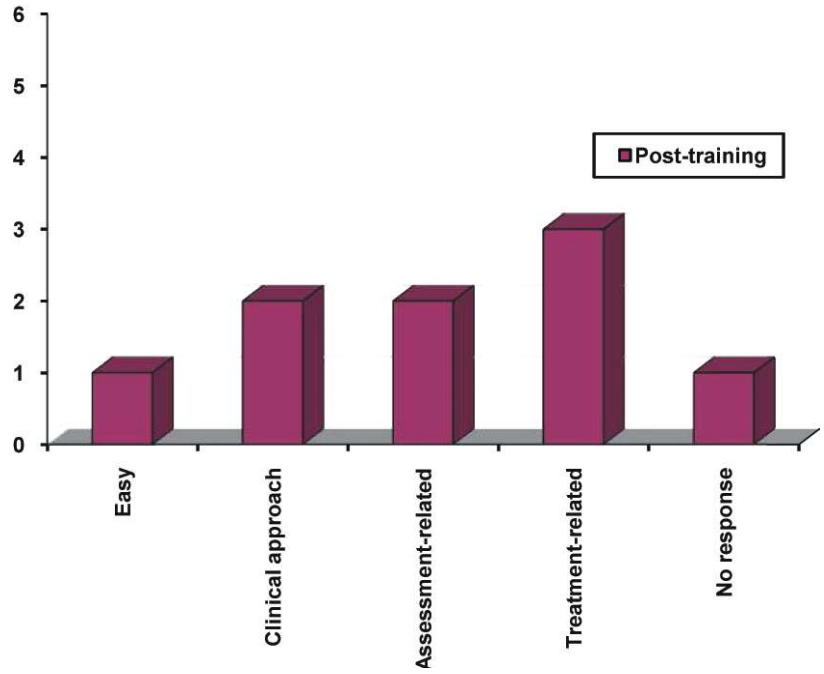
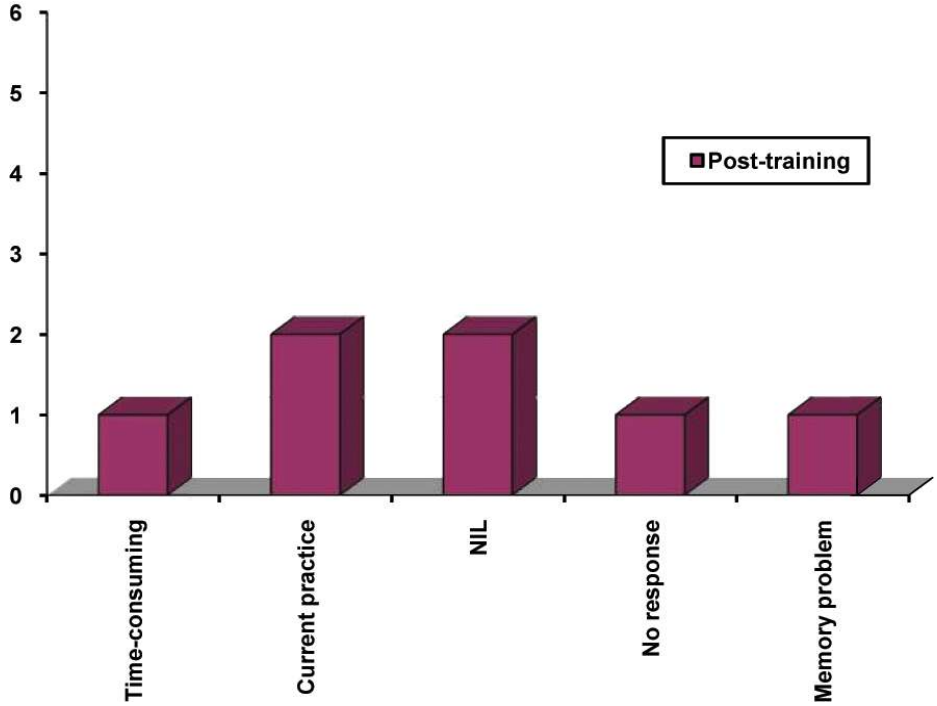


Fig. 14: Participants' opinions towards negative statements about MBC.



Overall rating of study material

All participants rated the study material as either 'good,' 'very good,' or 'excellent' (figure-12).

Did you evaluate patients using the provided evaluation form?

Yes (6)/ No

If yes; how many patients were evaluated (the completed forms have to be handed over to the instructor)? (5, 5, 5, 4, 3, 5)

What were your positive experiences (state at least two; if none, state NIL) while using mechanism-based classification of patients with pain?

About a half of the participants felt that MBC was related directly to treatment decision-making (figure-13).

What were your negative experiences (state at least two; if none, state NIL) while using mechanism-based classification of patients with pain?

Few participants felt that MBC was not reflecting current clinical practice (figure-14).

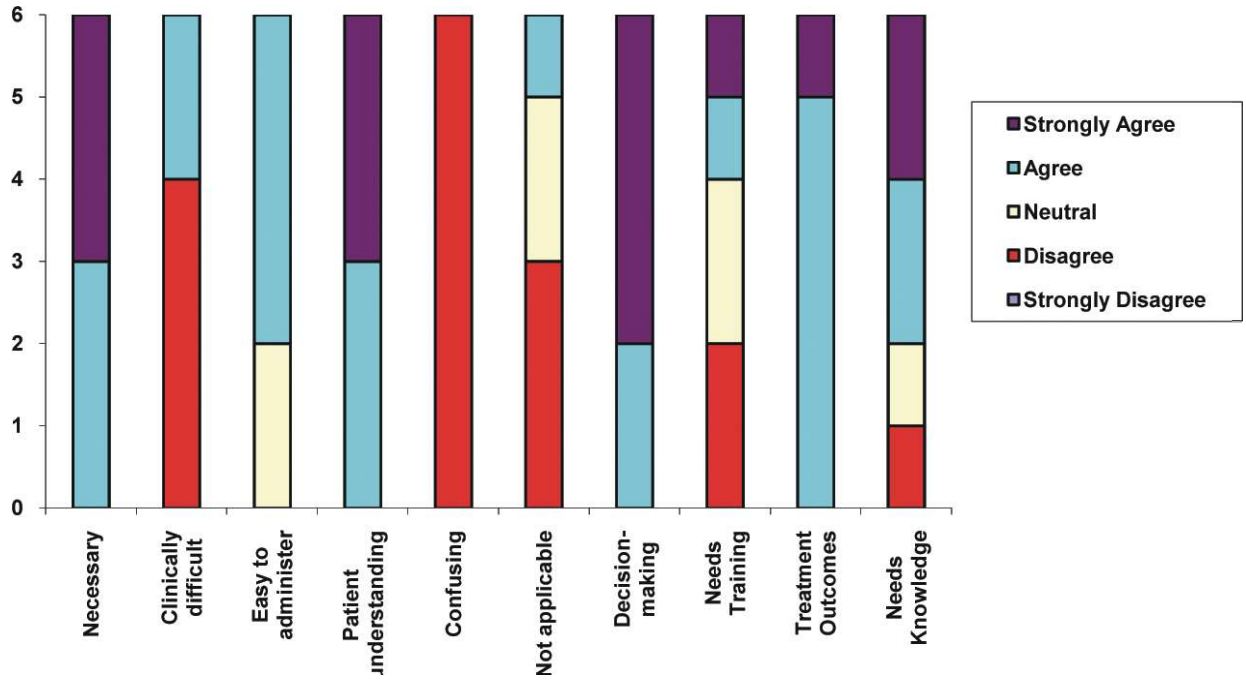
Attitudes

Of the total ten statements, five were positive, three were negative and two were neutral.

Positive statements

All the participants felt MBC is necessary in musculoskeletal physical therapy practice. All participants also felt that MBC improved their understanding about patients, clinical decision-making and treatment outcomes. Most of them felt that MBC was easy to administer while some answered neutral.

Fig. 15: showing post-participation overall participants' attitude responses towards mechanism-based classification.



Negative statements

While all participants refused that MBC were confusing, most of them refused statements of MBC being confusing and MBC was being clinically difficult.

Neutral statements

All participants opined in a mixed manner that using MBC on patients with musculoskeletal pain required additional knowledge and expert training

Overall attitudes of all participants towards MBC was given in figure-15.

Discussion

As we witness a professional (r)evolution over the past 100 years, into autonomy and direct access physical therapy services [11], the continuous growth in research evidence and enablement of evidence-based practice (EBP) [12] which later transformed itself into evidence-informed paradigm [13]. An evidence-informed paradigm currently warrants the use of MBC for assessment and treatment of patients with MSK pain.

Though previous reports emphasized inadequacies in physical therapists' clinical decision-making in treatment of patients with MSK pain, this study is the first of its kind on an educational intervention. The strengths of the study- being a qualitative design, was able to capture the subjective attributes of physical therapy students. We evaluated three categories: participants' responses regarding evaluation form, the case example, and participants attitude towards MBC. It was evident from our study that the perceived cause for symptoms was based on the pain mechanisms post training. Also the goal setting and therapeutic selection was based on objective examination post training. Thus, our results suggests that the clinical decision making was not dependent on the structure or tissue damaged but on the mechanism causing the damage. The mechanism based classification recognized the importance of neurophysiological basis of the cognitive- affective mechanisms of pain and their influence on other pain mechanisms in modulation and processing of pain. Thus, training in mechanism based classification may improve the understanding regarding the link between psychological and physiological factors in pain modulation which was evident from our results where participants selected cognitive behavioral therapy as one of the treatment technique post training.

The overall impression, learning experience and rating about the case example improved post training suggesting that the training improved the understanding about the case example. Also, the mechanism based classification was directly related to clinical decision making according to half of the participants. Along with the improved clinical decision making post training among the participants, they all had positive attitude towards mechanism based classification. According to the results of our study, mechanism based classification is necessary in musculoskeletal physical therapy practice and is easy to administer. It also improved understanding about patients and clinical decision- making. Thus, training in mechanism based classification improved clinical decision making among the post graduate physical therapy students. However, the study has its own limitations- smaller sample size, limited external validity due to differences that may exist in post-graduate curriculum across India [14]. Physical therapists need to be aware of their role in a multidisciplinary rehabilitation team to keep thinking 'out of the box [15].'

Statements	SD 1	D 2	N 3	A 4	SA 5
Mechanism-based classification is necessary in musculoskeletal physical therapy practice					
Mechanism- based classification is difficult in a busy clinical situation					
Mechanism-based classification is easy to administer					
Mechanism-based classification is useful to understand patients' clinical presentation					
Mechanism-based classification is confusing and ambiguous.					
Mechanism-based classification is not applicable for all patient types					
Mechanism-based classification is useful to improve clinical decision-making					
Mechanism-based classification is not possible without explicit training					
Mechanism-based classification is useful to improve treatment outcomes					
Mechanism-based classification is not possible without an in-depth knowledge of the subject					

Acknowledgments

Physical therapy post-graduates for their whole-hearted participation during training, case assessments and evaluation.

Conflicts of interest

None identified and/or declared.

Appendix

Answer the following (tick only one option per statement)- there are no right or wrong answers:

SD- Strongly disagree (1); D- Disagree (2); N- Neutral (3); A- Agree (4); SA- Strongly agree (5).

Conclusion

The focus group training program produced better positive effects on clinical decision making process among post-graduate physical therapy students in this

study. Overall, the participants responded positively and there were observable changes in their clinical decision-making in favor of mechanism-based reasoning.

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Original Article

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Acute Effect of Active Cycle Breathing Techniques (ACBT) and Autogenic Drainage for Airway Clearance in Bronchiectasis: Randomized Cross Over Trial

Smriti J. S.*, Narasimman Swaminathan, Cherishma D'Silva*****

Abstract

Background: Impaired airway clearance is the most common problem faced by the subjects diagnosed with bronchiectasis which makes bronchial hygiene a primary concern in the management. Several airway clearance techniques are used in the management of which Active cycle of breathing technique (ACBT) and autogenic drainage are considered to be effective and patient friendly. *Objective:* The objective of this study was to compare the immediate effects of ACBTwith Autogenic Drainage for airway clearance in subjects with Bronchiectasis. *Methodology:* Eighteen patients(5 males ,13 females) mean age of 55.39 years with the history of bronchiectasis based on purposive sampling, were recruited for the study . Assessment and familiarization session was conducted following which all participants underwent both ACBT and Autogenic Drainage in a random sequence for continuous 2 days. All the outcomes were compared pre- and post- intervention for the outcome measures, except sputum quantity, which was measured immediately after the intervention. Subjects' treatment preference was recorded at the end of the 2nd day. *Results:* None of the outcome measures showed statistically significant difference except patient preference. ACBT was preferred by most of the (11/18) patients than Autogenic drainage, hence showed statistically highly significant values between the techniques. *Conclusion:* ACBT was found to be easier technique to perform and was more effective in clearing out the secretions than Autogenic Drainage which requires more concentration to become compliant with the treatment.

Keywords: Bronchiectasis; Active Cycle of Breathing Techniques; Autogenic Drainage.

Background

Bronchiectasis is characterised by repeated pulmonary infections requiring antibiotics, disabling productive cough, shortness of breath and occasional haemoptysis. Retention of mucus is one of the primary problems of this disease which leads to chronic cough, airway obstruction and bacterial infection [1,2].

Airway clearance techniques (ACTs) are an important component of the management of patients with bronchiectasis. They are regarded as a lifelong process and the compliance to these techniques is of prime importance in these patients [3]. Various airway clearance techniques are used in the management of bronchiectasis includes postural drainage, percussion, vibration, Active Cycle of Breathing Techniques (ACBT), Autogenic drainage (AD), positive expiratory pressure therapy, flutter, A capella, high-frequency airwayoscillation, and chest wall oscillation therapy. The effectiveness of airway clearance regimen is influenced by mucus viscosity and disease severity [4]. Out of these techniques ACBT and AD are considered as simple techniques which do not require any equipment.

Active cycle of breathing technique is a form of airway clearance that improves lung function without decreasing oxygenation. The rationale by which ACTs may improve sputum clearance includes changes in lung volumes, pulmonary

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pressures and expiratory flow, use of gravity and the application of direct compressive or vibratory forces 4.

Autogenic drainage uses controlled breathing to maximize expiratory flow with minimal airway closure, starting with the small airways and moving secretions from smaller to larger airways. The advantages of AD are that it can be performed independently and even in cases with airway hyperactivity [5].

Autogenic drainage has been found to be as good as ACBT at clearing mucus in patients with cystic fibrosis and is therefore an effective method of home physiotherapy. Both methods have showed improved ventilation [6].

To our knowledge little research isdone to study the effects of Autogenic drainage in comparison with other airway clearance techniques and none comparing it with ACBT in Bronchiectasis. This study compared the immediate effects of ACBT and Autogenic Drainage for airway clearance in subjects with Bronchiectasis and patients preference.

Methodology

Methods

Subjects diagnosed with bronchiectasis aged between 20–60 were recruited for this study from a tertiary care hospital. Subjects with haemoptysis, active tuberculosis and undergone lung surgeries were excluded from the study. A total number of 18 subjects met the inclusion criteria during the study period. Ethical clearance was obtained from the Institutional review board prior to the commence of the study. All the included participants were explained about the study and a written informed consent were obtained.

All the participants were provided ACBT and AD for the continuous two days in a random order. The randomisation of the techniques was done by using www.randomozation.com [7]. The wash out period between the techniques was 24 hours. The subjects were demonstrated both the techniques and they were instructed to perform the technique early morning. A same therapist trained with the techniques supervised the sessions.

ACBT

During this procedure the subjects were seated in relaxed position and instructed to relaxed diaphragmatic breathing several times followed by which they were encouraged to take deep inspiration with tactile and vocal stimulus from the therapist. This was repeated till the subject could feel the movement of the sputum and then they were instructed to do forced expiratory technique.

AD

During this procedure the subjects were asked to take low volume breaths, from expiratory reserve volume in relaxed sitting position. They were asked to repeat this for 10 – 20 times followed by which they were asked to take larger breath until secretions were felt gathering in the airways. Then they were instructed to take even larger breaths followed by several huffs. The subjects were instructed to suppress the cough during the entire procedure.

Quantity of sputum expectorated immediately following the administration of each techniques and 30 minutes after was measured by using a calibrated volumetric jar. Oxygen saturation was also measured by using Pulse oximeter (VIAMED Ver. 2.2 D) before and after the sessions. Perceived exertion was assessed by modified Borg scale. On the second day after the sessions the subjects were asked about their preferred method of choice and the reason for in their own language, which was documented.

Data analysis

All statistical testing was performed using the Statistical Package for social science version 13.0 soft ware. Mann –Whitney test was used to compare the outcome measures between both the techniques. Wilcoxon Signed Rank Test was used for within group analysis between pre and post treatment parameters. A p value of <0.05 with confidence interval of 95% was considered statistically significant.

Results

18 subjects with mean age of 35.39 years completed the study out of which 13 were females and 5 males.

The sputum volume expectorated post ACBT was 6.33 ml and post AD was 5ml .The mean difference for sputum quantity between ACBT and Autogenic Drainage was not significant but the mean score for ACBT was higher (Table 1).

The mean score for perceived exertion following ACBT showed a reduction from 1.67 to 1.39 with a mean difference of 0.28 where as breathlessness score following AD showed a reduction from 1.11 to 1.08

Table 1: Sputum quantity post intervention

Technique	Mean (SD)	Mann Whitney test z-value	p-value
ACBT	6.33 (0.72)	0.773	0.439
AD	5.00 (0.61)		NS

with a mean difference of 0.03. The mean HR score increased from 83.67 to 85.50 with a mean difference of 1.83 post ACBT treatment but there was no change in mean HR post Autogenic Drainage. There was an increase in SpO2 levels from 96.67 to 97.61 with a mean difference of 0.94 post ACBT, along with the increase in SpO2 score from 97.17 to 97.61 with a mean difference of 0.94 post AD. The data showed that there was no effect of either of the treatment on breathlessness, heart rate, respiratory rate and oxygen saturation. Out of the 18 subjects 11 preferred ACBT over Autogenic Drainage (table 2).

Table 2: Effect of acbt and autogenic drainage on various parameters

			Mean score	S.D	Wilcoxon signed ranks test Z-value	p- value
Perceived exertion	ACBT	Pre	1.67	.372	1.85	.064
		Post	1.39	.568		
	AD	Pre	1.11	.278	.111	.913
		Post	1.08	.141		
HR	ACBT				t- value	
		Pre	83.67	18.036	1.33	2.00
		Post	85.50	15.401		
	AD	Pre	85.06	14.594	0.00	1.000
		Post	85.06	14.169		
		Post	24.56	6.784		
	AD	Pre	22.22	6.015	1.62	.124
		Post	23.56	7.139		
SpO2	ACBT	Pre	96.67	4.472	1.71	.105
		Post	97.61	2.500		
	AD	Pre	97.17	2.749	1.29	.215
		Post	97.61	2.330		

Discussion

The present study aimed to compare the immediate effects of ACBT with Autogenic Drainage in airway clearance in Bronchiectasis .There will be increased production of mucus in Bronchiectasis with impaired mucociliary system. Improper airway clearance will lead to atelectasis, infection, and increased airway resistance, increased work of breathing and ultimately hypoxemia and tissue hypoxemia [5]. Airway clearance is the combination of the mucociliary escalator and coughs that is the natural, mechanical defence mechanism of the lung. ACTs are safe and effective in acute and stable Bronchiectasis [8].

There is little research done to study the effects of Autogenic drainage in comparison with other airway clearance techniques and none comparing it with ACBT in Bronchiectasis. The outcome measures used in this study were sputum weight, breathlessness, HR, RR, SpO2 and patient preference. None of the outcome measures showed significant difference between both the groups except for the patient preference.

ACBT showed more sputum clearance than Autogenic Drainage as mean sputum quantity for ACBT and Autogenic drainage was 6.33 ml and 5.00 ml respectively, but it was not statistically significant. This may be due to small sample size and lack of homogeneity in those subjects. In another randomised crossover trial done in 30 COPD subjects to compare the effects of ACBT and Autogenic Drainage, both the treatments were found equally effective in sputum clearance however, no significant difference was found in sputum volume between the treatments. Sputum volume was measured by using a plastic beaker because it is a simple non- invasive short-term clinical outcome measure of the effectiveness of airway clearance technique. The mean volume of the

sputum was not specifiedby the authors [9]. It has been suggested that sputum volume or weight is misleading, as unknown quantity of saliva may be included [10]. Similar observations have been reported by Miller et al comparing AD with ACBT in 18 cystic fibrosis patients, observed no significant difference in sputum weight between the two methods as the mean difference between Autogenic Drainage and ACBT was -0.4 (1.8) g. The reason for this is not explained in the study except for ventilation [6].

Perceived was reduced on Modified Borg scale post treatment with both ACBT and Autogenic Drainage but the mean difference score was higher post ACBT (0.28) when compared with post Autogenic Drainage (0.03). This may be due to the components of breathing control and thoracic expansion in ACBT. Moreover both the techniques have a component of relaxed diaphragmatic breathing. The mean perceived exertion score between ACBT and Autogenic drainage was statistically not significant. In a similar study done by Moiz et al [9] in COPD patients, breathlessness reduced after removal of secretions with both the treatments but the reduction was more with Autogenic Drainage but explanation for this is not specified in the study.

The mean score for HR between ACBT and Autogenic drainage did not show significant change. HR was found to be increased post ACBT technique with a mean difference of 1.83 but there was no change in HR post Autogenic Drainage (0.00). The reason of this increase in heart rate can be explained by this theory which says that 'at low level of exercise, heart rate increases almost exclusively via vagal withdrawal, with little evidence for systemic increases in sympathetic nerve activity until the intensity of exercise is at or above the maximal steady state [11,12] .

The mean RR score was statistically not significant when compared between both the techniques (mean difference post ACBT and Autogenic drainage was 0.56 and 1.34 respectively). In a similar study by Moiz et al [9], subjects were found to have no significant change in respiratory rate during both ACBT and Autogenic Drainage techniques in COPD, but there was a significant decrease seen 30 minute post treatment both with Autogenic drainage and ACBT ($p= 0.001$ and $p= 0.016$ respectively) when compared to their baseline values.

The mean score for SpO2 between both the techniques was not significant but the mean score increased post intervention when compared to the pre intervention reading, both during ACBT and Autogenic Drainage (mean difference of 0.94 and 0.44 respectively). Effectiveness of ACBT may be attributed to one of its components of breathing control which increases oxygen saturation post treatment. In a study done Savci found that in AD treatment, the increase in oxygen saturation was significantly higher than in ACBT [13]. In contrast Miller et al in a study comparing Autogenic Drainage and ACBT with postural drainage, both the treatments were found equally effective and there was no much difference in oxygen saturation values in cystic fibrosis patients. However, no patients dropped saturation in either method. Increase in oxygen saturation might have been the results of removal of retained mucus plugs from the airways, lead to improved alveolar ventilation, optimized ventilation- perfusion mismatch, and finally improved oxygen transport to the tissue.

ACBT was preferred by most of the (11/18) patients than Autogenic drainage, hence showed statistically highly significant values between the techniques. ACBT was found to be easier to perform and was more effective in clearing out the secretions. Autogenic drainage requires more concentration to learn the technique as it is to be performed at 3 different lung volumes. In a study by Miller et al in cystic fibrosis, patients who preferred Autogenic Drainage (9/18) to ACBT (8/18) seem to be with better concentrations who were generally more compliant with treatment. The time taken to learn Autogenic Drainage is much longer than the time to learn ACBT [6].

Conclusion

ACBT was found to be easier technique to perform and was more effective in clearing out the secretions than Autogenic Drainage which requires more concentration to become compliant with the treatment.

Limitations of the study

The limitations of this study were smaller sample size with lack of homogeneity in subjects. Moreover the quantification of the sputum produced was done using the volumetric jar, instead of which measurement of dry sputum weight could have been done.

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Review Article

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Role of BOMB Test in Shot Put Players Evaluation

Malika Nazish*, Saurabh Sharma**

Abstract

Medicine ball overhead throw test is a dynamic test to evaluate and assess the dynamic involvement of the trunk and upper body as a contributor to athletic performance. The reliability of the BOMB test has been found to be high. Medicine ball throws involves, multidimensional, functional training that use a varied muscle activity sequences and velocities. The ball throw test is serving as talent selection and evaluation for power in these sports athlete. Therefore, Medicine ball tests have several advantages: they are relatively affordable field tests, they give a high degree of testing flexibility, and a lot of information can be derived from the test results when evaluated properly. However very limited research work is done in the event of shot put and considering this further work is required in this a athletic event.

Key words- BOMB Test; Shot Put; Functional Training.

Introduction

Nowadays , sports is considered to be event but also as image lifter of the nation, amongst all sports athletics is one of the most popular sports . The world events are successful only because of athletes [1,5] the requirements of the game/sports require varied skill and conditioning limits. Track and field events have a huge requirement of muscle power generation [19]). Training programs should aim at increasing at increasing force and velocity to develop power [7,8]. Medicine ball throw test are generally used to test the power of the kinetic chain of the body. The explosive power is produced by the lower quadrant and must be conducted smoothly through the kinetic chain to execute a skill successfully. Any athletic activity that involves a amalgamation of strength and speed will usually have explosive power as a feature for the successful execution of its required skills [13]. As in shot put technique athlete require both speed and power for execution of the proper throw. And BOMB is the valid tool for assessing power. Therefore , we are reviewing the role of BOMB test in shot put players evaluation.

As we all know shot put throwing is one of the most popular games in the athletics which needs a power full strength in the upper extremity to throw a metal ball with the one hand. Shot put is an extremely complex and dynamic stereotype requiring the optimal interaction of movements of individual segments and interaction of strength and power. As power is the application of strength with speed. The quest for the development of power as a means to better sports performance is insatiable. Training methods to improve power have had a spectrum shift from heavy resistance training to light resistance training to plyometrics where the acceleration and deceleration of the body is the overload. Above mentioned methods have given result but the results have not always been in line with the training time invested.As we all know that BOMB (backward overhead medicine ball throw) test is the reliable and valid test for determining the power of the upper extremity. Medicine ball throwing correlates with upperbody strength as well as with throwing and hitting ability[3,4.16,18]. The reliability is well proved by Stockbrugger and Haennel [16] of the BOMB test was high (interclass correlation coefficient = 0.86). Tests of explosive power involving the upper quadrant that assess the dynamic involvement of the trunk and upper body to athletic performance are becoming more acceptable [17]. The implication for practitioners in using the medicine ball throw for

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children aged 5–6 years is that the medicine ball throw seems to be a reliable field test of upper body strength for that age group [1]. Medicine ball throw tests have several advantages: they are inexpensive, they offer flexibility in testing, and they can provide physical education teachers with information on the effectiveness of strength programs for children [16]. But according to Mayhew et al [9] showed that the BOMB throw may have limited potential as a predictor of total body explosive power in college football players. They studied that peak and average powers generated during the vertical jump correlated moderately but significantly with the best BOMB throw distance (r = 0.59 and 0.63, respectively). Considering power relative to body mass or lean body mass failed to produce significant correlations with BOMB throw distance (r = 0.27 and 0.28, respectively).

In relation to core strength the study done by Chris Sharrocket al [14], results of this pilot study suggest that weakly significant relationship is present between the double leg lowering test as a measure of core stability and the medicine ball throw. Top performers demonstrated a stronger, significant correlation between these tests as compared to bottom performers. The data for males was better than females.. Although there was limitation of that study was that possible limitations in this study include the absence of height and weight measurements for the subjects used in the study chances are that there is a relationship between variables. Another study done by Okada et al [10] tried to find out the relationship between core stability, functional movement and performance, and the alternative aim was to explore assessment tests that best predict, performance and interestingly, BOMB did not have significant correlations with any of the core stability variables. This may be caused by the different components tested. The core stability is used to measure muscle endurance, whereas BOMB is used to assess explosive power. During BOMB, the core muscles quickly contracted to produce explosive power, so muscle endurance does not appear to impact the task. Significant positive result (BOMB vs. hurdle step, push-up, and Rotatory stability). They give the possible reasons for these results may be body coordination patterns or body movements. For example, BOMB recruited similar body coordination and movement patterns as hurdle step, push-up, and Rotatory stability.This indicates that both tests required great total-body coordination and integration.In addition, both BOMB and Push up occurred in the sagittal plane while maintaining a symmetrical body motion. Similarly, stability and mobility combined with body coordination and integration were important for better throwing distance; they contribute to efficiently transfer the kinetic energy through a kinetic chain and prevent an ''energy leak'' while performing the task [16].

Medicine ball throws involves, multidimensional, functional training that use a varied muscle activity sequences and velocities. The dynamic nature of standing medicine ball throws has increased their use as a training tool because they integrate the whole body into each movement task. Newer methods of using medicine ball are being explored to develop newer and better training programs [17]. Explosive power generation using medicine ball throws involves high levels of reactive neuromuscular control [1]. It also demands high levels of proprioception and coordination, with movement often occurring through multiple planes [1]. To assess athletic ability during this type of activity, testing may also need to involve integrated, multidimensional movement that simulates as closely as possible the activities required for success in a particular sport [1]. The use of an integrated total-body movement task may be an important tool in assessing the ability of athletes to transfer the training effect of upper- and lower-body strength and power into the necessary functional movements in their sport and optimize performance. It is recommended that medicine ball throws be incorporated into both the testing and trainingof athletes in all sports. The recommendation is that coaches find specific movement tasks that can be simulated with medicine ball throws and use these as both testing and training activities [17]. BOMB test carries an advantage over seated shot put as it an integrated functional pattern suited to shot put [5,12]. Stockbrugger et al [17] found in their research that the evidence from that study suggests that the relative contributions of upper- and lower-body strength and power to performance of the integrated, multidimensional movement task of a B-MBT will vary depending on athlete type. The performance characteristics necessary for volleyball and wrestling tend to express themselves as the key factors related to B-MBT throw distance. It is critical to judge specific performance requisites such as upper- and lower-body strength and power. It is also valuable to evaluate athletes in ways that integrate these characteristics to determine if they are able to effectively integrate the upper and lower body as well as strength and power characteristics to accomplish more complex, multidimensional movement tasks. And with the use of integrated total body movement tests combined with more specific activities, it may be possible to identify areas of specific weakness or areas where additional increases in strength and power may not add significantly to performance of

integrated multidimensional movements or sport-specific performance. The study result by reis et al [11] suggest that a combination of throwing tests (Over-Head Back Throw and Squat Double-Jump Front Throw) and heavy-lift tests (Bench Press, Half Squat and Power Snatch) may provide a good predictive power, as they could explain ~88% of the variance of the Shot Put performance with a relative error of ~2.7%. This is one and only a pilot study that validates the medicine ball throw test in shot put players. The other studies done are generally on sports and games and on different population. In relation to shot put medicine ball throw test are serving as talent selection and evaluation for power in these sports athlete [6]. Therefore Medicine ball tests have several advantages: they are relatively affordable field tests, they give a high degree of testing flexibility, and a lot of information can be derived from the test results when evaluated properly [16].

Conclusion

As after studying the literature we found there is dearth of this important test in shot put athlete. Therefore, our purpose of this review is to find out the role of BOMB test in evaluation of shot player especially in females.

Fig. 1: showing starting and ending position of BOMB test

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Review Article

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A Scoping Literature Review on Effects of Eye Exercises for Myopia in Children

Rahul Pandey*, Vencita Priyanka Aranha, Asir John Samuel ***, Senthil P. Kumar**

Abstract

The scoping review on eye exercise for myopia in children was aimed to provide an evidence-informed overview to highlight the role of exercises for myopia in children. This helps in the treatment of myopia and to improve the visual health in easy and better way. More high quality research articles are needed to prove the effort of exercise on myopia in children.

Keywords: Pediatric Myopia; Pediatric Visual Rehabilitation; Oculomotor Rehabilitation.

Introduction

Myopia is the commonest type of refractive error in eye where the light from infinity will focus in front of retina rather than focusing on the retina leads to blurring of image. Myopia is derived from Greek word *muópia* which means "trying to see like a blot", and also called as shortsightedness. Shiny et al [1] described the eye with myopia as "one for which the punctum remotum is a short distance off, sometimes only a little inches from the eye", and also says myopia is "one in which the images focus in front of the retina while eye at rest".

The preponderance of shortsightedness varies by country and by indigenous assortment, reaching as high as 70-90% in some Asian populations [2]. Near epidemic levels of myopia of up to 80% have been reported in countries such as Hong Kong, Taiwan, Singapore and Japan [3-5]. In Europe and America, its preponderance varies between 30-40%, while in Africa 10-20% of the population is affected. Shortsightedness affects 25% of the population in United States. The prevalence of myopia in India is 45% [6-8]. Available treatment option for myopia are optical correction, pharmaceutical treatment like cycloplegic promoters, vision therapy, orthokeratology, refractive surgeries like (radial keratotomy, excimer laser photorefractive keratectomy), osteopathy, yoga therapy and aerobic exercise therapy [9]. These treatment choices have many problems like post-operative complication, cosmetic problem, eye infection, the daily use of spectacles may limits their daily activities such play, dance, and even other activities specially in children. The simple eye exercise will be more beneficial for the treatment of myopia in children

Exercise therapy for eye is not a new approach. In fact, vision workout and treatment approach have been around for years. The designs of these treatment or eye exercises aids in conquer different visual disorders including binocular function. Not all the treatment methods have been proven effective by exercises. In this study we explored the research articles from the pubmed and Cochrane library for eye exercises and myopia in children and all available articles selected for review.

Exercises and Myopia

Samia [10] have done a randomized clinical trial on myopia with 15 female aged between 12 to 15 years in Saudi Arabia and the results of the study showed that there is improvement in visual acuity in subjects with myopia. These results suggest that clinicians should consider the use of eye exercises as a way of improving visual acuity for adolescents suffering from myopia.

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Rathod et al [11] performed research work on myopia in thirty subjects, age ranging between 18-25 years. Subjects were randomly assigned in to two group that is Group A (Experimental Group) and Group B (Control group). Group A received Eye focusing exercises 10 repetition 3 sets daily for 4 weeks with standard care and the control group does not received any exercises except standard care for myopia for 4 weeks. The results show that, the eye exercises are effective in improving near point convergence in myopia but the improvement of visual acurity was not statistically significant

Gosewade et al [12] have conducted a study on the effect of eye exercise techniques along with *kapalbharti pranayama* on Visual Reaction Time (VRT). 60 participants with an age group of 18–30 years were divided into two equal groups (study group and control group) containing 30 subjects (18 male and 12 female) each. VRT of all participants were taken prior to the study. Eight weeks of regular eye exercise techniques and *kapalbharti pranayama* was trained for the study-group subjects whereas the control-group subjects were not practiced any eye exercises techniques. After 8 weeks VRT was measured again. The result shows there was significant decrease in the VRT after intervention in study group and there were not any changes noticed in VRT of control group. They concluded that the simple eye exercises along with pranayama helps in improvement of visual reaction time.

Gopinathan et al [13] have performed a research and they were aimed to evaluate the role of eye exercises and Trataka Yoga Kriya on Ammetropia and Presbyopia. 66 patients were divided under two main groups with four sub groups of refractive error like shortsightdness, hyperopia, astigmatism, and presbyopia, respectively, (Group A – 32 patients, Group B – 34 patients) by random sampling method. Group A subjects were asked to perform eye exercises daily once for 3 weeks. Group B subjects were instucted to perform Trataka Yoga Kriya once at daily (either in morning or in evening) for 3 weeks. The prescribed eye exercises were Sunning, Eye wash, Palming, Candle light reading, Shifting and Swinging, Playing with ball, Vaporization and Cold pad. The subjects were observed for 1 month in order to see any adverse effects of the therapy. The study suggests that there was one line rectification in Snellen's chart reading and concluded that a non-medicinal, inexpensive, relaxation approaches can rectify the quality of vision, by which it discursively review the betterment of the disease status.

Discussion

The available treatment option for myopia have many consequences like cosmetic problems, eye strain, asthenopic symptoms, post LASIK infection, postoperative infection, recurrence of refractive error etc. to overcome from these consequences the eye exercise can provide beneficial therapeutic effect for the treatment or prevention of the development of myopia without any consequences. Limitation of this review is lack of systemic review and lack of clinical trials.

Conclusion

In these literature reviews we found that how eye exercises are effective in the treatment of myopia. But there are only three cochrane and two pubmed indexed researches are published till date. The intension of this review is focused to emphasize the research for the treatment of myopia with exercise in future days. So that myopia can be treated in a better and easy way.

Conflict of Interest

Non declared

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Review Article

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Scapular Dyskinesis

Mohd Iqbal*, Saurabh Sharma**

Abstract

Scapular dyskinesia is the alteration in the static and dynamic positioning of the scapula on the thorax. It is not an independent entity and is associated with other shoulder problems. Statistics has shown that its incidence to be 67% in cases of shoulder instability and 100% in cases of shoulder impingement. There are various means of scapular dyskinesis measurement. 3D measure analysis is considered to be the gold standard. Number of clinical tests have been developed but the problem is that dyskinesis may also be associated in asymptomatic patients also. So it is important to distinguish whether it is a factor which is perpetuating symptoms or not. Tests like SRT (Scapular retraction test) and its refined version SRT (Scapular repositioning test) has been found to have acceptable reliability. The main purpose of these tests is to identify scapular dyskinesia in patients with shoulder pathology who can be helped by improving scapular muscle balance.

Keywords: Scapular Dyskinesis; SRT; Shoulder Impingement.

Introduction

The normal movement of the scapula during arm elevation is a synchronized sequence of superior rotation and posterior tilt [2,15,21] with a variable amount of mediolateral rotation[21]. Alteration in both static position and movement pattern of the scapula on the thorax has been called 'scapular dyskinesis' [8]. This abnormality has been seen along with different shoulder conditions like rotator cuff injuries, shoulder instability and shoulder impingment [6,31,32]. Etiological factors for this problem are loss of muscular control that may due to reduced serratus anterior muscular activity and increased upper trapezius muscular activity [14]: nerve damage like injury to dorsal scapular nerve, long thoracic nerve or spinal accessory nerve [5] alteration in muscular length like decreased pectoralis minor muscle length [1] and a direct trauma to these muscles can result in impairment of normal function. Non muscular causes of scapular movement include AC joint separations clavicular fractures and muscle detachments [9].

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Scapular dyskinesia as a nondependent entity

Scapular dyskinesis is not a independent entity and may occur adjunctly with other shoulder pathologies [11,15,23]. Scapular dyskinesia has also been observed in asymptomatic individuals and there is little difference in magnitude of scapular dyskinesia when compared between symptomatic and symptomatic individuals [14,16,31].

This dyskinesia is reflected by the tilts described in the three types of dyskinesis that predispose the individual to further injury. Type I has prominence of inferomedial border of the scapula that occurs due to abnormal posterior tilt of scapula. Type II has prominence of whole medial border that occurs due to excessive external rotation of scapula. Type III has a pathological upward migration of the superomedial border of scapula. Lukasiewicz et al [16]described the scapular dyskinesia in individuals with impingement syndrome. This relationship was further studied by Schmitt and Snyder-Mackler [24] who observed concomitant serratus anterior weakness, middle and lower trapezius weakness in a case of primary subacromial impingement. Such patients have type I inferior medial border winging. Kibler [5] has explained a spectrum of pathologies that can lead to scapular dyskinesia as:

1. Lack of protraction increases the decelerating force during throwing which can lead to both micro- and macrotrauma to the external rotators.
2. Lack of protraction results in anterior opening of the glenohumeral joint during arm deceleration thus increasing stress to anterior static stabilizers of glenohumeral joint leading to laxicity or glenohumeral instability [5].
3. Excessive protraction reduces the scapular elevation and upward rotation thereby decreasing the subacromial space thus leading to shoulder impingement syndrome. This impingement can further lead to rotator cuff tendinitis, glenohumeral instability, and inefficient supraspinatus function [5].
4. Scapular dyskinesis leads to a breakdown of the kinetic chain because of that force that is generated in the lower extremity and/or torso cannot be appropriately transmitted for involved upper extremity movements. This loss of controlled motion leads to greater muscle activation and force generation being by the intrinsic and extrinsic shoulder muscles as well as the muscles of the arm and hand in order to compensate for the lost kinetic force. The end result is overuse and injury of these musculatures [5].

Modes of scapular dyskinesia evaluation/measurement

There are various methods to assess scapular motion and position like clinical examinations, video analysis and X ray imaging. The goal of scapular assessment is to identify abnormal scapular motion or positioning, identify the causative factors of scapular dyskinesia, determine any relationship between the symptoms and altered motion [7,9]. Clinical assessment of scapular dyskinesis is very challenging because of 3-dimensional nature of scapular movement and presence of soft tissue over and around the scapula obscuring direct measurement of bony positioning. Various methods/ tests have been described to identify scapular dyskinesia, however many of those tests have adequate level of reliability but validity of those tests is questionable because of lack of correlation of scapular dyskinesia and symptoms [9]. Clinical evaluation of scapular dysfunction should include 3 basic elements: (1) visual observation to determine the presence or absence of scapular dyskinesis in the symptomatic patient; (2) the effect of manual correction of dysfunction on symptoms; and (3) evaluation of surrounding anatomic structures that may be responsible for dyskinesis [9].

3 dimensional kinematic analysis of scapular movement have produced reliable measures, with ICC coefficient of values ranging between 0.77 and 0.90 and SEM values ranging from 1° to 2° [19]. However availability of 3D motion analysis in every clinical set up is the limiting factor. Various clinical tests that are used to identify scapular dyskinesia are as under:

The Lateral Scapular Slide Test involves the static measurement of the side-to-side difference of the distance from the inferior angle of the scapula to the adjacent spinous process of vertebra [5]. The measurements are taken with arms in three different positions and if the side to side difference is greater than 1.5cm, it is considered as pathological. This test has shown fair to moderate levels of reliability and is easily applicable in a clinical settings [5,20]. The major advantage of this test is its ease of use in the clinics. However, the validity of this test has been questioned because of the findings that both symptomatic and asymptomatic individuals will show asymmetry while testing by this method [13,19]. Also if both the shoulders have symmetrical scapular dyskinesia then the validity of this test is questionable when comparison is made only to the contralateral side. Furthermore, due to 2 dimensional and static nature of this test, it fails to fully assess the dynamic 3-dimensional motion found to occur with scapular movement [13,18,28]. This inadequacy of measurement along with questionable validity of results requires the use of other methods of scapular assessment during clinical examination.

Visual assessment schemes of classifying scapular dyskinesis have been developed in an attempt to resolve the issues with linear or static measures [12,18,30]. These methods involve classifying scapular movement that occurs during shoulder motion into normal or abnormal categories. These measures are considered more functional and more inclusive with the ability to judge scapular movement in 3-dimensional plane. Kibler et al [12] was the first who gave the observational method for rating scapular dysfunction into three categories. The above mentiones system had too low reliability and it had to be refined later [18,30].

The Scapular Dyskinesis Test is a visually based test for scapular dyskinesis that involves a subject performing weighted shoulder flexion and abduction movements while visual observation of the scapula is performed [18]. This test is basically a classification for presence and absence of dyskinesia. Dyskinesis included a cluster of findings like winging or dysrhythmia [18,28]. Interrater reliability of this test, has been shown to be better than other previously

described visual classification systems. Concurrent validity was assessed in overhead athletic population and it was shown that those judged as demonstrating abnormal motion by this method also demonstrated decreased scapular upward rotation, less clavicular elevation, and less clavicular retraction when measured with 3-dimensional motion tracking [28]. Abnormalities were seen far more prevalent during shoulder flexion compared with shoulder abduction abduction. These results support the assertion that the shoulders which are visually judged as having dyskinesis using this system, demonstrate distinct alterations in 3-dimensional scapular motion during shoulder movements particularly during shoulder flexion. Although visually observed dyskinesis demonstrated altered 3 dimensional scapular motion, subjects shown to be having dyskinesia by this method were no more likely to report any shoulder symptoms during sports [28].

Uhl et al [30] classified dyskinesis into "yes" or "no"(if they showed normal scapular motion.) They studied both patients having shoulder symptoms with various soft-tissue pathologies as well as an asymptomatic group. The "yes/ no" test was found to have superior interrater reliability (inter-rater percent agreement (79%, K Š§ 0.40) , and demonstrated better specificity (74%) and sensitivity values (76%) when using asymmetry found with 3-dimensional testing as a gold standard [30]. An important finding in this study was a higher frequency of dyskinesis during shoulder flexion in patients (54%) compared with asymptomatic subjects (14%), whereas no differences between groups were detected during scapular plane elevation. Because scapular dyskinesis is a common finding in asymptomatic individuals also, a basic problem in evaluation is deciding if the presence of scapular dyskinesis is an important abnormality perpetuating symptoms or not. It may be possible that scapular dyskinesia could be a pain reducing phenomenon. Scapular dyskinsis can be considered to be a contributing factor if alteration in scapular position causes decrease in shoulder symptoms.

There are two main symptom alteration tests: the scapular assistance test [5,22] and the scapular reposition (or retraction) test (SRT) [13,27] . The scapular assistance test involves manual assistance of scapular upward rotation during shoulder elevation and determining its effect on pain [3]. Rabin et al, later modified this test by incorporating scapular posterior tilting as well [22]. The test is positive if pain with elevation is either decreased or abolished during the assisted maneuver. This test has shown acceptable levels of reliability and has been shown to be acceptable for clinical use [22].

The scapular retraction test involves manually positioning and stabilizing the entire medial border of the scapula in a retracted position on the thorax while the subject is asked to elevate the arm against manual resistance [3]. This test was developed to help identify whether shoulder elevation strength loss in patients is due to a loss of proximal stability of the scapula or not. The test may be considered positive when either improvement in strength or reduction in pain is seen with isometric contraction in scapular plane [3,7]. Kibler et al [10] studied this test in symptomatic and asymptomatic subjects and they demonstrated that there was no change in pain levels and all subjects demonstrated improved strength output, regardless of symptoms.

The Scapular Reposition Test (SRT) is a refinement of the Scapular Retraction Test and involves components like scapular tilting and external rotation, without full scapular retraction. This modification was based upon previous investigations who demonstrated a decrease in shoulder elevation strength with maximal active scapular retraction [26]. Scapular reposition test has demonstrated acceptable reliability and when performed on a large group of overhead athletes 47% subjects had shown reduction in pain and 26% had a substantial increase in isometric elevation strength [33]. Therefore, this test may be helpful at identifying the patients with shoulder pathology that may benefit from interventions focused towards improving scapular muscle function.

Conclusion

3D motion analysis of scapular motion is appropriate method of studying any alteration in scapular motion and thereby diagnosis of scapular dyskinesia. EMG study of scapular muscles provides the valuable information about variation in muscle activation in dyskinesic scapula. However they cannot be available in every clinical set-up. Various clinical tests have been introduced with good reliability but variable validity with scapular dyskinesia was evaluated between symptomatic and asymptomatic subjects.

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The second page should carry the full title of the manuscript and an abstract (of no more than 150 words for case reports, brief reports and 250 words for original articles). The abstract should be structured and state the Context (Background), Aims, Settings and Design, Methods and Material, Statistical analysis used, Results and Conclusions. Below the abstract should provide 3 to 10 keywords.

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State the background of the study and purpose of the study and summarize the rationale for the study or observation.

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Include summary of key findings (primary outcome measures, secondary outcome measures, results as they relate to a prior hypothesis); Strengths and limitations of the study (study question, study design, data collection, analysis and interpretation); Interpretation and implications in the context of the totality of evidence (is there a systematic review to refer to, if not, could one be reasonably done here and now?, What this study adds to the available evidence, effects on patient care and health policy, possible mechanisms)? Controversies raised by this study; and Future research directions (for this particular research collaboration, underlying mechanisms, clinical research). Do not repeat in detail data or other material given in the Introduction or the Results section.

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Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006;35:540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003;61:347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997;195 Suppl 2:3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000;71:1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM,

editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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