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THE EFFECT OF "MOVE IN THE TUBE EXERCISES" VERSUS CONVENTIONAL PHYSIOTHERAPY ON STERNAL STABILITY AND CHEST EXPANSION ON POST-OPERATIVE VALVE REPLACEMENT SUBJECTS

Physiotherapy

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ABSTRACT

Valvular heart disease is a leading cause of cardiovascular morbidity and mortality worldwide. The study was conducted on 30 valve replacement subjects who were split into group-1 and group-2 with age group between 20 to 50. Group-1 subjects were given the conventional physiotherapy and group-2 subjects were given 'move in the tube exercises' for 6 weeks. Sternal stability and chest expansion were the outcome measures and were assessed pre-operatively and post-operatively after 6 weeks. The results showed that there was no significant difference on sternal stability and chest expansion in both the groups. The study concluded that both the interventions are effective in improving sternal stability and chest expansion in post operative valve replacement subjects.

KEYWORDS

valve replacement surgeries, conventional physiotherapy, move in the tube exercises and sternal stability.

INTRODUCTION

Valvular heart disease is a leading cause of cardiovascular morbidity and mortality worldwide. Four valves are present in heart: the mitral, tricuspid, aortic and pulmonary valve. These valves prevent regurgitation between four heart chambers and maintain the hemodynamic circulation which is essential for life. The most prevalent valve pathologies are the mitral regurgitation, aortic regurgitation, aortic valve stenotic disease and rheumatic heart disease [1]. The most common causes for the valvular diseases are the older age i.e., changes in the heart valve structure due to the age, coronary artery disease, heart valve infection, birth defects [congenital heart defects] and rheumatic fever etc.,[2]

Mitral regurgitation [MR] is characterized by systolic retrograde flow from left ventricle to the left atrium and the causes are classified as ischaemic and non- ischaemic [3]. Congenital or acquired anomalies of the aortic root or the cusps of aortic valve result in insufficient coaptation of 3 cusps, which causes aortic regurgitation [AR][4]. Aortic stenosis [AS]which occurs due to the calcification and thickening of aortic valve. AS is also known as aortic valve stenotic disease [AVSD]. Congenital anomalies, prior exposure to chest radiation, mucopolysaccharidosis, severe mitral annular calcification, and left atrial myxoma are the causes of Mitral stenosis [MS][5]. TR is classified as the primary (organic) and secondary (functional). The changes in tricuspid leaflet and sub-valvular tissue itself is referred as primary Tricuspid regurgitation [TR], the causes of TR include trauma, infective endocarditis, prolapse due to myxomatous change, iatrogenic causes, congenital tricuspid valve lesions and tricuspid stenosis is often found with other valvular diseases, particularly MS, but the isolated TR is rare[4]. Rheumatic heart disease is a permanent damage to the heart valves which develops a repeated episodes of acute rheumatic fever, an autoimmune reaction to the Group A streptococcus bacterial infection[6].

The majority of surgical corrections in valvular replacements require sternotomy to gain access to the heart [7]. Milton was the person who described the median sternotomy for clear exploration of the posterior mediastinum in 1897[8]. The median sternotomy leads to the sternal instability[9]

MOVE IN THE TUBE" [MITT] is an imaginary truncal tube, where the patient is asked to do the activities by limiting the movement of humerus to prevent the arms from being outstretched [10]. The main aim of the move in the tube ex's is to prevent the excessive load / stress over the sternum by limiting the movement of humerus and to prevent the sternal lateral deviation. Subjects are asked to do the specified ex's like how to get out of bed within the tube how to do upper limb movements in a limited range, how to cough [2].

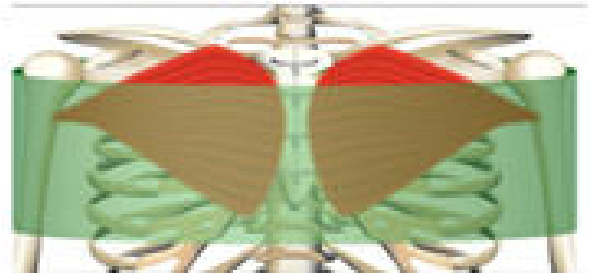

Figure-1 imaginary truncal tube in MITT ex's **Produced by Fernholz K, Theis J, et al.**

NEED OF THE STUDY

Conventional physiotherapy aims to restore the patients to their functional status after valve replacement and the post operative sternal stability is minimally concentrated. Move in the tube exercises are proved to be effective in the post operative CABG subjects and which showed the improvement in the sternal stability. So there is need to know the effects of move in the tube ex's in subjects who underwent the valve replacement surgeries. Hence the study is designed to compare the efficacy of MITT ex's versus conventional physiotherapy, chest expansion and sternal stability in subjects who underwent the valve replacement surgeries.

AIM

To know the effect of move in the tube exercises vs conventional physiotherapy on sternal stability, chest expansion on subjects with post-operative valve replacement.

OBJECTIVES

- To know the effect of MITT Exercises on sternal stability using sternal instability scale in subjects with post-operative valve replacements.
- To know the effect of Conventional physiotherapy on sternal stability by using sternal instability scale in subjects with post-operative valve replacements.
- To know the effect of MITT Exercises on chest expansion by using inch tape in subjects with post-operative valve replacements
- To know the effect of Conventional physiotherapy on chest expansion by using inch tape in subjects with post-operative valve replacements.

- To know the effect of MITT Exercises vs. Conventional physiotherapy on sternal stability by using sternal instability scale and chest expansion by inch tape on subjects with post-operative valve replacement.

METHODOLOGY AND MATERIALS

MATERIALS

1. Paper and pen for documentation
2. Inch tape to measure the chest expansion

METHODOLOGY

Study set-up: SVIMS hospital, Tirupati.
Study duration: 6 weeks
Study design : Experimental study.
Sample size : 30 samples

Inclusion Criteria

- Heart valve surgeries including aortic, mitral, tricuspid and pulmonary valve replacements
- Age - 20 – 50 years
- Both males and females
- post-operative medically and clinically stable subjects
- Both single and double valve replacements

Exclusion Criteria

- Subject with musculoskeletal disorders neurological disorders
- Subjects who underwent emergency surgical treatment
- History of severe pulmonary diseases
- Re-intubated subjects
- Subjects who are mentally unstable
- post-operative renal or hepatic failure
- Subjects who cannot follow our instructions and who are not willing to participate in the study.
- History of previous cardiothoracic surgeries

Outcome Measures

1. Sternal stability by sternal instability scale
2. Chest expansion

Study Procedure

The study was commenced after obtaining permission from the Institutional Ethics Committee [IEC no- 1701].

Subjects who fulfilled the inclusion criteria and were detailed about the study procedure and after obtaining informed consent were included in the study. The baseline measurements height, weight, sternal stability and chest expansion were measured in the pre-operative phase. On the 2nd POP day they are randomized into the control group & experimental group by simple random sampling (lottery method). Control group received the conventional physiotherapy and experimental group received the MITT exercises. The sternal stability was assessed by sternal instability scale by palpation and the chest expansion by the inch tape [8]. The inch tape which is used to measure the chest expansion. The most used levels for chest expansion are the xiphoid process and second to the fourth intercostal space/axillary level [10]. They were assessed at the time of discharge and after 6 weeks. The pre-operative physiotherapy education was done.

Treatment Protocol

The experimental group received the MITT exercises and common sternal precautions, training for breathing exercise [Diaphragmatic breathing, segmental breathing, pursed lip breathing etc.,], spirometry, splinted coughing and huffing techniques, movements of both upper limb and lower limbs in the tube from the day following surgery. The subjects were asked to do the daily living activities by limiting the movement of shoulder to prevent the arms from being overstretched. The subjects were told to do certain exercises like how to get up from the bed, how to cough, how to limit upper limb exercises in a limited range. Patients are also advised to splint their chests (wrapping their arms around their chests) when moving or coughing. A leaflet was given to the subject. The subjects were asked to follow the green colour (which is correct) but not the red (which is incorrect) from the leaflet. The follow-up was done by phone call and assessment is taken after 6 weeks.

The control group received the conventional physiotherapy treatment which includes common sternal precautions and ankle pump exercise, lower limb active range of motion (ROM) exercises training for mobility and transfer activities as well as training for breathing exercise, spirometry, coughing and huffing techniques.

At the time of discharge, the post operative education was done to the subject and family members. After getting discharge, the follow-up was done through video calls.

The exercise program [which include respiratory muscle training, stretchings and aerobic exercises] was given to the subject at the time of discharge for both the groups. The session starts with warm-up and stretchings each 10 minutes, later the aerobic exercises were taught to the patient which includes brisk walking, squats and lunges for 30 minutes and the cool down for 10 minutes.

Figure-2: spirometry exercises

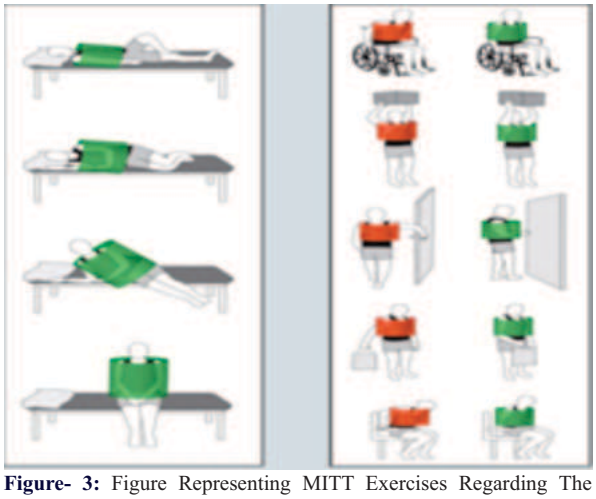

Figure- 3: Figure Representing MITT Exercises Regarding The Colour

Produced with reference to Fernholz K, Theis J, et al

Statistical Analysis

The results were analyzed using SPSS Software version 23. Data was described using mean and standard deviation and ANOVA test was used and compared between 2 groups. The "p" value<0.05 was considered statistically significant.

RESULTS

Table – 2: Baseline Descriptives

	Mean	Std. Deviation
Age	36.93	9.33
BMI	25.19	2.66
Pre_SIS	0.00	0.00
Pre_Ins2	47.41	55.41
Pre_Ins4	35.76	1.96
Pre_InsX	34.99	11.98
Pre_Exp2	34.92	2.33
Pre_Exp4	35.30	2.01
Pre_ExpX	33.43	2.09

BMI- body mass index, Pre SIS – pre-operative sternal instability scale, Pre_Ins2- pre-operative inspiration at the 2nd ICS, Pre_Ins4 - pre-operative inspiration at the 4th ICS, Pre_InsX- - pre-operative inspiration at the xiphoid process, Pre_Exp2 – pre-operative expiration

at the 2nd ICS, Pre_Exp4- pre-operative expiration at the 4th ICS, Pre_ExpX- pre-operative expiration at the xiphoid process.

The LEVENE STATISTICS is used to calculate this data. The variables Age (0.15), BMI (0.90), pre_Ins4 (0.95), pre_InsX (0.49), pre_Exp2 (0.39), pre_Exp4 (0.89) and pre_ExpX (0.66) are greater than 0.05 (p>0.05). so, the homogeneity of variances is preserved. The p-value of Pre_Ins2 is 0.03 which is less than 0.05 (p<0.05) indicating the homogeneity of samples is varied.

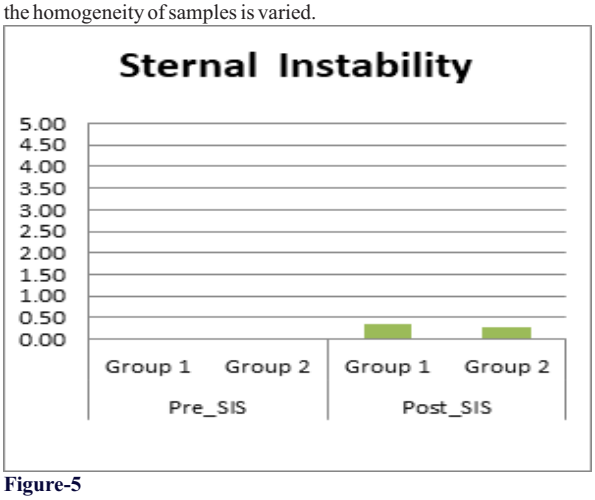

Figure-5

This figure represents that the pre-SIS (group -1 and group-2) shows no sternal instability and in Group -1 of Post_SIS shows more sternal instability than Group-2 of Post_SIS.

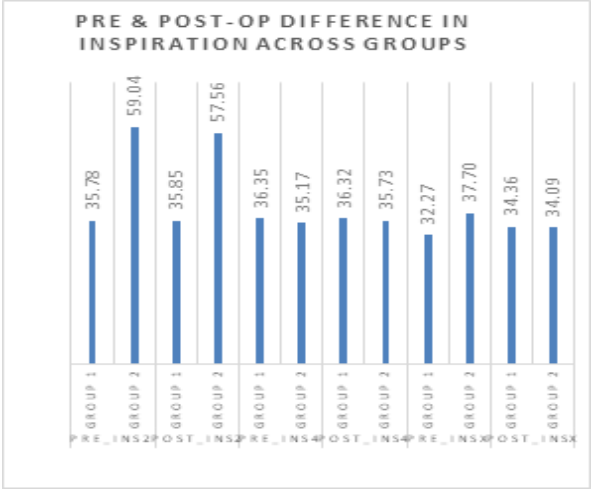

Figure- 6

This figure is representing the bar graph illustration regarding the "difference in inspiration across the groups". The group-2 (59.04) is higher than group-1(35.78) in pre_Ins2 and the group-2 (57.56) is higher than group-1 (35.85) in post_Ins2. The group-1 (36.35) is higher than the group-2 (35.27) of pre_Ins4 similarly in post_Ins4 group-1 (36.32) is higher than the group-2 (35.73). In pre-InsX , the group-2 (37.70) is higher than the group-1 (32.27) but in post_InsX, the group-1 (34.36) is bit higher than the group-2 (34.09).

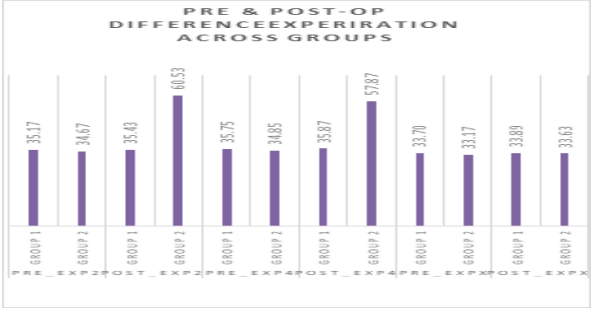

Figure-7

This figure is representing the bar graph illustration regarding the "difference in expiration across the groups". The group-1 (35.17) is higher than the group-2 (34.67) in pre_Exp2 and group-2 (60.53) is higher than group-1 (35.43) in post_Exp2. The group-1 (35.75) is higher than group-2 (34.85) in pre_Exp4 and group-2 (57.87) is higher than group-1 (35.87) in post_Exp4. The group-1 (33.70) is higher than the group-2 (33.17) in pre_ExpX and post_ExpX [group-1(33.89) & group-2 (33.63)]

Table-4: ANOVA Table Showing The Pop Difference Between Groups

		Sum of Squares	Mean Square	F	P Value
Post_SIS	Between Groups	0.03	0.03	0.15	0.70
Post_Ins2	Between Groups	3533.85	3533.85	0.98	0.33
Post_Ins4	Between Groups	2.58	2.58	0.78	0.38
Post_InsX	Between Groups	0.56	0.56	0.14	0.71
Post_Exp2	Between Groups	4727.59	4727.59	1.38	0.25
Post_Exp4	Between Groups	3627.80	3627.80	0.93	0.34
Post_ExpX	Between Groups	0.51	0.51	0.13	0.72

The comparison of SIS and chest expansion (inspiration and expiration at 3 levels) measurements post intervention was analyzed using the one-way ANOVA. Post-intervention score between groups [group-1 & group-2] is post_SIS (p =0.70), Post_Ins2 (p =0.33), Post_Ins4 (p=0.38), Post_InsX (0.71), Post_Exp2 (p=0.25), Post_Exp4 (p=0.34), Post_ExpX (p=0.72) which denotes there was no significant change after the intervention.

The above results indicated that there was no significant difference in the sternal stability in Group-1 who received conventional physiotherapy and Group-2 who received the MITT ex's.

Similarly, chest expansion between Group-1 and Group-2 showed no significant significance.

DISCUSSION

the post-operative sternal instability was little higher in group-1 compared to the group-2 [figure-7]. In group-1 (conventional physiotherapy group), the chest expansion shows improvement in inspiration at the 2nd ICS and Xiphoid process post-operatively rather than at the 4th ICS. In group-2 (MITT ex's group), the chest expansion shows the improvement in inspiration at the 4th ICS post-operatively rather than 2nd ICS and xiphoid process. In group-2 (MITT ex's), chest expansion showed improvement in expiration at the levels of 2nd and 4th ICS post-operatively as well as a group-1(conventional physiotherapy) showed little increment post-operatively. In both the groups, the chest expansion showed improvement in expiration at the level of xiphoid process post-operatively.

Results in this study showed that both conventional physiotherapy and MITT exercises showed similar effect in improving sternal stability and chest expansion.

Prolonged physical inactivity linked to decreased functional ability is a common side effect after valve replacement surgery [7]. The SIS offers a standardized and uniform physical evaluation technique for sternal stability screening and monitoring. Health providers can use this non-invasive, useful manual clinical evaluation method in acute and community settings for screening, diagnosis, and tracking outcomes after conservative or surgical treatment. It takes no training. More significantly, it makes it easier for health providers to report in a standardized and consistent manner and encourages early referral to physicians and surgeons for evaluation and rapid action [11].

Doa El-Ansary, Tanya Kinney LaPier et.al (2019) reported in a study 'An Evidence-Based Perspective on Movement and Activity Following Median Sternotomy' as that the principles of "Keep Your Move in the Tube" that encourage movement and use of the upper body within the safe limits of pain are supported by strong evidence, which is likely to facilitate optimal recovery following a median sternotomy since it encourages active patient participation in ADL and functional tasks [12].

Sudhakara PM and Hamsalekha MC 2018- reported in their study 'The effect of deep breathing exerises and incentive spirometer on lung function in subjects following abdominal surgery' as the significant improvement in PEFR and Thoracic excursion measurements

observed in the subjects showed that deep breathing exercises and Incentive spirometer is effective in physical therapy intervention to reduce pain and improve lung volumes due to increased neurological arousal and a greater stimulus to deeper breath [13].

McKenna, Heather PT, Jennifer OTR, Erin, et.al (2022) reported in a study 'Move in the Tube Sternal Precautions: A Retrospective Analysis of a Single Inpatient Rehabilitation Facility' as the Patients on MIT precautions were admitted to an IRF with more medical complications but higher functional independence. Both groups had minimal sternal complications, providing evidence that modified sternal precautions are safe and can benefit patients in an IRF setting [13].

Study Limitations

The study was performed in a small group of patients. Duration of the study is less. The study cannot be generalized as the sample size is small and the follow-up is done upto 6 weeks only after valve replacement.

These limitations should be addressed in future studies and a long follow-up is recommended.

Future Recommendations

Large sample size is recommended. The future study is recommended for more than 6 weeks of duration.

CONCLUSION

In conclusion, both conventional physiotherapy and 'move in the tube exercises' are effective in treating sternal stability and chest expansion in post operative valve replacement subjects. So, both conventional physiotherapy and MITT exercises could be effective in improving sternal stability as well as chest expansion in postoperative valve replacement via median sternotomy. Encouraging the stable patients with valve replacements in doing any one of both interventions should be a routine treatment protocol.

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