



## RESEARCH ARTICLE

### PREVENTION OF KYPHOSIS DEVELOPMENT AFTER CORONARY ARTERY BYPASS SURGERY (CABG) USING KINESIOTAPE: CASE STUDY

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#### ABSTRACT

**Background:** Kinesiotaping (KT) is a type of taping treatment method involving the application of elastic therapeutic tapes to the skin. The benefits of taping were said to be due to sensorimotor and proprioceptive feedback mechanisms. Taping offers immediate sensorimotor input, and patients often report symptom relief, increased relaxation, or increased joint stability. The elasticity of KT allows for movement by conforming to the body. The most common cardiovascular disorder is coronary artery disease (CAD), which is correlated to a decline in quality of life. For the treatment of CAD, revascularization procedures such as Coronary Artery Bypass Graft. The patient was not resumed with protocol. After a month, he developed dyspnea while walking, chest discomfort, and neck pain. An examination revealed moderate kyphotic posture, trigger points in the trapezius and sternocleidomastoid muscles, and spasm of neck muscles on palpation, as well as a decrease of neck range of motion. **Case presentation:** we present a male patient 55 years old diabetic and hypertensive with coronaries obstruction, his BMI was 22 kg/m<sup>2</sup>. **Methods:** we conducted a case study of targeted patient kinesiotape effect on primary outcome Cobb angle of kyphosis post coronary artery bypass surgery and investigated with sagittal radiographic evaluation whether the magnitude of change differed from baseline and follow up radiographs for Cobb angle measurements. The patient was delivered physical therapy protocol daily and for one week post operation and re-evaluated after 1 month. The protocol included: breathing exercises, incentive spirometry, expansion exercises, neck and trunk mobility exercises and walking combined with kinesiotape application on back muscle. **Results:** The Cobb's angle base line measurement was 42° degree and follow up was 40° degree. There was significant difference between Cobb angle measurements after intervention. **Conclusion:** Kinesiotape has an important role in prevention of kyphosis posture development as a secondary complication after coronary artery bypass surgery.

#### INTRODUCTION

Kinesiotaping (KT) is a type of taping treatment method involving the application of elastic therapeutic tapes to the skin, and was developed by Kase Kenzo, a chiropractor in the 1970s. Previous studies have reported that KT is effective in increasing the flow of blood and lymph in local and peripheral areas, enhancing proprioceptive sensation, increasing muscular strength, controlling pain, and promoting an improved range of motion<sup>1</sup>. Kinesiotaping can improve the following musculoskeletal conditions: strengthen weakened muscles, control joint instability, assist the postural alignment, and relax the overused muscles. KT is more elastic as compared with conventional tape forms.

It was claimed that the effects of taping may be due to the sensorimotor and proprioceptive feedback mechanisms. Taping provides immediate sensorimotor feedback, and patients often report symptom relief, improved comfort level, or stability of the involved joint. The elasticity of KT conforms to the body, allowing for movement<sup>2</sup>. Coronary artery disease (CAD) is the most frequently encountered cardiovascular disease and is associated with a decline in quality of life. Revascularization procedures such as Coronary Artery Bypass Graft (CABG) surgery and Percutaneous Coronary Intervention (PCI) are ideally sought for the management of CAD. These procedures are associated with declining functional capacities due to plausible ebb-flow phases occurring from the surgical stress, hospitalization, and drug related effects further leading to lowered levels of physical activity<sup>3</sup>. In most cases, the surgeon constructs at least one of the bypasses by using an artery called the internal mammary artery that is located behind the breastbone or sternum.

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Other bypasses may be constructed by using a vein from the leg (saphenous vein) or an artery from the forearm (radial artery)<sup>4</sup>. Cardiac rehabilitation had been given in the hospital following CABG which included breathing exercises, incentive spirometer, chest physiotherapy techniques, expansion exercises, neck, upper limb, chest and trunk mobility exercises, walking, stair climbing etc., whereas after discharge most of the patients' didn't continue rehabilitation, which lead to decreased breathing efficacy, reduced mobility of shoulder, neck and trunk muscles and causes difficulty in leading the normal life. After the discharge the patient was not active and didn't continue the rehabilitation. After one month he had dyspnea on walking, chest discomfort and neck pain where examination was done which showed mild kyphotic posture, on observation, trigger points in trapezius and sternocleidomastoid muscles and spasm of neck muscles on palpation, reduction in range of motion of neck on examination<sup>5</sup>. The purpose of this study was to determine the effectiveness of kinesiotape as a modality for prevention of kyphosis development in patient after Coronary Artery Bypass surgery. It was hypothesized that, the kinesiotape as a modality for prevention has no significant difference on kyphosis development in patient after CABG.

**Case Presentation:** This study was conducted at hospitalized inpatient from open heart department of police authority hospital El-Agouza, to determine the effectiveness of kinesiotape as a modality for prevention of kyphosis development in patients after Coronary Artery Bypass surgery. The patient who participated in this study had felt out a written consent before the study.

**Inclusion criteria:** Patient's age was ranged 55 years old. Patient's body mass index was 22 kg/m<sup>2</sup>. Patient was suffering from shallow and rapid breathing, sputum collection, on kyphotic posture, limited shoulder & trunk mobility and had trigger points on trapezius and rhomboid muscles. The patient was diabetic and hypertensive. The patient had medical history of hepatitis C virus. The patient had sufficient cognition enough to understand the instructions and the requirements of the study.

**Exclusion criteria:** Patients were with any other previous operations. Patients suffered from any other diseases which may contribute to their posture control or sensorimotor in general. Patients had any previous musculoskeletal disorders that interfere with their postural control as spinal deformities or spinal operation. Patients with decreases thoracic mobility like congenital anomalies or bony block of vertebral spines. Patients suffered from unstable medical condition. Patients had history of neurological disorder that may contribute performance the procedure instructions.

**Evaluation tools:** The assessment procedure which includes radiographic evaluation was applied for the patient one day before operation and one month after operation's date.

**Radiographic evaluation:** The role of the sagittal plane contour in the normal function of the spine and its various disease states is becoming more widely recognized. Cervical lordosis, thoracic kyphosis, and lumbar lordosis are reciprocal curves that allow for efficient absorption of loads applied to the spinal column and increase the efficiency of the spinal musculature. As a result, it's important to maintain both frontal and sagittal alignment while treating complex spinal

deformities like scoliosis or kyphosis. Although the most important radiographic parameters of the sagittal balance of the spine in upright posture are well defined, few reports present the normal physiological values<sup>6</sup>.

**Cobb angle of kyphosis** (56 degrees) measured from standing lateral radiograph Line a is drawn from the superior endplate of T4, line b is drawn from the inferior endplate of T12, lines c and d are perpendicular lines drawn from lines a and b. Cobb angle of kyphosis (56 degrees) is where lines c and d intersect<sup>7</sup>. Thoracic kyphosis angle value varies between 20° and 40°. This value is called hypokyphosis (flat back) if it is below 20 degrees, and hyper kyphosis if it is above 40 degrees. While the normal kyphosis angle varies between 20-40 degrees in young individuals, this value varies between 20-48 degrees in women and 20-44 degrees in men<sup>8</sup>. One lateral radiograph of the spine was taken for the patient using a vertical 30 x 90-cm film and a constant distance between the subject and the radiographic source. The participant stood in a relaxed position, legs fully extended and arms flexed forward to 45° and supported by supports. The radiograph was taken during inhalation and was centered on the twelfth thoracic vertebra<sup>6</sup>.

## Treatment procedures

### Physical therapy protocol

*Phase 1* cardiac rehabilitation was given in the hospital following CABG which includes:

**Breathing exercises** (segmental breathing exercises and diaphragmatic breathing exercises). The patients was trained about the breathing technique and practiced it preoperatively. The exercises begin approximately one hour after extubation, and patient was advised to take 30 deep breaths once per hour while awake (during the day) for the first four days after surgery. Three sets of ten deep breaths were performed, with a 30- to 60-second pause between each cycle. During the pause, patient may be asked to cough to evacuate secretions if needed. If required, the patient was advised to perform deep breathing while sitting<sup>9</sup>.

We started first with segmental breathing for each lobe of the lung by putting therapist hands on the anatomical position for each lobe to guide and palpate chest expansion and air entry to the selected lobe then give the patient the command to take breath and push my hands up with the air entry and hold it for 3 seconds and push the air out with pursed lips. With my hand movements I could detect if the lung expansion was defected in one lung more than the other one, so repeat the exercise and ask patient to inhale more air on the less expanded lung and trying to push my hand up.

**Diaphragmatic breathing** or "deep breathing," is defined as efficient integrative body-mind training for dealing with stress and psychosomatic conditions. Diaphragmatic breathing involves contraction of the diaphragm, expansion of the belly, and deepening of inhalation and exhalation, which consequently decreases the respiration frequency and maximizes the amount of blood gases<sup>10</sup>. While the patient under stood the exercises well and could do it properly, evacuation of pleural collective fluid (which was remained post-surgery in the pleural cavity) will be faster through chest tubes and more lung expansion will be gained.

**Incentive spirometry;** Incentive spirometer is designed to help you perform normal breathing exercises. In turn, the spirometer will help the patient to prevent the possibility of respiratory complications or to improve your breath pattern if you have a respiratory condition<sup>11</sup>. During the healing period after a median sternotomy, upper-limb movement and exercise are beneficial. Upper-limb movement and exercise are thought to enhance circulation to the muscles of the chest wall, shoulder girdle, and sternum. It's also necessary to stay active to avoid general physiological decline, such as adhesion formation and muscle atrophy<sup>12</sup>.

**Chest physiotherapy techniques;** Chest physiotherapy techniques include percussion and vibration. Percussion is a manual technique used by respiratory physiotherapists to improve airway clearance by mobilizing secretions in one or more lung segments to the central airways. Percussion over an affected area produces an energy wave, which is transmitted to the lungs and airways.

It is performed with the aim of loosening thick, sticky or retained secretions from the chest wall. We were very carefully on this technique and only applied when it was needed to clear airway from obstructive sputum. Percussion was applied from sitting position with patient back was not supported and patient was asked to cross his arms around his chest to support incision area, percussion was gentle and not allowed if there were chest pain.

**Expansion exercises;** We started expansion exercises which are connected with breathing exercises. There are many benefits for these connected exercises such as: motivate patient to apply breathing exercise with distracted mind from pain after surgery, improving psychological states, decrease fear from movement, improve chest expansion and improve gas exchange. The patient was asked to inhale air with shoulder raising up in flexion up to 90° degree then asked to exhale air with shoulder down in extension or neutral position and we could repeat this exercise with shoulder abduction up to 90° degree also.

**Neck, Upper Limb, Chest and Trunk Mobility Exercises;** Patient started with 2 cycles of active free flexion and extension of the fingers of both hands, then followed with 2 cycles of ankle pump, each cycle consist of 10 repetitions. Active free range of motion of neck and trunk was applied with sternal precautions like chest belt was wearied and crossed arms. Shoulder girdle mobility was very important and patient could perform pain free to relax accessory muscle of respiration and stimulate scapular muscles to prevent postural deformities.

**Walking:** The patient was encouraged at the 3<sup>rd</sup> day post operation to start walking free without support and was advised to regulate breathing pattern while walking to avoid exhaustion.

**Stair climbing;** The patient was asked to start climb upstairs on the 5<sup>th</sup> day after surgery only few stairs up and down. Then started to increase the number of stairs gradually until reach to one floor at the 7<sup>th</sup> day post-surgery. Most patients do not resume phase 2 recovery after discharge, which results in impaired breathing effectiveness, reduced mobility of the shoulder, spine, and trunk muscles, and trouble living a normal life<sup>5</sup>.

**Application of Kinesiotape:** We used two equal pieces of kinesiotape to tape the spine. These two parts had been adhered to the erector spine muscles in a parallel line with the T1 and T12 spinous processes (5 cm from the origin and insertion of each piece at above and below of T1 and T12 installed without stretching)<sup>13</sup>. Taping had been applied at the same day of extubating (which it the day 1 for traditional treatment), and applied for one week.



**Fig. 1. Postoperative kinesiotape application**

*The patient was instructed after physical therapy sessions to perform the following as a home program:*

**Deep breathing exercises** The patients was trained about the breathing technique and practiced it preoperatively. The exercises begin approximately one hour after extubation, and patient was advised to take 30 deep breaths once per hour while awake (during the day) for the first four days after surgery<sup>9</sup>.

**Incentive spirometer** Incentive spirometer is designed to help you perform normal breathing exercises. In turn, the spirometer will help the patient to prevent the possibility of respiratory complications or to improve your breath pattern if you have a respiratory condition<sup>11</sup>.

**Neck and trunk mobility exercise** Patient started with 2cycles of active free flexion and extension of the fingers of both hands, then followed with 2 cycles of ankle pump, each cycle consist of 10 repetitions. Active free range of motion of neck and trunk was applied with sternal precautions like chest belt was wearied and crossed arms.

**Chest technique** Chest physiotherapy techniques (percussion – vibration) were used postoperative. These techniques decreased the amount of sputum in the chest when compared immediately postoperative versus after one month.

## RESULTS

The main aim of this study was to determine the effectiveness of kinesiotape as a modality for prevention of kyphosis development in patients after Coronary Artery Bypass surgery. This was determined by the measurement of Cobb's angle before and after treatment. The Cobb's angle before operative procedures was 42° degree, the kinesiotape was applied one week postoperative and last for one month. Then, X-ray was repeated for the patient after one month. The Cobb's angle became 40° degree. On the other hand, breathing exercises were started immediately post-operative and continued for one month. The segmental breathing decreased the psychological fear of patient from expanding his chest. This is due use of chest belt during breathing exercises. Chest physiotherapy techniques (percussion – vibration) were used postoperative. These techniques decreased the amount of sputum in the chest when compared immediately postoperative versus after one month. Early mobilization and active mobility exercises for neck and trunk were encouraged to decrease musculoskeletal complications post operatively, and exercises connected with breathing were increased chest expansion, improved lung capacity, decrease dyspnea and improve psychological fear. We used two pieces of kinesiotape para thoracic vertebra started from T1 to T12, which stimulate the mechanoreceptors in the cutaneous layer and support the muscle to enhance muscle contraction and prevent kyphosis posture development post-surgery.

## DISCUSSION

This study was conducted to investigate kinesiotape as a modality for prevention of kyphosis development after coronary artery bypass surgery as a case study. This was determined by the measurement of Cobb's angle before and after treatment. The most common cardiovascular condition in adults is coronary artery disease (also known as CAD). It's caused by cholesterol deposits forming in the walls of the coronary arteries, which carry blood to the heart muscle (myocardium). The flow of blood through the coronary arteries is restricted by these deposits. Even in the absence of previous symptoms, coronary artery disease may cause a heart attack (myocardial infarction) or chest pain (angina pectoris). Coronary artery bypass surgery (CABG) requires the development of new arteries to supply blood to the heart by bypassing the obstructions in the patient's coronary arteries by using other blood vessels as conduits<sup>4</sup>. Post CABG surgery complications pleural effusions and atelectasis are most common complications that will occur after CABG whereas other musculoskeletal problems also occur due to immobility and adopt kyphotic posture due to pain over the sternal incision site which leads to overload on the surrounding muscles<sup>5</sup>.

Post-CABG inactivity can reduce physical capacity, as well as ability to perform daily activities. Regarding the importance of body posture and its association with pain in shoulders, vital capacity of patients undergoing CABG, undesirable and unwanted complications that can affect such patients and influence postoperative results, and considering that exercises can have positive effects on the improvement or prevention of

this syndrome after CABG<sup>14</sup>. The patient received basic post-operative chest physiotherapy as conventionally used at the clinic by physiotherapists once daily. The therapy consisted of mobilization and active exercises of the upper limbs and thorax, breathing exercises and instructions in coughing techniques. Patient was mobilized as early as possible by the nursing staff and physiotherapists according to the ordinary routines. Although the use of incentive spirometry with a deep breathing exercise (DBE) is widely used in clinical practice in patients who have undergone coronary artery bypass graft (CABG) surgery, the effect of this combination therapy had significantly better recovery of inspiratory muscle strength on day 4 post-CABG<sup>15</sup>. There was marked increase in chest expansion and lung capacity. Heart rate and respiratory rate decreased contaminated with increased gas exchange. After the discharge the patient was not active and didn't continue the rehabilitation. Patient also had a complaint of neck pain where examination was done which showed mild kyphotic posture, on observation, trigger points in trapezius and sternocleidomastoid muscles and spasm of neck muscles on palpation, reduction in range of motion of neck on examination<sup>5</sup>. Many approaches have been made to improve postoperative pulmonary function including regional anesthetic techniques and application of continuous positive airway pressure (CPAP). Although postoperative immobilization may be an important contributory factor, it is notable that recent reviews on the pathogenesis and prevention of pulmonary complications do not mention the effects of posture. Changes of postoperative position from supine to sitting or standing may be of major importance in the interpretation of postoperative pulmonary outcome studies and in future strategies to improve pulmonary outcome<sup>16</sup>. Kinesiotaping (KT) in the 1970s. It is a form of taping treatment that involves the application of elastic therapeutic tapes to the skin. KT has been shown to improve blood and lymph flow in local and peripheral areas, enhance proprioceptive sensation, increase muscle strength, regulate pain, and promote an enhanced range of motion in previous studies<sup>1</sup>. Thoracic kyphosis angle (Cobb's angle) value varies between 20° and 40°. This value is called hypokyphosis (flat back) if it is below 20 degrees, and hyper kyphosis if it is above 40 degrees. While the normal kyphosis angle varies between 20-40 degrees in young individuals, this value varies between 20-48 degrees in women and 20-44 degrees in men<sup>8</sup>. The Cobb's angle before operative procedures was 42° degree, the kinesiotape was applied one week postoperative and last for one month. Then, X-ray was repeated for the patient after one month. The Cobb's angle became 40° degree. Finally, after the patient had received physical therapy protocol and applied kinesiotape, Cobb's angle has improved, lung capacity has increased and no development of kyphotic curve was noted.

## Conclusion

This case demonstrates that Kinesiotape has an important role in prevention of kyphosis posture development as a secondary complication after coronary artery bypass surgery.

**Conflict of interest:** There is no conflict of interest.

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