



Effect of kinesio tape on shoulder pain and range of motion in liver transplantation donor patients

Dalia Mohamed Safwat¹, Dr. Mohamed Maher Elkeblawy², Dr. Essam Anwar Morsy³, Dr. Asmaa Fawzy El-Sayed⁴

¹ Physical Therapy, Department for Surgery, Faculty of Physical Therapy, Cairo University, Egypt

² Researcher in National Center of Research, Egypt

³ Professor and Head, Department of Gastrointestinal Tract Liver and Head of the Liver Transplant, at El Sahel Teaching Hospital, Egypt

⁴ Assistant Professor of Physical Therapy, Department for Surgery, Faculty of Physical Therapy, Cairo University, Egypt

Abstract

Purpose: The aim of this study was to evaluate effect of kinesio tape as physical therapy approach on shoulder pain and range of motion in liver transplantation donor patient.

Subjects: Thirty liver transplants donor patients of both sexes were selected anrecruited randomly from Police Hospitals and Elsahel Teaching Hospital out clinic. Patient's ages ranged from 30-40 years.

Method: The practical work was recruited from Police hospitals and elsahel teaching hospital out clinic Post operatively. They were assigned into two groups: Group A (Kinisio tape group) included 15 patients who received physical therapy treatment in form of ROM, mobilization and stretching exercises 3 times per week, and kinisio tape 5days for 4 weeks. Group B (control group) included 15 patients who received only physical therapy treatment in form of ROM mobilization and stretching exercise. VAS, electronic goniometer, and blood cortisol level are used in this.

Results: The post treatment results revealed: regarding to visual analog scale (VAS): Group A the percent of change was 67.70 % Group B the percent of change was 11.925%. Regarding to shoulder flexion: Group A the percent of change was 60.805 %. Group B the percent of change was 13.4600%. regarding to shoulder abduction: Group A the percent of change was 59.009 % Group B the percent of change was 1.148. regarding to shoulder external rotation: Group A the percent of change was 52.20 %. Group B the percent of change was 38.46%. Conclusion: Usage of kinesio tape and physical therapy modalities produce more objective improvement in shoulder pain and ROM than usage of physical therapy treatment only.

Keywords: liver transplantation, kiniso tape, physical therapy treatment, shoulder joint, ROM, pain

Introduction

Liver transplantation is a potential treatment for acute or chronic conditions which cause irreversible and severe ("end-stage") liver dysfunction. Since the procedure carries relatively high risks, is resource intensive, and requires major life-modifications after surgery, it is reserved for dire circumstances (Varma *et al.*, 2011) ^[1].

Liver transplantation is the therapeutic option of choice for acute and chronic end-stage liver disease. The indications and contraindications to liver transplantation have become established, as has the operative and postoperative management. This article provides a practical clinical approach to the evaluation and management of patients with acute and ch recipient selection, clinical management, and complications. The goal is to provide helpful guidelines to caregivers involved in the multidisciplinary care of these complex patients (Koffron and Stein, 2008) ^[2].

Living donor surgery is done at a major center. Very few individuals require ronic liver failure, with particular emphasis on liver transplant any blood transfusions during or after surgery. All potential donors should know there is a 0.5 to 1.0 percent chance of death. Other risks of donating a liver include bleeding, infection, painful incision, possibility of blood clots and a prolonged recovery. The vast majority of donors enjoy complete and full recovery within 2–3 months (Mazza *et al.*, 2015) ^[3].

Early postoperative severe right shoulder pain and

inadequate incisional pain relief, despite an epidural infusion rate of 8 mL/h. This donor was also the only one who had an unacceptable degree of central nervous system depression after systemic opioid supplementation, prompted by refractory right shoulder pain (Schumann, 2004) ^[4].

In recent years, the use of Kinesio Tape (KT) has become increasingly popular. Kinesio Tape was designed to mimic the qualities of human skin. It has roughly the same thickness as the epidermis and can be stretched between 30% and 40% of its resting length longitudinally. Kinesio Tape has several benefits, depending on the amount of stretch applied to the Tape during application: (1) to provide a positional stimulus through the skin, (2) to align fascial tissues, (3) to create more space by lifting fascia and soft tissue above area of pain/inflammation, (4) to provide sensory stimulation to assist motion, and (5) to assist in the removal of edema by directing exudates toward a lymph duct. (Kase *et al.*, 2003) ^[5].

Kinesio Tape (KT; Kinesio Precut, Albuquerque, NM) is a specialized elastic tape that mimics the elasticity of skeletal muscle as it stretches up to 140% of its original length, allowing for no ROM restrictions. According to KT creator Kenzo Kase, it can strengthen an already weakened muscle by correcting the muscle's function, improving circulation of blood and lymph, decreasing pain, repositioning subluxed joints, and improving joint position and kinesthetic awareness. These effects allow the fascia and muscle to

return to normal function by relieving the buildup of abnormal muscle tension and can improve joint function by increasing sensory mechanisms (Prentice, Arnheim and Arnheim's, 2010) [6].

1. Subjects material and methods

Thirty liver transplants donor patients of both sexes were selected anrecruited randomly from Police Hospitals and elsahel teaching hospital out clinic. Patient's ages ranged from 30-40 years.

Criteria of patient selection

The patients had the following criteria:

Inclusion criteria

- Liver transplants donor patients of both sexes.
- Their age ranges from 30-40 years old.
- All patients had the same medical and nursing care.
- All the patients were received a good explanation of treatment and measurement device.
- They were neurologically free.

Exclusion criteria

Patients were excluded from this study for any of the following

- Uncooperative patients.
- Instability of patient's medical condition.
- Association of another medical problem.
- Patients who had diabetes.
- Patients who had history of medical chronic relevant diseases.
- Patients who have pacemaker.
- Patients who had genitourinary infections.

Subjects were selected and divided randomly into two equal groups

Groups design of the study

These patients were divided into two equal groups in number:

Group A (Kinesio tape group)

In this group of the study, fifteen liver transplants donor patients were received traditional physical therapy in form of mobilization, stretching and ROM exercises three times per week for one month and kinesio tape 5 days per week for one month.

Group B (Control group)

In this group, fifteen liver transplants donor patients were received only traditional physical therapy in form of mobilization, stretching and ROM exercises three times per week for one month.

Measurements were conducted before starting the treatment as a first record, and at the end of 4 weeks of treatment as final record.

2. Materials and Methods

2. a. Measuring tools and materials

Blood analysis for measurement of cortisol level

An abnormal serum concentration is an excellent biologic marker for uncontrolled pain.

Visual analog scale

The pain VAS is a continuous scale comprised of a

horizontal (HVAS) or vertical (VVAS) line, usually 10 centimeters (100 mm) in length, For pain intensity, the scale is most commonly anchored by no pain (score of 0) and pain as bad as it could be or worst imaginable pain (score of 10) (Burckhardt and Jones, 2003).

Electronic goniometer

It is first developed by Karpovich in the late 1950's. a goniometer with an electrical potentiometer at its axis and give continuous graphic recording of relative joint angle, inexpensive and give immediate output.

2.b. Therapeutic equipment

In this phase, the treatment procedures was conducted by the following equipment and tool

Kinesio Tape

Kinesio tape (K-tape) for lymphatic drainage is a new choice in the field of physical therapy. K-tape had been designed to allow 30--40% longitudinal stretch. It is composed of 100% cotton fibers and acrylic heat sensitive glue (Kase *et al.*, 2003) [5].

3. Procedures of the study

A verbal explanation about the important justification and main point of achievement of the study was explained to every patient. The procedures of the study were divided into two main categories:

3.1. Measurement procedures

Technical assessment procedure was conducted through:

Measurement of cortisol level

Cortisol level was measured before conduction of the training program and after the completion of the study.

Measurement of pain intensity procedures (VAS)

While the patient was seated comfortably he is instructed to point out the degree of pain on a visual analogue scale in a form of a horizontal 100 mm line numbered from 0 to 10 in an interval of 10 mm drawn on a paper where she marks on the degree of pain at which 0 is the point of no pain and 10 is the point of severe pain both before and after treatment.

Measurement of shoulder ROM by electronic goniometer: Steps

1. Electrogoniometer sensor was mounted across the right shoulder with one end mounted on dorsal scapular surface and other on dorsal surface of the right upper arm.
2. The two sensors ends were abducted, flexed and external rotated.

3.2. Therapeutic Procedures

The procedures of treatment applications was achieved. By kinesio tape as the following;

How to Cut Kinesio: Tape (Kase *et al.*, 2007) [8].

“Y” cut, “X” cut, “fan” cut and “I” cut = just a strip of Tape

Kinesio Tape Application tips: (Kase *et al.*, 2007) [8].

- a. Prepare skin
- b. Rubbing
- c. Special care to remove.

Treatment duration in typical four weeks, kinesio tape was worn 23/24 hours a day, change it every 5 days a week, Standard 2-in (5-cm) Kinesio Tex tape was used.

1-Kinesio tape for supraspinatus and deltoid muscle:

- a. The first strip was a Y-strip representative of the supraspinatus, which was applied from its insertion to origin with paper off tension.
- b. A Y-strip refers to a section of tape that has a portion cut down the middle to produce 2 tails.
- c. Paper-off tension means applying the tape directly to the skin as it comes off the paper backing.
- d. The first strip was applied with the subject in a position combining cervical side bending to the contralateral side and the arm reaching behind the back as if reaching into the contralateral back pocket.
- e. The second strip was a Y-strip representative of the deltoid, also applied from insertion to origin with paper-off tension (Thelen *et al.*, 2008) ^[9].

Kinesio tape for latissimus dorsi muscle

- a. Patient position: standing or seated and Place the shoulder in full glen humeral flexion. The elbow may be flexed. Apply the base of the Kinesia Tex to the border of the fibers of the posterior deltoid on the proximal third of the upper arm.
- b. Keeping the arm overhead in external rotation and laterally flex the trunk to the opposite site. Stabilize the base of the Kinesio Tex and pull the skin superiorly

while assisting the patient into lateral flexion to increase tissue tension. Apply the lateral "y" tail to the iliac crest, enclosing the lateral border of the latissimus dorsi. Return the patient to the neutral standing position.

- c. With the glenohumeral joint in overhead flexion, adduction and external rotation, flex the trunk to place the superficial tissue under tension. Stabilize the base of the Kinesia Tex and pull the underlying skin medially while assisting in glenohumeral adduction and flexion.

Data analysis

Descriptive statistics

In this study, the descriptive statistics in form of mean and standard deviation was calculated for all patients in both groups of the study to determine the homogeneity and central deviation of the groups.

Analytic statistics

The analysis and comparison of the data was made by student's T-test to compare the variables between all groups of the study. Paired T-test was used to compare the dependent variables before and after treatment in the same group. A value of P > 0.05 was considered statistically significant. (Maronna *et al.*, 2006) ^[10].

Results

The purpose of the study to investigate the effect of kinesio tape on shoulder pain and range of motion.

Table 1: Physical characteristics of the subjects in both group A and group B.

Variables	Group I (Mean +S.D)	Group II (Mean + S.D)	T	P	Significance
Age (Years)	35.4667 + 3.56304	35.6000 + 3.48056	-0.104	0.918	NS
Weight (Kg.)	64.0000 + 8.19407	63.9333 + 9.92448	0.020	0.948	NS
Height (Cm.)	164.2000 +9.16671	167.6667 +7.98809	-1.104	0.279	NS
BMI	23.6733 + 1.54294	22.6000 + 1.79960	1.745	0.090	NS

P>0.05 NS: Non significant P: P-value t: t-value

3-Effect of treatment on shoulder flexion

Group A: There was a significant change in the mean value of flexion post treatment compared with pre-treatment P-value was (p = 0.000) and the t-value was (t= -12.266).

Group B: There was a significant change in the mean value of flexion post treatment compared with pre-treatment (p = 0.002) and the t-value was (t= 3.843).

Table 2: Paired T test measuring effect of treatment on shoulder flexion

Group A		Group B	
Pre	Post	Pre	Post
$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$
91.0000± 16.16875	146.3333± 16.7403	87.6667± 6.18370	75.8667± 12.79434

Un-paired T-test		P value	Significance	T value	
Within group	Pre vs. post	A	P=0.000	S	12.266
		B	P = 0.002	S	3.843
Between group	Pre treatment	Group A versus group B	P = 0.462	NS	0.746
Between group	Post treatment	Group A versus group B	P = 0.000	S	12.9

\bar{X} : mean, SD: standard deviation, p value: probability, S: significance, NS: non significance

Effect of treatment on shoulder abduction

Group A: There was a significant change in the mean value of abduction post treatment compared with pre-treatment P-value was (p = 0.000) and the t-value was (t= -8.054).

Group B: There was non significant change in the mean value of abduction post treatment compared with pre-treatment (p = 0.200) and the t-value was (t= 1.344).

Table 3: Paired T test measuring effect of treatment on shoulder abduction

Group A		Group B	
Pre	Post	Pre	Post
$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$
74.0000± 15.49193	117.6667± 16.56876	69.6667± 15.63726	68.8667± 14.61343

Un-paired T-test			P value	Significance	T value
Within group	Pre vs. post	A	P=0.000	S	-8.054
		B	P = 0.0200	NS	1.344
Between group	Pre treatment	Group A versus group B	P = 0.452	NS	0.762
Between group	Post treatment	Group A versus group B	P = 0.000	S	8.55

\bar{X} : mean, SD: standard deviation, p value: probability, S: significance, NS: non significance

Effect of treatment on shoulder external rotation

Group A: There was a significant change in the mean value of external rotation post treatment compared with pre-treatment P-value was (p = 0.000) and the t-value was (t= -16.560).

Group B: There was a significant change in the mean value of external rotation post treatment compared with pre-treatment (p = 0.000) and the t-value was (t=- 13.596).

Table 4: Paired T test measuring effect of treatment on shoulder external rotation

Group A		Group B	
Pre	Post	Pre	Post
$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$
53.0000± 7.02038	80.6667± 6.22973	56.3333± 5.49892	78.0000± 5.91608

Un-paired T-test			P value	Significance	T value
Within group	Pre vs. post	A	P=0.000	S	-16.46
		B	P = 0.000	S	- 13.596
Between group	Pre treatment	Group A versus group B	P = 0.159	NS	-1.4
Between group	Post treatment	Group A versus group B	P = 0.239	NS	1.20

\bar{X} : mean, SD: standard deviation, p value: probability, S: significance, NS: non significance

Discussion

In recent years, the use of Kinesio Tape (KT) has become increasingly popular. Kinesio Tape was designed to mimic the qualities of human skin. It has roughly the same thickness as the epidermis and can be stretched between 30% and 40% of its resting length longitudinally. Kinesio Tape has several benefits, depending on the amount of stretch applied to the Tape during application: (1) to provide a positional stimulus through the skin, (2) to align fascial tissues, (3) to create more space by lifting fascia and soft tissue above area of pain/inflammation, (4) to provide sensory stimulation to assist motion, and (5) to assist in the removal of edema by directing exudates toward a lymph duct. (Kase *et al*, 2003)^[5].

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received only traditional physical therapy in form of mobilization, stretching and ROM exercises three times per week for one month.

Measurements were conducted before starting the treatment as a first record, and at the end of 4 weeks of treatment as final record.

Instrumentations

Measuring tools and materials

These categories were divided into 3 various tools:

1. Blood analysis for measurement of cortisol level

An abnormal serum concentration is an excellent biologic marker for uncontrolled pain. Cortisol screening should be a routine measure in any patient with chronic pain who claims pain to be constant or persistent and severe enough to require daily opioid treatment (Khoromi *et al.*, 2006)^[11].

2. Visual analog scale: The pain VAS is a unidimensional measure of pain intensity.

3. Electronic goniometer: For measuring range of motion

The results of present study was as follow:

The aim of this study was to investigate the effect of kinesiotape on shoulder pain and range of motion in liver transplantation donor patients.

Above finding may be established by the previous study done by Kaya, *et al.*, 2011 that after applying kinesio taping over the supraspinatus and deltoid muscles using the insertion-origin technique in addition with a home exercise

program in SIS patients for a minimum of 2 months, they observed a significant decrease in pain and disability in the KT group in the first two weeks.

The results of current study supported by Thelen *et al.* 2008^[9]. Shakeri, Hassan, *et al.* 2013^[13]; and supported by Mark D. Thelen, *et al.* 2008^[9]. (Simoneau *et al.*, 1997)^[14]; (Smith *et al.*, 2009)^[15]. (*et al.*, 1998); (Celik *et al.*, 2009)^[17]; (Kuhn and John, 2009)^[18]; (Shakeri *et al.*, 2013)^[13].

(Thelen *et al.*, 2008)^[9]. that shoulder movement facilitation through its entire ROM, the stretching of the skin over the region caused by KT, guides the shoulder through the arc. An improvement in glenohumeral motion will facilitate the effects of KT. This will decrease the mechanical irritation present in the soft tissues surrounding the shoulder joint.

Shakeri, Hassan, *et al.* 2013^[13]. In this study Range of motion is measured by goniometer. Our results are also consistent with the previous reports showing that KT can have a positive response on ROM when thought to be limited by musculoskeletal shoulder pain.

The significant changes in ROM may be supported by the findings of another study where it was claimed that patients often report symptom relief, improved comfort level and stability of the involved joint that the response of taping may be due to the proprioceptive and sensory-motor feedback mechanisms (Simoneau *et al.*, 1997)^[14].

In one another study investigators focus on the role of muscle imbalance which should be cured through the alternative treatment methods like KT as well as the exercises. The result of this study shows a significant decrease in disability, pain and improve functional performance after 4 weeks of Taping compared with pre-treatment score in Group 2 (Experiment) and in Group 1 (control) (Smith *et al.*, 2009)^[15].

In this study, we used KT and not rigid tape to minimize the skin irritation following taping. Exercise programs for SIS aimed to stimulate recovery in the affected tissues and improve shoulder movements without an increase in pain (Bøhmer *et al.*, 1998)^[16].

The significant result may be supported by the finding of another study by Celik, *et al.* that noticed a significant reduction in level of pain following their exercise treatment which they applied beneath the painful arch for 2 weeks in subjects with SIS (Celik *et al.*, 2009)^[17].

Out of 11 randomized controlled studies investigating the effects of exercise in SIS, 6 discussed the effects of exercise on pain and found exercise therapy alone to be efficient in pain control in both the short- and long-term. Kinesio tape may enhance joint stability and movement biomechanics with the mechanical support. It is believed that the skin receptors are stimulated and proprioception increases, particularly when KT is applied with the correction technique and extra stretching (Kuhn and John, 2009)^[18].

The results of current study unsupported by (Kneeshaw and David, 2002)^[20]; (Mostafavifar *et al.*, 2012)^[21].

The study of (Kneeshaw and David, 2002)^[20]. on a small sample size including subjects having shoulder pain found that KT provides an immediate effect in limitation of the active ROM and pain during abduction with no improvements in disability score after tape application. However, a different study using multiple types of tape, including KT, found positive changes in scapular motion and muscle performance in amateur baseball players with shoulder impingement syndrome. One study included in our

review showed that the use of KT after musculoskeletal injury may immediately improve function, but it was not clear whether this effect is long lasting or not (Mostafavifar *et al.*, 2012).

Conclusion

Within the limitations of the present study, the most notable conclusions are

The Electronic goniometer is extremely effective, valid and inexpensive tool in assessment of range of motion, this study may be useful for improving shoulder range of motion and functional mobility after liver transplantation in donor patients and improving physical performance of daily living activities, because of independent lifestyle among those populations.

References

1. Varma V, Mehta N, Kumaran V. "Indications and contraindications for liver transplantation International Journal of Hepatology. 2011;121862.
2. Koffron A, Stein AJ. Liver Transplantation: Indications, Pretransplant Evaluation, Surgery, and Post-transplant Complications. Med Clin N Am. 2008; 92:861-888.
3. Mazza G, *et al.* Hepatic regenerative medicine" (Journal of Hepatology. 2015; 63(2):523-524.
4. Schumann R, Zabala L, Angelis M, Bonney L, Tighiouart H, Carr BD. Altered Hematologic Profiles Following Donor Right Hepatectomy and Implications for Perioperative Analgesic Management. Liver Transplantation. 2004; 10(3):363-368.
5. Kase K, Wallis J, Kase T. Clinical Therapeutic Applications of the Kinesio Taping Method. Tokyo, Japan: Ken Ikai Co Ltd, 2003.
6. Prentice WE, Arnheim DD. Arnheim's Principles of Athletic Training: A Competency-Based Approach. 14th ed. New York, NY: McGraw-Hill Higher Education, 2010, 743-752.
7. Burckhardt CS, Jones KD. Adult measures of pain: The McGill Pain Questionnaire (J\1PQ), Rheumatoid Arthritis Pain Scale (RAPS), Short Form McGill Pain Questionnaire (SF-1\1PQ), Verbal Descriptive Scale (VDS), Visual Analog Scale (VAS), and West Haven Yale Multidisciplinary Pain Inventory (WHYMPI). Arthritis Rheum. 2003; 49:S96-104.
8. Kase K, Youshida, Kase T. Clinical Therapeutic Applications of the Kinesio Taping Method. Tokyo, Japan: Ken Ikai Co Ltd, 2007.
9. Thelen MD, Dauber JA, Stoneman PD. The Clinical Efficacy of Kinesio Tape for Shoulder Pain: A Randomized, Double Blinded, Clinical Trial. Journal of Orthopaedic & sports physical therapy. 2008; 38(7):389-395.
10. Maronna RA, Martin RD, Yohai VJ. Robust statistics theory and methods. Journal of American Association, 2006; 90(1):330-341.
11. Khoromi S, *et al.* Effects of chronic osteoarthritis pain on neuroendocrine function in men. J Clin Endocrinol Metab. 2006; 91(11):4313-4318.
12. Kaya, Erkan, Murat Zinnuroglu, Ilknur Tugcu. "Kinesio taping compared to physical therapy modalities for the treatment of shoulder impingement syndrome." *Clinical Rheumatology*. 2011; 30(2):201-207.
13. Shakeri Hassan, *et al.* Therapeutic effect of kinesio-

- taping on disability of arm, shoulder, and hand in patients with subacromial impingement syndrome: a randomized clinical trial. *Journal of Novel Physiotherapy*. 2013; 3(161):2.
14. Simoneau, Guy G, *et al.* Changes in ankle joint proprioception resulting from strips of athletic tape applied over the skin. *Journal of Athletic Training*. 1997; 32(2):141-47.
 15. Smith, *et al.* Upper and lower trapezius muscle activity in subjects with subacromial impingement symptoms: is there imbalance and can taping change it? *Physical Therapy in Sport*. 2009; 10(2):45-50.
 16. Bøhmer, Audhild S, Peer H. Staff, Jens Ivar Brox. Supervised exercises in relation to rotator cuff disease (impingement syndrome stages II and III): a treatment regimen and its rationale. *Physiotherapy Theory and Practice*. 1998; 14(2):93-105.
 17. Celik Derya, Gulseren Akyuz, Ipek Yeldan. Comparison of the effects of two different exercise programs on pain in subacromial impingement syndrome. *Acta Ortho Paedica et Traumatology Turcica*. 2009; 43(6):504-509.
 18. Kuhn, John E. Exercise in the treatment of rotator cuff impingement: a systematic review and a synthesized evidence-based rehabilitation protocol. *Journal of Shoulder and Elbow Surgery*. 2009; 18(1):138-60.
 19. Shakeri H, Keshavarz R, Arab AM, Ebrahimi I. Clinical effectiveness of kinesiological taping on pain and pain free shoulder range of motion in patients with shoulder impingement syndrome: a randomized double blinded placebo controlled trial. *The International Journal of Sports Physical Therapy*. 2013; 8(6):800-810.
 20. Kneeshaw, David. Shoulder taping in the clinical setting. *Journal of Bodywork and Movement Therapies*. 2002; 6(1):2-8.
 21. Mostafavifar, Mehran, Jess Wertz, James Borchers, A systematic review of the effectiveness of kinesio taping for musculoskeletal injury. *The Physician and Sports Medicine*. 2012; 40(4):33-40.