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Full Length Review Article

EFFICACY OF KINESIO TAPING VERSUS PHONOPHORESIS ON MECHANICAL NECK DYSFUNCTION

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ABSTRACT

Background: Mechanical Neck Dysfunction (MND) affects about two thirds of people in middle age with common cause of bad posture in people who spent much of their working day at a desk with a bent-forward posture.
Purpose: To compare the efficacy of kinesio taping versus phonphoresis on neck pain intensity, cervical ROM and neck disability in patients with MND.
Design: pre - posttest experimental design
Methods: 45 patients with MND participated in this study, their age ranged from 20-45 years. They were assigned randomly and equally into three groups; Control group (A) received exercises program, Group (B) received phonophoresis with exercise program and Group (C) received kinesio taping replaced every 4 days with 2days off with exercise program. All groups received treatment 3 times weekly for 12 sessions. Pain intensity, cervical ROM and neck function disability were measured pre and post treatment by Visual Analogue Scale, OB Goniometer and Neck Disability Index respectively.
Results: There was significant improvement in the three groups after intervention in favor of kinesio taping group.
Conclusion: It was concluded that improvement in the kinesio taping more than phonophoresis on Pain intensity, cervical ROM and neck function disability in MND.

INTRODUCTION

Mechanical neck dysfunction is a type of dysfunctional syndrome affecting the cervical spine, characterized by intermittent pain, restriction of end range movement and dysfunction of the cervical muscles especially when the cervical spine is loaded. A myriad of impairments have been demonstrated that include changes in the physical structure, as well as changes in behavior of the cervical muscles (McKensie and May, 2008). Mechanical neck dysfunction may result from postural dysfunction, trauma, or it may be of insidious onset (Fraser, 2009). There is irrefuTable evidence of an association between mechanical neck pain and dysfunction of the muscles of the cervical spine (O'Leary and Falla, 2009). In adults, mechanical dysfunction of the cervical spine can be the primary cause of recurrent neck pain (Hellstenius, 2009).

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Kinesio taping (KT) is a new therapeutic modality to correct and treat many musculoskeletal disorders. It is a rehabilitative, therapeutic modality based on natural healing process, which makes it a healthy drug-free alternative to many other methods of treatment. Its basic principle is to release tension between deep skin and muscle. This allows better flow of body fluids under the application area, which results in reducing edema, inflammation and discomfort (Kase, 2007). Kinesio taping method incorporates a special tape product plus different techniques for various conditions. The elastic tape is unique in that it can stretch to 130-140% of its static length; theoretically allowing full range of motion while the muscle is placed on gentle functional stretch during the application. The tape can be worn for 3-5 days (Kase *et al*., 2003). The KT is hypothesized to encourage normal muscular function, increase lymphatic and vascular flow, diminish pain and aid in correction of possible articular mal-alignments (Callaghan *et al*., 2008). Its frequently applied for pathologies in the musculoskeletal system, especially in the field of sports injuries (Zajt-Kwiatkowska *et al*., 2007).

In recent studies, KT increased the EMG activity of the scapular muscles (Lin *et al*., 2011), lower trapezius muscle (Hsu *et al*., 2009), other studies proved that it is an evidence based method used for treating patellafemoral pain (Alicia *et al*., 2013), treatment of subacromial impingement syndrome (Simsek *et al*., 2013). The short term effect of kinesio taping on cervical pain and range of motion in patients with an acute whiplash injury has been investigated, and significance were found improvements immediately following its application and 24 hour later (González-Iglesias *et al*., 2009). Phonophoresis implies application of ultrasound energy to drive molecules into and across skin (Polat *et al*., 2011).

The exact mechanism behind enhancement of transdermal delivery by phonophoresis is not yet known. However, acoustic cavitation (formation and oscillation of micro bubbles in the coupling medium) is thought to play an important role in ultrasound assisted delivery. Collapse of these micro bubbles on the surface of skin (stratum corneum) leads to skin permeabilization (Ueda *et al*., 2009). It has several advantages. It has a low risk of burning the skin, no need to ionize the drugs, and its penetration is approximately 5 cm and its treatment time is short. The drug is placed on the skin in the form of a gel, cream, ointment, or liquid and serves as a medium for the ultrasound transmission. This procedure is intended to enhance transdermal penetration of particles of the drug while providing the therapeutic effects of ultrasound (Koeke *et al*., 2005).

MATERIALS AND METHODS

Study Design: This study was a pre - posttest experimental trial. The procedures were followed according to the ethical standards and after approval of the patients with written consent. The study was conducted in the Physical Therapy Department of El Delengat General Hospital, Behira, Egypt

Subjects: Forty five patients diagnosed with MND of both sexes were referred from the orthopedic department of the hospital and participated in the current study. Patients were randomized equally into three group. Control Group A (15 patients received exercises program only).Group B (15 patients received phonophoresis with exercises program) .Group C (15 patients received kinesio taping with exercises program). Inclusive criteria: age of patients ranged from 20-45 years. All patients referred from orthopedic consultants with MND. Their neck disability index (NDI) is above 5 (Haneline, 2006). Patients were able to perform (ROM) test of cervical spine. Exclusion criteria were: Cervical disc problems or cervical spondylosis.

History of neck trauma or head injuries. Ankylosing spondylitis. Osteoporosis of cervical spine. Cervical rib.Post-surgical neck conditions.Open wound over the cervical region. Internal fixation of cervical vertebrae. Cerebrovascular abnormalities. Patients sensitive to kinesio tape

Procedures

- Evaluative Procedures.
- Treatment Procedures.

Evaluative Procedures

OB Goniometer

Myrin OB goniometer is valid and has good reliability for measuring cervical spine range of motion and studies support the continued use of the myrin OB goniometer in routine clinical orthopedic work (Malmstrom *et al*., 2003).

Visual Analogue Scale (VAS)

To measure pain intensity. The VAS has good validity and test-retest reliability between 0.95 and 0.97 (Kelly, 2001).

Neck Disability Index (NDI)

Measuring self-rated disability due to neck pain was done by NDI which is a standard instrument questionnaire. The NDI has high test-retest reliability and good concurrent validity (Vernon and Moir, 1991).

Treatment Procedures

Group A (Exercises Program only)

It consisted of two stages; isometric exercises for (Neck Extensor , Flexor and Side-Bending Muscles) patient hold 6 sec and relax 6 sec repeated 5 times and stretching exercises for(Levator Scapula ,upper fibers of trapezius and sternocleidomastoid muscles) repeated 3 times stretch hold for 30 sec and relax 30 sec (Borestein *et al*., 1996; Jordan *et al*.,1998).

Group B (phonophoresis)

Ultrasonic device (Phyaction ub gymna uniphy) US was applied on the para spinal muscles of the neck and on upper fiber of the trapezius muscle after applying diclofenac sodium gel as a coupling media (Álvarez-Soria *et al*., 2008). 1 MHz frequency with transducer having an affective radiating area of 5.0 cm2. Intensity of 1.5W/ cm2 in continuous mode to insure reaching the deep tissues (Kitchen and Bazin, 2002).

Group C Kinesio Tape

The tape (Kinesio Tex) used in this study was water proof, adhesive, had a width of 5cm, thickness of 0.5 mm and 5 meters length made in Japan. It was made from gentle porous cotton fiber strip. It was able to get stretched up to140% of its original length. I have used (pink, blue, piege and black) colors of tape. The tape was worn on the skin and replaced every 4 days (Kase *et al*., 2003). The tape was measured and cut according to patient's required area, which was to be treated. Two strips (I and Y) of the tape were used; Y strip started from thoracic vertebrae 3-5 to occiput of the skull (hair line), and I strip was put at middle of the neck horizontally. The patient was asked to move his neck in flexion. Then the base of Y strip was applied over the spinous process of T3-5 and with no tension the tails of Y strip were applied para-spinal up to the hair line. With the same position of the patient, the middle paper packing of I strip was torn and tension was applied on the middle, adhesive of the tape at middle of the neck horizontally then the tension was released at the ends (Kase *et al*., 2003). The total period of treatment was one month for all groups of treatment modalities Fig. (1).

Fig. 1. Application of Y and I strip tape

Data Analysis: The statistical analyses were performed the aid of the statistical package of social sciences (SPSS) version 20. Descriptive statistics (mean and standard deviation) were computed for all data. The paired t - test was used to measure changes of pain, cervical ROM and neck disability pre and post treatment in the same group. ANOVA-Test was used to measure changes of pain, cervical ROM and neck disability between the three groups pre and post treatment.

RESULTS

General characteristics of the subjects

In this study, 45 patients with MND were assigned into 3 equal groups with 15 patients in each group. There was no significant difference between the 3 groups in their ages, weights, heights and BMI where their F and P-values were (0.58, 0.55), (0.43, 0.65), (0.6, 0.55) and (0.91, 0.4) respectively. As shown in Table (1).

Pain Level: There was no significant difference among the three groups for the pre treatment value as F value was 0.09 and P value was 0.91. While there was a significant difference for the post treatment value as F value was 16.14 and P value was 0.0001 as shown in Table (2) and Figure (2).

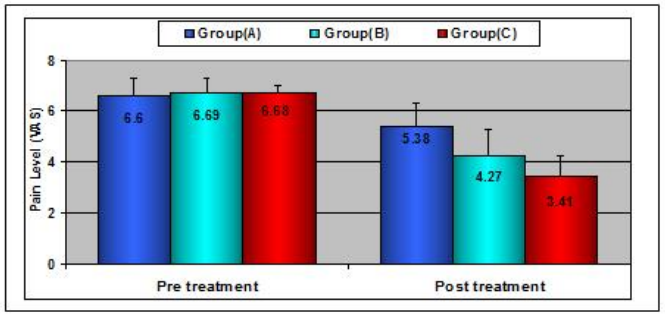

Fig. 2. Mean and SD of Pain Level for the three groups Pre and post treatment

Neck flexion ROM: There was no significant difference among the three groups for the pre treatment value as F value was 0.009 and P value was 0.99. While there was a significant difference for the post treatment value as F value was 11.53 and P value was 0.0001 as shown in Table (3).

Neck extension ROM: There was no significant difference among the three groups for the pretreatment value as F value was 0.05 and P value was 0.94 .While there was a significant difference for the post treatment value as F value was (16.31) and P value was 0.0001 as shown in Table (4).

Neck side bending ROM: There was no significant difference among the three groups for the pre treatment value as F value was 0.05 and P value was 0.94 .While there was a significant difference for the post treatment value as F value was 14.3 and P value was 0.0001 as shown in Table (5).

Table 1. Mean and standard deviation of the age, height, weight and BMI of groups (A, B, C)

Items	Group (A)		Group (B)		Group (C)		Comparison		
	Mean	±SD	Mean	±SD	Mean	±SD	F-value	P-value	S
Age (yrs)	31.73	± 4.9	30.66	±5.34	32.86	±6.31	0.58	0.55	NS
Weight (Kg)	79.46	± 5.95	79.73	±4.55	78.13	±4.47	0.43	0.65	NS
Height (cm)	169.8	±5.99	171.93	±5.47	171.86	±6.58	0.6	0.55	NS
BMI (Kg/m^2)	27.65	± 2.85	27.05	±2.37	26.49	±1.65	0.91	0.4	NS

SD: standard deviation, P: probability, S: significance, NS: non-significant

Table 2. Results of ANOVA among the three groups for Pain Level

Pain Level		SS	MS	F	P value	S
Pre Treatment	Between Groups	0.06	0.03			
	Within Groups	15.04	0.35	0.09	0.91	NS
	Total	15.1				
Post Treatment	Between Groups	29.36	14.68			
	Within Groups	38.2	0.91	16.14	0.0001	S
	Total	67.57				

SS: Sum of Square, MS: Mean Square, P: probability, S: significance, S: Significant

Table 3. Results of ANOVA among the three groups for Neck flexion ROM

Neck flexion ROM		SS	MS	F	P value	S
Pre Treatment	Between Groups	0.4	0.2			
	Within Groups	896.8	21.35	0.009	0.99	NS
	Total	897.2				
Post Treatment	Between Groups	488.93	244.46			
	Within Groups	890.26	21.19	11.53	0.0001	S
	Total	1379.2				

SS: Sum of Square, MS: Mean Square, P: probability, S: significance, S: Significant

Table 4. Results of ANOVA among the three groups for Neck extension ROM

Neck extension ROM		SS	MS	F	P value	S
Pre Treatment	Between Groups	1.73	0.86			
	Within Groups	689.46	16.41	0.05	0.94	NS
	Total	691.2				
Post Treatment	Between Groups	790.93	395.46			
	Within Groups	1018.26	24.24	16.31	0.0001	S
	Total	1809.2				

SS: Sum of Square, MS: Mean Square, P: probability, S: significance, S: Significant

Table 5. Results of ANOVA among the three groups for Neck side bending ROM

Neck side bending ROM		SS	MS	F	P value	S
Pre Treatment	Between Groups	1.24	0.62			
	Within Groups	470.53	11.2	0.05	0.94	NS
	Total	471.77				
Post Treatment	Between Groups	315.51	157.75			
	Within Groups	463.06	11.02	14.3	0.0001	S
	Total	778.57				

SS: Sum of Square, MS: Mean Square, P: probability, S: significance, S: Significant

Table 6. Results of ANOVA among the three groups for Neck rotation ROM

Neck rotation ROM		SS	MS	F	P value	S
Pre Treatment	Between Groups	6.93	3.46			
	Within Groups	444.26	10.57	0.32	0.72	NS
	Total	451.2				
Post Treatment	Between Groups	435.37	217.68			
	Within Groups	452.26	10.76	20.21	0.0001	S
	Total	887.64				

SS: Sum of Square, MS: Mean Square, P: probability, S: significance, S: Significant

Table 7. Results of ANOVA among the three groups for Functional disability

Functional disability		SS	MS	F	P value	S
Pre Treatment	Between Groups	1.64	0.82			
	Within Groups	230.26	5.48	0.15	0.86	NS
	Total	231.91				
Post Treatment	Between Groups	277.37	138.68			
	Within Groups	207.86	4.94	28.02	0.0001	S
	Total	485.24				

SS: Sum of Square, MS: Mean Square, P: probability, S: significance, S: Significant

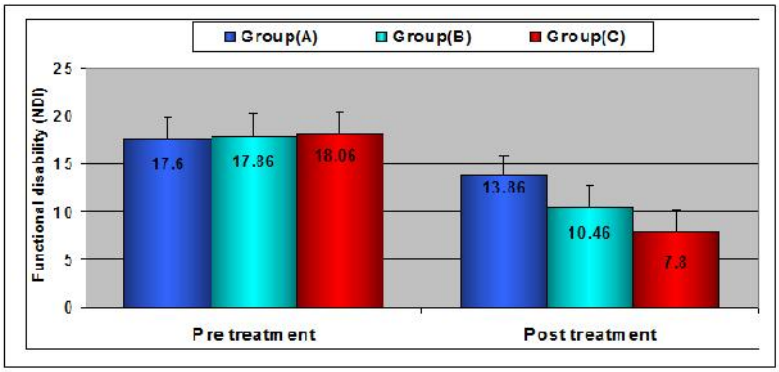

Fig. 3. Mean and SD of Functional disability for the three groups Pre and post treatment

Neck rotation ROM: there was no significant difference among the three groups for the pre treatment value as F value was 0.32 and P value was 0.72. While there was a significant difference for the post treatment value as F value was 20.21 and P value was 0.0001 as shown in Table (6).

Functional disability: there was no significant difference among the three groups for the pre treatment value as F value was 0.15 and P value was 0.86.

While there was a significant difference for the post treatment value as F value was 28.02 and P value was 0.0001 as shown in Table (7) and Figure (3).

DISCUSSION

There is limited of research studying effect of kinesio taping in patients with mechanical neck dysfunction, the purpose of the current study was to investigate the effect of kinesio taping versus phonophoresis in patients with mechanical neck dysfunction.

The result of this study showed that regarding the effects of exercises program on MND in control group: Exercise therapy aimed to improve the performance of the cervical muscles is effective for the alleviation of pain and improvement of disability and function associated with MND (Gross *et al*., 2007). Improvement of muscle strength had a great effect on reducing pain and disability (Murphy, 1999). According to the results of the current study, the exercise program showed that there was a significant improvement in the values of VAS, cervical ROM and NDI .

This came in agreement with (Lars *et al*., 2014) who stated that strength training had high clinical relevance and led to marked prolonged relief in neck muscle pain. Also, the results confirmed by (Ylinen *et al*., 2004), whom evaluated the effect of isometric exercises on 2 groups; chronic neck pain group and control group of healthy women. The exercises applied for 6 weeks 3 sessions/ week. They found that there was a significant difference in muscle strength and neck pain before and post treatment compared to healthy women. In addition, Berg *et al*. (1994) concluded that strengthening exercises have a great effect on reducing pain and function disability in workers with a high prevalence of neck disorders. Similarly, Ylinen *et al*. (2007) compared between stretching exercise and manual therapy on non-specific neck pain and disability.

Measurements were done after 4 weeks and 12 weeks, and there were significant improvements in both groups in neck pain and disability with no difference between both groups. Conclusion: low-cost stretching exercises can be recommended in the first instance as an appropriate therapy intervention to relieve pain, at least for the short-term treatment. Furthermore, chiu *et al*. (2005) evaluated the efficacy of a neck exercise program in patients with chronic neck pain. It was concluded that patients with chronic neck pain could benefit from the neck exercise program with significant improvement in disability, pain and isometric neck muscle strength in different directions. The current study was supported by Takamura *et al*. (2005). They evaluated the usefulness of the stretching exercise in reducing severe postoperative neck pain in the patients who had undergone thyroid surgery. It was concluded that the stretching exercise had effectively reduced postoperative neck symptoms and also reduced the use of analgesics after thyroid surgery. The exercise program treatment may cause a significant positive change in the line of treatment of mechanical neck dysfunction patients.

Regarding the effects of Phonophoresis on MND: The tissues undergo several changes via their interaction with therapeutic ultrasound waves. General result skin permeability enhanced by the augmented mechanical stress and/or by creation of permanent or temporary cavities through corneocytes and keratinocytes. This may also be due to thermal effects (Kim *et al*., 2007). The results of the current study showed that there was a significant improvement in the values of VAS, cervical ROM and NDI with Phonophoresis.

Pain level improvement was due to the effect of diclofenac sodium gel it has pharmacological effects deep within the tissues, including analgesia, reducing inflammation and inhibition of prostaglandins production as increased prostaglandins release causes sensitization of nociceptors (Grace *et al*., 1999).

Range of motion improvement might be due to the effects of non-steroidal anti-inflammatory agent that inhibit pain, allow for the application of stretching exercises and strengthing exercises, in addition to that it increased ability of the patients to maintain their daily training and enable them to maintain more active (Yang *et al*., 2006). These findings are in line with the findings of recent research work done by Ays *et al*. (2001). They compared the effect of phonophoresis, ultrasound and placebo ultrasound therapies in the treatment of myofascial pain syndrome. Patients were allocated into three groups. Group 1(n = 20) was received diclofenac phonophoresis, group 2 (n = 20) was received ultrasound and group 3 (n = 20) was received placebo ultrasound therapies over trigger points, 10 min a day for 15 session during 3 weeks (1 MHz-1,5 watt/cm²).

All patients were given neck exercise program including isotonic, isometric and stretching. Patients were assessed by means of pain measured by visual analog scale (VAS) and Likert scale, range of motion (ROM) of neck, number of trigger points (TP), algometric measurement and disability measured by neck pain disability index (NPDI). Measurements were taken pre and post treatment. There were statistically significant improvements in pain severity, NTP, pressure pain threshold (PPT), ROM and NPDI scores both in phonophoresis and in ultrasound therapy. They concluded that both diclofenac phonophoresis and ultrasound therapy were effective in the treatment of patients with MPS. The study was supported by Durmus *et al*. (2013). Who investigated and compared the effects of phonophoresis and ultrasound therapy on pain, disability, trunk muscle strength, walking performance, spinal mobility, quality of life, and depression in the patients with chronic low back pain. The patients were randomized into three groups. Group 1 (n = 20) control group and was given only exercises. Group 2 (n = 20) received ultrasound treatment and exercises. Group 3 (n = 20) received phonophoresis and exercises. All of the programs were performed 3 days a week, for 6 weeks. All of the groups showed statistically significant improvements in pain, disability, muscle strength, endurance, 6MWT, mobility, QOL, and depression. They concluded that US and PH treatments were effective in the treatment of patients with chronic low back pain.

Regarding the effects of kinesio taping on MND

According to the data analysis in the current study, the results of kinesio taping group revealed that there was a significant improvement in the values of VAS, cervical ROM and NDI. The results of the present study come in agreement with González-Iglesias *et al*. (2009) which showed a significant improvement of neck pain and cervical range of motion following short term application of the kinesio tape; on acute whiplash disorders immediately and at a 24-hour follow-up in comparison to sham tape. The results confirmed by Saavedra *et al*. (2012) . They compared the effectiveness of cervical spine thrust manipulation and Kinesio taping applied to the neck on self-reported pain and disability, and cervical range of motion in individuals with mechanical neck pain. They found that cervical thrust manipulation and Kinesio taping exhibited similar reductions in neck pain intensity and disability and similar changes in active cervical range of motion except for rotation.

Furthermore, Paoloni *et al*. (2011) compared the effects of kinesio taping plus exercise, kinesio taping alone or exercises alone for four weeks on chronic low back pain. Pain, disability and lumbar muscle function were evaluated before and after the treatment period. They found that patients in all three groups displayed a significant reduction in pain after treatment. They concluded that kinesio taping plus exercises have superior effect in pain relief and lumbar muscle function normalization in chronic low back pain.

It was suggested that the findings of this study may be attributed to the effect of kinesio taping on proprioception as kinesio taping has an effect on cutaneous mechanoreceptors through stretching skin, in which the sense of stretching is thought to elaborate signal information of joint movement or joint position (Murray, 2001). In addition, Riemann and Lephart (Riemann and Lephart, 2002) stated that cutaneous mechanoreceptors might play a role in detecting joint movement and position resulting from the stretching of skin at extremes of motion, much like joint mechanoreceptors. Finally after treatment there was a significant improvement in the value of VAS, cervical ROM and NDI in all three groups. However, there were significant improvements in group C (kinesio taping) more than group B (phonophoresis) and group B more than group A (control group).

Recommendation: Additional research is recommended to investigate the effect of kinesio taping on EMG activity as an indicator of proprioception of neck muscle.

Conclusion

kinesio taping and exercises had a superior effect on neck pain intensity, cervical ROM and function neck disability compared to phonophoresis and exercises. Exercises program alone had the least effect.

List of abbreviations	
KT	Kinesio Taping
MND	Mechanical Neck Dysfunction
NDI	Neck Disability Index
QOL	Quality of life
ROM	Rang of motion
SPSS	Statistical package of social sciences

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Conflict of interests

We declare that we did not received any financial support from any institution or company.

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