Efficacy of Therapeutic Taping on Wrist Flexors hyper tonicity in Hemiplegia

Saleh A[1], Wadee AN[1] and El Nassag BA[2]

[1] Department of Basic Science for Physical Therapy, Faculty of Physical Therapy, Cairo University.

[2] Department of physical therapy for Neuromuscular Therapy, Faculty of Physical Therapy, Cairo University.

Abstract

Background: wrist hyper tonicity is one of the most common complications associated with hemiplegia. **Purpose**: To investigate the efficacy of therapeutic taping on wrist flexors hyper tonicity in hemiplegia. **Design**: A pre-test post-test experimental-control design. **Subjects:** Thirty hemiplegic patients from both genders (male\female:22\8).Their age ranged between (42 -63) years. **Materials and methods:** They were assigned randomly in two groups: group (A): Experimental group (n=15) received selected physical therapy program and therapeutic tapping treatment and group (B): Control group (n=15) received selected physical therapy program. All patients were tested for Hoffmann reflex/myogenic response ratio (H/M ratio) before and after twelve sessions using electromyography (EMG). **Results**: Paired t-Test revealed that there was high statistical significant decrease in hyper tonicity (t= 4.36 and p=0.001) concerning experimental group (pre-test mean 47.27% ±11.9, post-test mean 32% ±7.2) but there was insignificant statistical increase in hyper tonicity (t= 0.44 and p=0.07) concerning control group (pre-test mean 46.9% ±8.01,post-test mean 48.15% ±7.3). Unpaired t-Test revealed that there was insignificant results concerning the pre-mean H/M ratio (p= 0.07and t= 0.8) while there was significant results concerning the post-mean H/M ratio (p= 0.001 and t= 4.06). **Conclusion:** adding therapeutic taping to physical therapy sessions decreased wrist hyper tonicity.

Key words: hemiplegia, therapeutic tape, hyper tonicity, H/M ratio.

INTRODUCTION

Hyper tonicity is an increased resistance to passive movement and hypertonia resulting from loss of upper motor neuron inhibitory control. Hyper tonicity seems to be very common problem after stroke affecting 36 –

70% of stroke patients; the upper and lower extremities can be involved to a similar degree **(1).** Post-stroke hemiplgia, upper and lower limb hyper tonicity can impede activities of daily living, personal hygiene, and ambulation and, in some cases, functional improvement **(2).**

Stroke patients experience impairments of the upper limb in the chronic phase, including loss of strength, hyper tonicity, muscle contracture, pain, and edema. Patients with a more severe paresis have a higher risk of developing hyper tonicity and muscle contractures of the wrist and finger flexor muscles. Without appropriate hyper tonicity treatment or contracture prevention, patients are at risk of developing a clenched fist (a hand which is deformed into a fist) by shortening of flexor muscles of the fingers and soft tissue**(3).** It is widely used not only for sports injuries, but also for many other conditions such as muscle imbalance, unstable joints and impaired neural control. During treatment and rehabilitation, taping aids the healing process by supporting and protecting the injured structures from further injury or stress, thus reducing the need for prolonged treatment **(4).**

Therapeutic tape (KT) was developed in 1996 by KenzoKase, with the intention to alleviate pain and improve healing in soft tissues**.** The growing popularity of KT can be attributed, in some respects, to anecdotal support for its therapeutic benefit **(5 and 6). KT** has a long history of use by occupational therapists, physical therapists, athletic trainers, and other trained health professionals to achieve improvement in the treatment of joint sprains, joint instability, soft tissue inflammation, muscle weakness, and pain(**7).** KT was applied to facilitate a functional upright position of the trunk, to assist with positioning the shoulder in neutral alignment, and to provide palmar stability and arch support for the involved hand **(8).**

Some researchers found that therapeutic taping had a great effect in reduction of hyper tonicity. On the other hand, others were against this theory due to the lack of scientific evidence documenting the effectiveness of therapeutic taping **(9, 10 and 11)**.

Upper limb (UL) disabilities adversely affect the quality of life for stroke survivors, despite intense therapeutic efforts to treat UL hemiplegia, hyper tonicity and contractures are common complications experienced by clients post-stroke and are very disabling. Hyper tonicity and contractures restrict joint range of motion (ROM), limit function, cause pain and interfere with the performance of everyday activities **(12).** KT has become a widely used rehabilitation modality for the prevention and treatment of musculoskeletal conditions **(13).**

Researchers conclude that the use of the KT method appeared to have improved purposeful movement and provided needed stability of the shoulder and hand. Also it was suggested that the application of the KT provided the proper body alignment to allow performance of reach, grasp, release, and manipulation tasks **(14).** However so far, there are no enough

studies regarding the influence of KT on spastic wrist flexors muscles. Also the researches surrounding KT is still in its infancy and the scientific evidence to support its use and effects are still being established **(15 and 16).**

Subjects:

Thirty hemiplegic patients their age ranging from 40-65 years. All patients had grade 3 or less than 3 of wrist flexors hyper tonicity according to modified ashowrth scale **(MAS).**They were randomly assigned into two groups each group were fifteen patients: **Group A (experimental Group):** received selected physical therapy program in addition to KT for spastic wrist flexors. **Group B (Control Group):** received selected physical therapy program only twelve sessions of therapeutic exercises only/ 3 sessions per week.Each patient in both groups was examined in an evaluation sheet before and after study application.

Instrumentation:-

A. Evaluative instrumentations:

1- Assessment of hyper tonicity by Modified Ashworth Scale (MAS) (table 1) (12)

Table 1: Modified Ashworth scale for grading spasticity

Grade	Description
0	**No increase in muscle tone**
1	Slight increase in muscle tone , manifested by a catch or by minimal resistance at the end of the range of motion (rom) when the affected parts are moved in flexion or extension
1+	Slight increase in muscle tone , manifested by a catch followed by minimal resistance throughout the reminder less than half of the ROM
2	More marked increase in muscle tone through most of the ROM but affected parts easily moved
3	Considerable increase in muscle tone , passive movement difficult
4	Affected parts rigid in flexion or extension
5	Unable to test

2- Evaluation of H/M ratio by EMG Machine: Section 8 RONALD S. BIENSTOCK EMG, Inc.**Serial Number**77736183 British. This system was used to record the H-reflex. It consists of an amplifier; an oscilloscope display, gain and filter controls, and a stimulator electrode are plugged into a box that transmits signals to a preamplifier that in turn transmits signals to the main unit by a shielded cable. Bar electrodes with two surface electrodes attached to the skin. This system was used to record the H-reflex **(18)**.

B. Treatment instrumentation:

1- KT

2- Physical therapy instrumentations:

a. Shoulder wheel: used for active strengthening exercise for shoulder muscles.

b. Finger ladder used for active range of motion exercise for fingers muscles.
c. Strengthening machine for supinators and pronators.

Procedure

A. Evaluative procedures:

1- **Modified Ashworth Scale:** Before selection of patient to join the study passive movement was done in two separate times by using modified ashworth scale. All patients have grade 3 or less than grade 3 wrist flexors hyper tonicity.

2- Electrophysiological studies (H/M ratio): Hoffmann reflex (H-reflex) was recorded from flexor carpi radialis muscle. The surface recording electrode on the belly of flexor carpi radialis muscle, recording electrode at the junction of the upper one third and lower two third of the line drawn between medial epicondyle and radial styloid via stimulation of the median nerve in cubital fossa using one ms pulse at 0.2 pps of H-max. For each subject, the peak to peak amplitude of the maximum obtained H-reflex and the latencies of four separated traces were averaged for both upper extremities **(13)**.

1) The patient was positioned in sitting position.
2) The skin over the forarm area was cleaned by alcohol.
3) The recording electrodes were attached by tape. Conductive gel was used for electrodes. Active (green). Reference (yellow) recording electrode was placed three cm distal to the active electrode. Ground electrode was placed on wrist between recording electrodes and stimulating electrodes **(13)**.
4) The recording electrode and the ground electrode were connected to the preamplifier and the differential amplifier unit of the electromyography (EMG) unit.
5) The stimulating electrode was placed longitudinally, with the active electrode (cathode) proximally placed and the anode distally placed.
6) The patient was asked to relax, fix patient's head, legs and arms during the test.
7) The intensity of electrical stimulation was started by the lower amplitude and increased gradually. Increase the stimulus intensity until the maximum amplitude of the H-reflex (H maximum) was reached **(13)**.
8) Four repetitive H-maximums were recorded in the upper extremity (affected). The average was calculated. Procedure was repeated for the other upper extremity (sound) to compare amplitudes and latencies and to record side to side difference of H-reflex latencies.
9) Electrical stimulation parameters were: stimulus duration: 0.5-1ms, stimulus rate: 1 pulse every 5 seconds (0.2 pps) and stimulus intensity: subthershold to the action potentials.

10) Upper limit of flexor carpi radialis muscle H-reflex distal latency was 21ms, according to age, height and limb length.

11) Peak to peak amplitude ranged from 2-12mV and shape of action potential was biphasic or triphasic (fig 1).

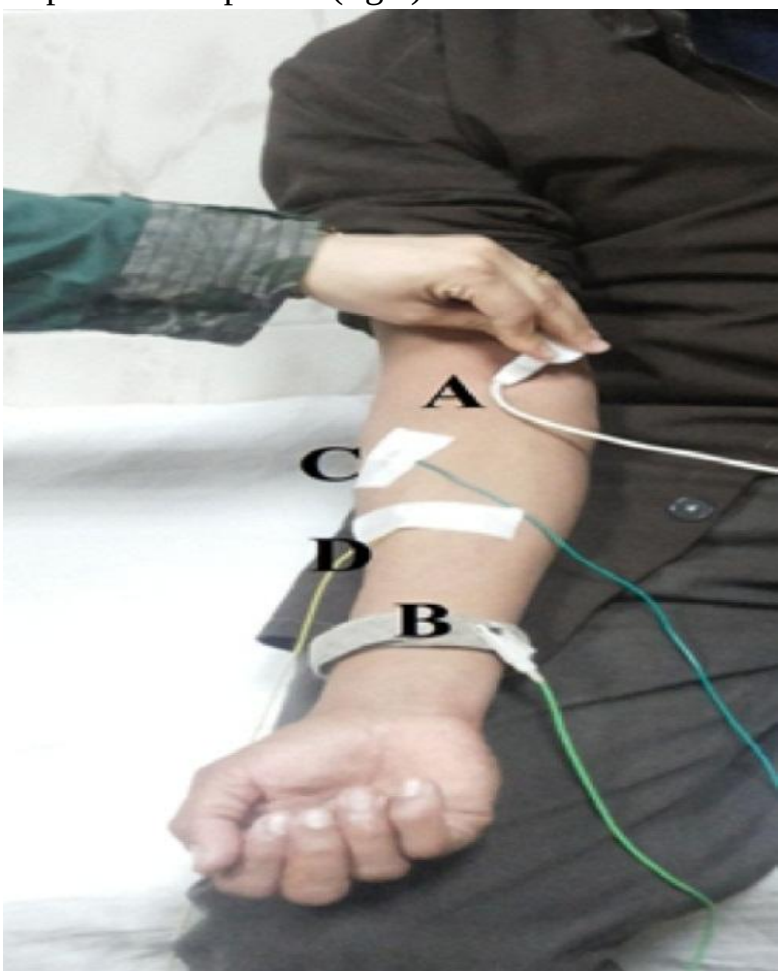

Fig (1): Position of Electrodes during Evaluation of H/M ratio.

A- Stimulation site medial to biceps tendon on brachial artery pulse (groove between brachioradials and biceps tendon.

B- Ground electrode over wrist joint.

C- Active recording electrode (green) on flexor carpi radials **(FCR)** muscle four fingers distal from elbow joint (one third on line between lateral epicondyle and two third proximal from radial wrist joint).

D- Reference electrode (yellow): 3-4 CM from active electrode.

Print the results in a documentation sheet

B. Treatment procedure:

Therapeutic tape application: Patients in experimental group were treated by tapping at dorsal aspect of wrist to stretch the wrist flexors muscles. The purpose of tapping was sustained stretching on spastic muscles. To reach the effect, the strips were gently but firmly pulled to reach the desired position of pull (figure 2) **(14).**

Figure (2): KT application

Tape removal:

Never rip tape off and use a tape cutter or bandage scissors for safe, fast removal. Lubricate the tip with petroleum jelly and slide it parallel to the skin in the natural soft-tissue channels. Remove the tape carefully by peeling it back on itself, and pushing the skin away from the tape. Pull the tape carefully along the axis of the limb Check the skin for damage and apply lotion to restore skin moisture.

Selected physical therapy program: were applied for all patients in both groups (A and B). It included:

a- Active strengthening exercises by shoulder wheel: The patient was asked to stand beside the shoulder wheel and try to turn it forward and backward for 10 minutes with mild resistance

b- Fingers ROM exercises by finger ladder: The patient was asked to climb the obstacles by his fingers up and down for five minutes.

c- Strengthening exercise for supinators/pronators: The patient was asked to grasp the machine and try to rotate it in and out with gradual resistance for five minutes, to isolate the moment of the shoulder joint the patient was asked to flex his/her elbow 90°during the exercise.

Results:

I. H/M ratio of experimental group (A): Paired t-Test revealed that the mean value of H/M ratio decreased at pretest from 47.27 ±11.96% to 32 % ±7.2 at posttest, these changes were highly significant (p= 0.001 and t= 4.36) (table 1and figure 1).

II. H/M ratio of control group (B): Paired t-Test revealed that the mean value of H/M ratio changed at pretest from 46.9% ±8.01 to 48.15% ±7.3 at

posttest, these changes were insignificant (p=0.07 and t= 0.44) (table 1and figure 1).

III. Results in between experimental and control group H/M ratio: Unpaired t-Test revealed that there was insignificant results concerning the pre-mean H/M ratio (p= 0.07and t= 0.8) while there was significant results concerning the post-mean H/M ratio (p= 0.001 and t= 4.06) (table 2 and figure 3).

Table 2: Paired and unpaired t-test results of experimental and control groups

			Paired t-test		Unpaired t-test			
					Pre-Mean H/M ratio ± SD		Post-Mean H/M ratio ± SD	
	Pre-Mean H/M ratio ± SD%	Post-Mean H/M ratio ± SD%	t-value	p-value	t-value	p-value	t-value	p-value
Experimental group (A)	47.27 ±11.96	32 ±7.2	4.36	0.001*	0.8	0.07	4.06	0.001*
Control Group (B)	46.9 ±8.01	48.15±7.3	0.44	0.07				

*significant

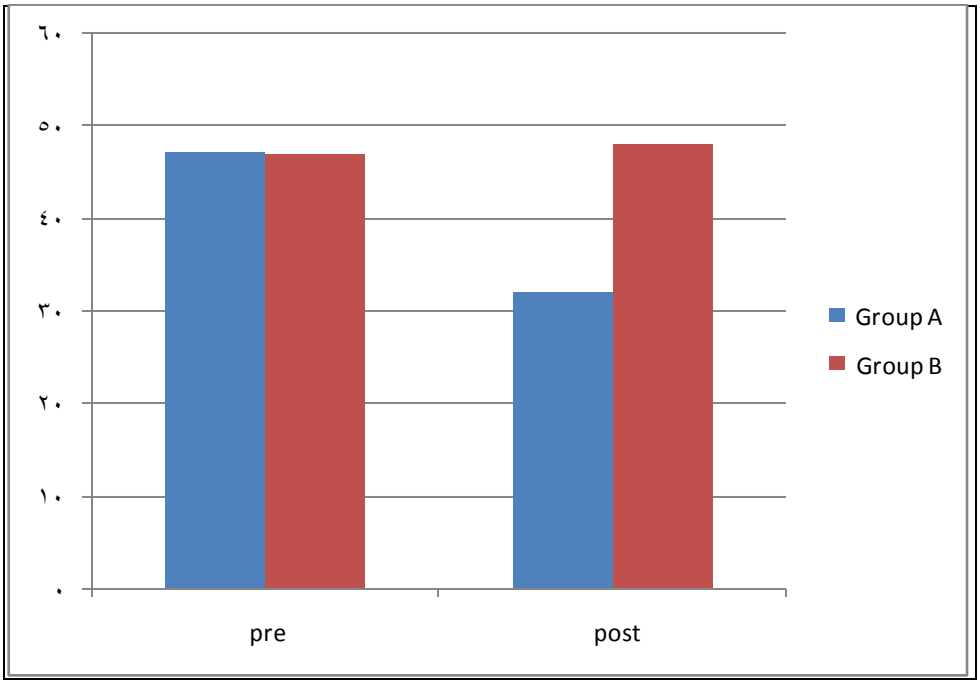

Figure (3): Pre and post-results of experimental and control groups

DISCUSSION

Basing on the results, KT can solve the problem of splinting limitation by making wrist extension with minimum palmar contact. Splinting is supposed to have both biomechanical and neurophysiological benefits Biomechanical benefits constitute stretch associated changes in muscles and connective tissues, and neurophysiological benefits involve reduction of hyper tonicity by inhibiting the reflexive contraction of muscles (**19 and 20)**. Adding the results of this research, KT can solve the confusion among therapists particularly in establishing splinting protocol since some prefer night-splinting, some day-splinting and others prefer a combination of both. There is also no consensus regarding the optimal amount of time that a client should wear a splint**.** Also, KT may replace the lack of established splinting guidelines seems to be playing a role not only in making decisions about splint prescription but also in establishing a wearing regimen**(21 and 22)**.
This agreed by some previous studies on the effectiveness of KT on wrist flexors hyper tonicity were done and found a positive significant reduction in wrist flexors hyper tonicity. one of these studies found that Adhesive taping could lead to higher and faster reduction on wrist and finger flexors hyper tonicity compared with other treatments such as casting, splinting and electrical stimulation; adhesive taping is well tolerated and inexpensive **(23 and 24).**

In a comparison between stretching exercises for wrist flexors and KT, the stretching group showed the least marked modifications in muscle tone over all evaluations. In our opinion this finding warrants particular attention because stretching is a common prescribed treatment after botulinum toxin type A. possible explanation for the poorer result of stretching is its shorter duration. In fact, passive stretching in the stretching group was applied for an hour a day only, whereas the treated muscles of patients in the casting and taping groups were maintained in a stretched position for 24 hours a day **(25 and 26).**

When we adding the result of my study to other researches**,** we found some methodological difference, as here in my study we depend on H/M ratio as an objective numerical method for assessing hyper tonicity but others depend on modified ashworth scale in measurement of hyper tonicity which is subjective but when I compare the results of both assessment methods (H/M ratio, MAS) there were high significance in both studies. Therapeutic taping applied to skin apparently provided tactile input. However, tactile input has been reported to interact with motor control by altering the excitability of the central neuron system. The negative results observed in this study can be explained by the fact that tactile input generated by Therapeutic taping may not be strong enough to modulate muscle power **(27 and 28).** So, researchers found that botulinum toxin type A associated with subsequent adhesive taping application is more effective

than botulinum toxin type A associated with splinting and electrical stimulation in reducing spastic hypertonia **(29 and 30).**

It was reported that the Mechanism of action of therapeutic taping application due to correcting muscle function by strengthening weakened muscles, Improving circulation of blood and lymph by eliminating tissue fluid or bleeding beneath the skin by moving the muscle, Decreasing pain through neurological suppression, Re positioning subluxed joints by relieving abnormal muscle tension, helping to return the function of fascia and muscle and an increase in proprioception through increased stimulation to cutaneous mechanoreceptors **(25)**. Also, Taping can be used as an adjunct during the rehabilitation program to enhance functional recovery by reducing pain, improving alignment, and stimulating or inhibiting muscle function and improving proprioceptive function of the joint structure (**26).** Muscle facilitation is another hypothesized benefit of KT and is dependent on the application of the tape. It is proposed that applying KT from the muscle origin to insertion will produce a concentric pull on the fascia, stimulating increased muscle contraction. To facilitate an eccentric or diminished contraction, believed to occur from an eccentric pull on underlying fascia, application of KT from insertion to origin is recommended **(31).**

Conclusion: Rehabilitation of spastic wrist flexors should be done in a multi-approach to minimize the effect of hyper tonicity and its complications so, application of KT should be done with other physical therapy modalities finally we reject the hypothesis that KT had no influence on spastic wrist flexors.

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