ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 5, Issue, 11, pp. 5996-6000, November, 2015

International Journal of
DEVELOPMENT RESEARCH

Full Length Research Article

EFFECT OF TAPING ALONG WITH PNF TECHNIQUES TO IMPROVE SHOULDER MOBILITY IN HEMIPLEGIC SUBJECTS

Bipin Rai, *Jimshad, T. U and Anil T John

Dayananda Sagar College of Physiotherapy, Shavige Malleswara Hills, K-S lay out, Bangalore 560078, India

ARTICLE INFO

Article History:

Received 27th August, 2015
Received in revised form
26th September, 2015
Accepted 12th October, 2015
Published online 30th November, 2015

Key Words:

Hemiplegics, Stroke,
Shoulder taping,
Peripheral neuromuscular
facilitation, Shoulder mobility.

ABSTRACT

Background: The application of Kinesio Taping along with PNF technique is yet to measure and also in this method sufficient research seems to be lagging. Objective of the study was to find out the effectiveness of shoulder taping along with PNF technique in hemiplegic subjects. **Method:** Total 50 subjects who met the inclusion criteria were randomly divided into two groups by purposive sampling making group-A (25) and group-B (25). Pre and post measurement of active range of motion of hemiplegic shoulder and arm component of the Motor Assessment Scale was recorded from both the group and the group-A was treated with Kinesio Taping and PNF technique. Group- B was treated with PNF technique alone.
Result: shows there was an improvement in Pre to Post scores of ROM and MAS for both the groups, but when comparing both the groups, there was a drastic improvement in scores of ROM and MAS in group A when compared to group B with p- value <0.0001.
Conclusion: The result suggests that shoulder taping along with PNF technique is more effective to improve the mobility in hemiplegic arm.

INTRODUCTION

Stroke is one of the commonest disabling diseases in the world. According to the definition of world health organization (WHO) stroke is a rapidly developing clinical signs of brain function due to disruption of focal or global, loss of cerebral function with symptoms that lasted for 24 hours or more and can cause death, without any other cause other than vascular. A stroke is caused by the interruption of the blood supply to the brain, usually because a blood vessel burst (hemorrhagic stroke) or is blocked by a clot (Ischemic stroke), hence there are two types' Ischemic stroke and Hemorrhagic stroke. Ischemic stroke accounts for about three-quarters of all strokes (http://www.strokerehabunit.ie/en/AboutStrokeRehabUnit/WHODefinition/Text_12599_en.html) A stroke study conducted in Kolkata from 1998 to 1999 showed a crude prevalence rate of 147/100,000 and an annual incidence rate of 36/100,000 being highest that is 42% in India. In people age group between 50-69 years the prevalence rate is more among male. Among stroke patients who underwent neuroimaging study (59.5% of all strokes), 68% proved to be infarct and the remaining 32% to be haemorrhage.

Corresponding author: Jimshad, T. U
Dayananda Sagar College of Physiotherapy, Shavige Malleswara Hills, K-S lay out, Bangalore 560078, India

According to the India stroke factsheet updated in 2012, the estimated age-adjusted prevalence rate for stroke ranges between 84/100,000 and 262/100,000 in rural and between 334/100,000 and 424/100,000 in urban areas. The mean onset of stroke for men in India ranges from 63-65 for men and 57-68 for women (Fiona *et al*., 2012).

The symptom of a stroke is sudden weakness or numbness of the face, arm or leg, most often on one side of the body. Other symptoms include: confusion, difficulty speaking or understanding speech; difficulty seeing with one or both eyes; difficulty walking, dizziness, loss of balance or coordination; severe headache with no known cause; fainting or unconsciousness (http://www.who.int/topics/cerebrovascular_accident/en/ 2015 january 5). Stroke patients has a problem to use affected extremity functionally due to muscle paralysis, muscle flaccidity or spasticity, impaired or lack of sensation, muscle imbalance, poor voluntary control, decreased postural control, body mal-alignment and neglect of the hemiplegic side. Three quarters of strokes occur in the region supplied by the middle cerebral artery. As a consequence, the prevalence of hemiplegic upper limb is more (Bard, 1965). Following the stroke, the victims require physical rehabilitation. Several studies have been conducted to examine the recovery of the hemiplegic arm in stroke patients. Up to 85% of patients show an initial deficit in the arm. Three to six months later,

problems remain in 55% to 75% of patients (Wade *et al*., 1983; Parker *et al*., 1986 and Olsen, 1990), hence this shows the recovery rate is very poor and traditional treatment method does not always give satisfactory results.

One study done by Ruth Dickstein (1986) evaluates the effectiveness of three exercise therapy approach which consist of Traditional Exercise with Functional Activities, Proprioceptive Neuromuscular Facilitation and Bobath approach. The author found that there is no substantial advantage that can be attributed to any one of the three therapeutic approaches. He did not found any important differences in improvements in ADL, in isolated motor control over the involved ankle and wrist joints, and in gait among the three groups of subjects. He only found the pattern of muscle tone improvement in the PNF-treatment group (Ruth Dickstein, 1986). This advocates that traditional treatment methods for the hemiplegic shoulder seem to be moderately effective. PNF is known to stimulate proprioceptive receptors within muscles and tendons, thereby improving function and increasing muscle strength, flexibility, and balance (Klein, 2002). It is a method of neuromuscular dysfunction treatment, primarily by means of facilitating the flow of information, mainly by the stimulation of proprioceptors. A variety of methods fall under the rubric of PNF, including the exploitation of postural reflexes, the use of gravity to facilitate movement in weak muscles, the use of eccentric contractions to facilitate agonist muscle activity, and the use of diagonal movement patterns to facilitate the activation of bi-articular muscles. Kuniyoshi Shimura *et al*. (2002) performed a study on the topic "Effects of proprioceptive neuromuscular facilitation on the initiation of voluntary movement and motor evoked potentials in upper limb muscles". The author concluded that PNF position improves movement efficiency of the joint by inducing changes in the sequence in which the muscles are activated (Kuniyoshi Shimura, 2002).

Supportive Aids are also often used in the rehabilitation at the initial stages following a stroke to support the affected arm. Conventionally shoulder sling and strapping are used to stabilize the joint. However, their use is controversial saying that they encourage flexor synergies, inhibit arm swing, contribute to contracture formation and decrease body image causing the patient to further avoid using that arm. Ada *et al* (2005) conducted a systematic Cochrane review evaluating the benefit of shoulder slings and supports, and concluded that there is insufficient evidence that these devices reduce or prevent shoulder instability following a stroke (Ada, 2005). In a systematic review done by Robert Teasell MD *et al*. on Strapping of the Hemiplegic Arm concluded that Strapping the hemiplegic shoulder does not appear to improve upper limb function, but may reduce pain (Robert Teasell *et al*.). To Regaining functional use of the upper extremity after a stroke becomes one of the most important goals for the therapist in the rehabilitation of the hemiplegic patient, but evidence shows we are yet to find the effective treatment method.

Kinesio Tape is an elastic therapeutic tape made of cotton strip with an acrylic adhesive that is used with the intent of treating pain and disability from and a variety of other physical disorders. Kinesio tape can be stretch up to 50-60% of its lengths. Kinesio tape, on application over the skin stimulates cutaneous mechanoreceptors that increased cutaneous afferent stimulation to the CNS and increase motor unit firing (Macgrego *et al*., 2005 and Chang *et al*., 2010). It also provides a positional stimulus through the skin in the form of sensory stimulus and helps in maintaining normal alignment, assist/limit motion and also allows unrestricted movement (Chang, 2010 and Kase *et al*., 2003). In other word it provides feedback to the muscles to maintain preferred postural alignment. According to the Mayhew (1972) tape has two functions one is supporting and decreasing passive instability of the joint and other is enhancing the active stability (Mayhew, 1972). Hence Kinesio Tape seems to be best choice for the improvement of mobility of the hemiplegic arm. In a study done by Yasukawa *et al*. the Kinesio tap was applied in improving upper extremity control and function in the pediatric rehabilitation setting.

Kinesio Tape was applied to facilitate the functional upright position of the trunk, to assist the positioning of the shoulder in neutral position and to provide palmar stability and arch support for the involved hand. He found that found that the application of the Kinesio Tape provided the proper body alignment to allow performance of reach, grasp, release, and manipulation tasks. Yasukawa concludes that the use of the Kinesio taping method appeared to have improved purposeful movement and provided needed stability of the shoulder and hand.[17] Another study by Yong-Kyu Choi *et al*. done in eight hemiplegic stroke patients concluded that PNF combination patterns and tape application enhanced stability of the knee joints during walking and promoted muscular activity in the surrounding muscles, positively affecting functional gait (Yong-Kyu, 2013).

As we noticed the effect and the proven benefits of Kinesio tape advocate by a few articles, it has lot to offer in the neurological rehabilitation, but at the same time the number of published journals and articles under the neurological-rehabilitation shows that not enough research has been done to explore the effect of Kinesio tape apart from its role as supportive aid. Kinesio tape not only support the structure but also allows the free movement of the particular structure because of its elastic and skin friendly nature giving it advantage from other traditional supportive aid. To explore its full potential we should not only look it as supportive aid but also as a neuromuscular facilitator and pain reducing technique. To best explore its effect it should be incorporated in neuro-rehabilitation along with other traditional treatment technique, hence to explore its possibilities, this study is to find out the effective of kinesio taping along with PNF in hemiplegic shoulder (http://www.strokerehabunit.ie/en/AboutStrokeRehabUnit/WHODefinition/Text_12599_en.html)

MATERIALS AND METHODS

Study was conducted at Sagar Hospital bangalore. The Ethical clearance has been obtained from the Ethical committee of Dayananda Sagar College of Physiotherapy, Bangalore, as per ethical guidelines research from biomedical research on human subjects, 2001, ICMR, New Delhi. The study is Experimental Design involving comparative analysis of Pre and Post test values between two groups, 50 subjects clinically diagnosed with cerebro vascular accident, who fulfilled

inclusion criteria were selected, Subjects with either right or left hemiplegia, Subjects in Brunnstrom motor recovery grade 4 or 5, Both males and females, Age between 50-65, Subjects with MMSE more than 25. Exclusion criteria were Subjects diagnosed with any shoulder pathology and congenital abnormalities, Subjects with uncontrolled hypertension, Subjects with history of multiple strokes, Mentally unstable subjects, Subjects who are allergic to kinesio-tape, Uncooperative subjects. Subjects selected for the study were randomly allocated into two groups by purposive sampling, Group-A who received shoulder taping and PNF techniques and Group-B who received PNF techniques alone.

Group-A Subjects were treated with shoulder taping and PNF technique. Procedure as saving of hairy skin was done and the skin was cleaned with spirit then the Kinesio Tape was applied. The taping was done on upper, middle and lower fibre of trapezius. The tape was applied from insertion to origin to relax tight muscle. The base of the 2- inch 1 strip Kinesio tape is attached to the lateral third of the clavicle. The patient rotated his or her head toward the opposite shoulder, and the tape was adhered to the stretched skin just below the hair line. To support and improve scapular alignment the kinesio tape was applied from origin to insertion for the middle and lower trapezius, thus improving the functional use of the upper extremity.

Both applications require 2-inch 1 strip Kinesio tape approximately affixed on spinous processes of C6-T3 for middle trapezius and on spinous processes of T4-T12 for lower trapezius and the tape was laid down along the muscle fibers with paper off tension, and it was affixed to the acromion and the spine of the scapula, respectively (Ewa jaraczewaka, 2006). Tape was applied 1hour prior to the PNF technique because the exercise which the subjects were going to perform could have cause sweating and that may reduce the adhesiveness of the tape. The fresh tape was applied at first session and in subsequent session the tape was re-examine, if the adhesiveness of the tape found to be reduces then it was replaces by new one. But the wasn't allow to use for more than 5 days because skin cells begin sloughing after 5 effecting on its adhesiveness and the elasticity (http://physioworks.com.au/ InjuriesConditions/Treatments/Kinesiology_Taping_Applicati ons. 17 febuary 2015).

The PNF technique in this study was applied as described by Knott and Voss for the Upper extremity; they are Flexion-abduction-external rotation (elbow flexed and elbow extended), Extension-adduction-internal rotation (elbow flexed and elbow extended), Flexion-adduction-internal rotation (elbow flexed and elbow extended), and Extension-abduction-external rotation (elbow flexed and elbow extended). Ten repetitions of each pattern were done before proceeding to the next pattern. After the set of patterns was completed, it was repeated twice in each treatment session making 3 sets per session. This usually lasted about 45 minutes for each patient (Morey *et al*., 2012). The emphasize was given for the appropriate use of the different PNF components such as commands, stretching, timing and manual resistance to optimize the patient's output. For group B performed PNF technique as described by Knott and Voss was similar to that of Group A.

The rehabilitation program consisted of 16 sessions for 8 weeks, that is 2 session for each week. Taping was done 1 hour prior to PNF techniques; each pattern of PNF was repeated for ten times and preceded to the next pattern. After the set of patterns was completed, it was repeated twice in each treatment session making 3 sets per session. This usually lasted about 45 minutes for each patient (Morey *et al*., 2012). This was performed under the supervision of a physiotherapist with support as and when required. Data analysis was performed using SPSS software (version 17).Alpha value was set at 0.05. Descriptive statistics was used to find out mean and standard deviation (SD) for demographic and outcome variables., Paired –T test was used to find out homogeneity for base line and demographic and outcome variable, Unpaired –T test was used to find out homogeneity for base line and demographic and outcome variable, Wilcoxon test was used to find out homogeneity for base line and demographic and outcome variable, Mann-Whitney test was used to find out the homogeneity for base line and demographic and outcome variable.

RESULTS

Table1 shows Base line characteristics of 50 subjects shown in the table 1, Mean age of group A was 59.00 and group B was 59.28 which was not statistically significant (p>.711.). Group A male and female ratio was 17 and 8 respectively and in group B was 20 and 5 which was not statistically significant (p > .333). Group-A 9 right hemiplegic 16 left hemiplegic where as in Group-B 11 right hemiplegic and 14 left hemiplegic(p >.564)

Table 1. Descriptive statistics for demographic variables

Variable	Group A	Group B	p-value
Age	59.00±2.47	59.28±2.84	>.711
Gender (M/F)	17/8	20/5	>.333
Side (R/L)	9/16	11/14	>.564

Table 2. Within comparison for Group-A

Variable	Pre	Post	p-value
Flexion	60.00±16.58	103.20±16.26	<.0001
Abduction	49.80±17.65	88.00±14.29	<.0001
ER	27.80±8.67	52.20±6.47	<.0001
MAS	1.12±0.33	4.71±0.44	<.0001

Table 3. Within comparison for Group-B

Variable	Pre	Post	p-value
Flexion	57.40±21.37	80.40±18.98	<.0001
Abduction	54.60±21.93	74.20±17.36	<.0001
ER	24.20±7.46	40.20±6.53	<.0001
MAS	1.16±0.37	4.04±0.20	<.0001

Table 2 Data are Mean of subject with respect to pre and post ROM of shoulder flexion, shoulder abduction, shoulder external rotation and MAS of Groups-A. Pre measurement Mean of shoulder flexion was 60.00 where as post measurement Mean shoulder flexion was 103.20 with SD and was statistically significance with p-value <.0001. Pre-measurement Mean of shoulder abduction was 49.80 where as post-measurement Mean shoulder abduction was 88.00 and

was statistically significance with p-value <.0001. Pre-measurement Mean of shoulder external rotation was 27.80 where as post-measurement Mean shoulder external rotation was 52.20 and was statistically significance with p-value <0001. Pre-measurement Mean of MAS was 1.12 where as post-measurement Mean of MAS was 4.71 and was statistically significance with p-value <.0001.

Table 3 Data are Mean of subject with respect to pre and post ROM of shoulder flexion, shoulder abduction, shoulder external rotation and MAS of Groups-B. Pre measurement Mean of shoulder flexion was 57.40 where as post measurement Mean shoulder flexion was 80.40 and was statistically significance with p-value <.0001. Pre-measurement Mean of shoulder abduction was 54.60 where as post-measurement Mean shoulder abduction was 74.20 and was statistically significance with p-value <.0001. Pre-measurement Mean of shoulder external rotation was 24.20 where as post-measurement Mean shoulder external rotation was 40.20 and was statistically significance with p-value <0001. Pre-measurement Mean of MAS was 1.16 where as post-measurement Mean of MAS was 4.04 and was statistically significance with p-value <.0001.

Table 4. Difference between the groups post measurement

Variable	Group A	Group B	p-value
Flexion	103.20±16.26	80.40±18.98	<.0001
Abduction	88.00±14.29	74.20±17.36	<.004
ER	52.20±6.47	40.20±6.53	<.0001
MAS	4.71±0.44	4.04±0.20	<.0001

Table 4 Data are Mean of subject with respect to shoulder flexion, shoulder abduction, shoulder external rotation and MAS of both the groups post measurement. Mean shoulder flexion of Group-A was 103.20 where as Mean shoulder flexion of Group-B was 80.40 and was statistically significance with p-value <.0001. Mean shoulder abduction of Group-A was 88.00 where as Mean shoulder abduction of Group-B was 74.20 and was statistically significance with p-value <.0001. Mean shoulder external rotation of Group-A was 52.20 where as Mean shoulder external rotation of Group-B was 40.20 and was statistically significance with p-value <.0001. Mean MAS of Group-A was 4.71 where as Mean MAS of Group-B was 4.04 and was statistically significance with p-value <.0001.

DISCUSSION

The purpose of the study was to evaluate the effectiveness of shoulder taping along with PNF technique on shoulder mobility in hemiplegic subjects.. Baseline data of Demographic data and outcome variable did not show because significant difference in patient population. Descriptive Statistics were used for outcome variables i.e. MAS and Goniometer. Our evaluation criteria were chosen to target effectiveness of shoulder taping along with PNF technique on shoulder mobility in hemiplegic subjects; hence goniometer was used in our study, Also MAS scale was used, it is commonly used scale to measure the mobility of arm. For Group-A Pre measurement for Flexion is 60.00 following treatment the Post test score was 103.20 and was statistically significant with p-value >.0001, abduction pre measurement is 49.80 and post-measurement is 49.80 and was statistically significant with p-value >.0001, pre-measurement of external rotation is 27.80 and post measurement is 52.20 and was statistically significant with p-value >.0001, and pre measurement MAS is 1.12 and post measurement of MAS is 4.71 and was statistically significant with p-value >.0001. This is in accordance with the study done by S. Beth Peters, *et al* that has showed taping has more benefit than traditional immobilization methods in the treatment of hemiplegic shoulders (Beth Peters, 2003), another supportive research that is conducted by Kim, Myung-Kwon *et al* showed that, Kinesio-taping improve the upper limb function. And also increase usage of affected upper limb and assist in daily living activity more than only modified CIMT (Kim, Myung-Kwon, 2009). This statistical significance could be due to taping that has more benefit than traditional immobilization methods in the treatment of hemiplegic shoulders.

For Group-B Pre measurement for Flexion is 57.40 following treatment the Post test score was 80.40 and was statistically significant with p-value >.0001, abduction pre measurement is 54.60 and post measurement is 74.20 and was statistically significant with p-value >.0001, pre measurement of external rotation is 24.20 and post-measurement is 40.20 and was statistically significant with p-value >.0001, and pre-measurement MAS is 1.16 and post-measurement of MAS is 4.04 and was statistically significant with p-value >.0001. This is accordance with the study done by Marilyn Pink *et al* which showed that upper extremity proprioceptive neuromuscular facilitation patterns improves the mobility of the shoulder joint hence this statistical significance could be due to facilitation of the joint mobility by the PNF technique (Marilyn Pink, 1981).

Mean while in comparing between Group-A and Group-B, the Post measurement for Flexion of Group-A is 103.20 where as in group-B Post measurement test score was 80.40 and was statistically significant with p-value >.0001, the Post-measurement for abduction of Group-A is 88.00 where as in Group-B post-measurement test score was 74.20 and was statistically significant with p-value >.0001, the Post-measurement for external rotation of Group-A is 52.20 where as in Group-B Post measurement test score was 40.20 and was statistically significant with p-value >.0001, the post measurement of MAS in Group-A is 4.71 where as in Group-B post measurement of MAS score is 4.04 and was statistically significant with p-value >.0001. This is in accordance with the study done by young-kyu choi *et al*, that showed PNF along with taping technique has significantly improve the mobility of the joint.

The scores of Goniometer and MAS have increase in both the groups from pre to post treatment, but when compared in between the groups, the scores of Goniometer and MAS have statistically increase in group-A than the group-B in post treatment, this is due to mechanical properties of the tape that is supporting and decreasing the passive instability of the joint and also enhancing the active stability by skin receptors facilitating signals from the intra muscular and joint receptors and eventually contributing in active control of the joint (Furnich, 1980). Hence this study shows the taping along with PNF technique significantly improves the mobility of the hemiplegic shoulder.

Conclusion

The result shows the significant improvement in both group A and group B, but when the results are compared between the groups, Group-A showed more significant effect than the Group-B in the functional mobility of the shoulder of the affected side. Hence, this study proved that shoulder taping along with PNF technique is more effective in improving the mobility of shoulder in hemiplegics.

Acknowledgements

Authors acknowledge help received from the scholars who articles are cited and included in references in the manuscripts, the authors are also grateful to authors/editors/publishers/ subjects/technical people who have been associated with study, those article/ journals and books from where the literature for this article has been reviewed and discussed.

REFERENCES

Ada, L., Foongchomcheay, A., Canning, C. 2005. Supportive devices for preventing and treating subluxation of the shoulder after stroke. *Cochrane Database Syst Rev*; CD003863. Management of Post Stroke

Bard, G., Hirschberg, G.G. 1965. Recovery of voluntary motion in upper extremity following hemiplegia. *Arch Phys Med Rehabil.* 1965; 46: 567–572.

Beth Peters, S., *et al*. 2003. Functional Impact of Shoulder Taping in the Hemiplegic Upper Extremity, Vol. 17, No. 2, Pages 35-46

Chang, H.Y., Chou, K.Y., Lin, J.J., Lin, C.F., Wang, C.H. 2010. Immediate effect of forearm Kinesio taping on maximal grip strength and force sense in healthy collegiate athletes. *Phys Ther Sport*; 11 : 122 – 127

Ewa Jaraczewaka and Carol Long, 2006. kinesio taping in stroke: improving functional use of the upper extremity in hemiplegia. Thomas land publishers, inc; 13(3): 31-42

Fiona, C., Taylor, Suresh Kumar, K., 2012. Stroke in India Factsheet; 2012

Furnich, R.M., Ellison, A.E., Guermi, G.J. 1980. The measured effect of taping on combined foot and ankle motion before and after exercise. *American journal of sports medicine* 9, 165-170

http://physioworks.com.au/InjuriesConditions/Treatments/Kinesiology_Taping_Applications. 17 febuary 2015.

http://www.strokerehabunit.ie/en/AboutStrokeRehabUnit/WHODefinition/Text_12599_en.html

http://www.who.int/topics/cerebrovascular_accident/en/ 2015 january 5.

Kase, K.,Wallis, J., Kase, T. 2003. Clinical Therapeutic Applications of the Kinesio Taping Method. Tokyo, Japan: Ken Ikai Co Ltd.

Kim, Myung-Kwon, *et al*. 2009. The Effect of Modified CIMT Combined with Kinesio-Taping on Upper Limb Function in Hemiplegic Patients Volume 4, Issue ,3,pp.183-192

Klein, D.A., William, J.S., Wayne, T.P. 2002. PNF training and physical function in assisted-living older adults. *J Aging Phys Act*, 41: 476–488

Kuniyoshi Shimura, et.al. 2002. Effects of proprioceptive neuromuscular facilitation on the initiation of voluntary movement and motor evoked potentials in upper limb muscles. *Human Movement Science* ; 21: 101–113

Macgrego, K., Gerlach, S., Mellor, R, *et al*. 2005. Cutaneous stimulation from patella tape causes a differential increase in vasti muscle activity in people with patellofemoral pain. *J Orthop Res* ;23:351-□358.

Marilyn Pink, *et al*, 1981. Contralateral Effects of Upper Extremity Proprioceptive Neuromuscular Facilitation Patterns, January 27.

Mayhew, J.L. 1972. Effect of ankle taping on motor performance. Athletic Training, 7, 1011.

Morey, J., Kolber, William J. Hanney. 2012. The reliability and concurrent validity of shoulder mobility measurements using a digital inclinometer and goniometer: a technical report. *International journal of sports physical therapy*. June; 7(3): 306-313.

Olsen, T.S. 1990. Arm and leg paresis as outcome predictors in stroke rehabilitation. Stroke ;21:247–251.

Parker, V.M., Wade, D.T., Hewer, R.L. 1986. Loss of arm function after stroke: measurement, frequency, and recovery. *Int Rehabil Med*. 8: 69 –73.

Robert Teasell, M.D., Norine Foley MSc, Sanjit, K. Bhogal MSc, Katherine Salter, BA, Management of Post Stroke Pain-EBRSR, www.ebrsr.com

Ruth Dickstein, 1986. Stroke Rehabilitation: Three Exercise Therapy Approaches. *Journal of the American physical therapy association*; 66: 1233-1238.

Wade, D.T., Langton-Hewer, R., Wood, V.A., Skilbeck, C.E., Ismail, H.M. 1983. The hemiplegic arm after stroke: measurement and recovery. *J Neurol Neurosurg Psychiatry* ;46:521–524.

Yasukawa, A., Patel, P., Sisung, C. 2004. The functional effects of Kinesio Taping in an acute pediatric rehabilitation setting as measured by the Melbourne Assessment. Paper presented at the Kinesio Taping Association Symposium; Japan.

Yong-Kyu Choi, Chan-Woo Nam, Jung-Ho Lee, Young-Han Park. 2013. The Effects of Taping Prior to PNF Treatment on Lower Extremity Proprioception of Hemiplegic Patients. *Journal of physical therapy science* Sep; 25(9): 1119-1122.

****