



Effect of Kinesiotaping in Improving Fine Motor Hand Functions Skills in Person with Spinal Cord Injury (Tetraplegia)

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Abstract

Background: *The purpose of this study was to examine the effectiveness of application of Kinesiotaping over the hand muscles for improving fine motor skills and hand functions in person with spinal cord injuries (tetraplegia).*

Objective: *To compare the effectiveness of kinesiotaping along with conventional therapy and conventional therapy alone for improving fine motor skills and hand functions in person with spinal cord injuries (tetraplegia).*

Study Design: *Parallel-Group, Randomized control trials.*

Methods: *30 patients with incomplete spinal cord injury (SCI) with traumatic and non-traumatic SCI were recruited, ISIC Institute of rehabilitation sciences, New Delhi, India. These patients were selected by simple random sampling divided into two groups one was experimental group and other was control Group. The Modified Ashworth scale, Box and Blocks test & WHOQOL-BREF instruments was used for measuring hand functions.*

Results: *After the intervention, there was significant improvement were found in WHOQOL and BBT scores ($p < 0.005$) in experimental group as compared to the control group, but there was no significant difference were found in MAS score ($p = 0.068$) of fine motor skills and hand functions in person with spinal cord injuries (tetraplegia).*

Conclusion: *This study concluded that the application of kinesiotaping along with the conventional hand therapy is effective in improving fine motor hand function skills, & the quality of life but this study did not show reducing spasticity of hands in the person with incomplete spinal cord injury.*

Keywords: *Kinesiotape, Spinal cord injury, Modified Ashworth Scale, Box and Block test, World Health Organization Quality of Life -BREF.*

Introduction

“Spinal cord injury (SCI) is characterised by an acute traumatic lesion of neural elements within the spinal canal (spinal cord and cauda equina) resulting in permanent neurological deficit”^[1]. There are various causes of SCI, falls, vehicle accidents or crashes, sports-related injuries or wounds etc. The incidence varied from 13.019 per million to 163.420 per million people^[2]. In India, the estimated average annual SCI incidence is 15,000 with a prevalence of 0.15 million^[3].

Loss of hand function is devastating feature of SCI associated with reduction in quality of life (QOL)^[4]. Previous studies reported that SCI patients have not focused on hand-specific training or quantitative measurements of hand function^[5]. Occupational therapists are often involved in providing several treatments to improve the hand function for the people with cervical SCI such as the splints, virtual reality. Task-oriented activity-based therapies. However, the application of the Kinesio Tape provided the proper body alignment to allow the performance of reach, grasp, release, and manipulation tasks & affects sensorimotor and proprioceptive systems, as seen in its benefit for the treatment of various neurological conditions.

Kinesio taping is a taping technique that was invented in 1973 by Dr Kenzo Kase to prevent unexpected situations occurring in standard taping and taping applications. Increased sensory input via tactile stimulation interpreted and incorporated by the central nervous system, which converts sensory information into planned motions and calculates the required programmes for movements (feed forward and feedback control). This process is known as sensorimotor integration^[6] The stretched around 30% to 40% has many advantages depending on the amount of stretch applied to the tape during application : (1)provides positional stimulation through the skin, (2) align fascial tissues, (3) creates more space by lifting fascia and soft tissue above the area of pain or inflammation, (4) to provide sensory stimulation to assist or limit motion, and

(5) to assist in the removal of oedema by directing exudates toward a lymph duct^[7], The stretch applied to the tape provides a pulling force on the skin by tapping over the skin continuously stimulates cutaneous mechanoreceptors, giving the central nervous system more sensory signals for the processing of information. Besides, reduction of motor neuron threshold induced by cutaneous stimulation would influence the recruitment of the motor unit, which can facilitate muscle contraction, and ultimately improve muscle strength it also that Kinesio taping enhances the sensory input of the taped area by stretching the skin, thereby promoting inactive muscle contraction. kinesiotaping is a type of treatment used in combination with other rehabilitation methods to treat various musculoskeletal and neuromuscular defects^[8]. As there is lack of evidence available the effect of kinesiotaping in the adult population with SCI& hand function is the most commonly affected, therefore, the purpose of present study is designed to investigate the effects of Kinesiotaping along with the conventional therapy on hand function in incomplete Tetraplegia patients. Thus, we could determine its effects on spasticity, fine motor skills, and to improve QOL in the person with incomplete SCI (tetraplegia) by clinical and instrument-based evaluations.

Methodology

30 subjects with medical diagnosis of incomplete spinal cord injured patients with traumatic and non-traumatic SCI were enrolled in this study. The Ethical Committee of university approved our protocol. Inclusion criteria for the subjects with incomplete spinal cord injured patients with traumatic and non-traumatic SCI were age range 18 years to 65 years, both males and females, C5-C7 level, Modified Ashworth Scale (MAS) -2 OR less than 2, Target hand - Hand which has lower MAS compared to both the hands were included in this study. Subjects excluded from the study those who were complete SCI, Age less than 18 years and above 65 years, MAS- more than 2,

Subjects who had undergone any surgery for upper limb, and those who have an allergic reaction to Kinesio tape.

The study purpose and test procedure were elaborately explained to the patients, after which written informed consent was obtained for their child's participation and their caregivers. A duly signed consent form was obtained from the subjects. These subjects were then randomly divided into two groups by simple random Sampling method. Group I: Experimental group, Group II: Control Group

Before the intervention, baseline characteristics were collected including demographics data, diagnosis, and mode of injury, date of injury, level of injury, occupation, dominant and target hand. One hand of each subject was identified as the target hand based on the inclusion criteria. In the situation where both the hand met the criteria, the hand which had lower MAS grade was identified as the target group. The Modified Ashworth scale, Box and Blocks test & WHOQOL-BREF were used as assessments tools before the intervention and after 4 weeks the same patients were assessed again using the same scales (MAS, BBT & WHOQOL-BREF)

Experimental group

Kinesio tape application was performed in a comfortable position on the table. Before the application of kinesiotape, following points were noted: no hair, no oil/lotions and the skin should be dry. The skin was cleaned by Surgical Spirit (70% alcohol). The tape was measured from right above the lateral epicondyle, down the forearm and to the metacarpophalangeal joints and then folded into itself. Three longitudinal cuts were eventually made to the folded end resulting in four stripes, one for each finger (2nd to 5th). The kinesiotaping was applied over the muscle belly of Extensor Carpi Radialis Brevis, Extensor Carpi Radialis longus, Extensor digitorum, Extensor carpi ulnaris, Extensor digiti minimi in a Proximal to distal manner, lateral epicondyle to distal phalanges by using the fanning technique. The

Tape was applied from lateral epicondyle the proximal anchor point with no tension, down to the forearm with 25% to 35% tension & no tension to the distal phalanges anchor. The Kinesio tape was kept for 3 days. After 3 days Kinesio tape was removed and the area of application was left open for 24 hours. Then again it was applied for another 3days. This sequence was carried out for 4 weeks. Along with the Kinesio tape the subject also received 30 minutes of conventional hand therapy which includes finger prehension device, paper cutting, therapeutty activity, paper tearing, writing practice, pinch activity and small steel pegboards

Control group

The subject of Group II or control group was assessed before the intervention by using the Modified Ashworth scale, Box and Blocks test & WHOQOL-BREF. They underwent an intervention session of 30 minutes, 5days for 4weeks. They received conventional hand therapy such as

- 1) Finger prehension device (fig.3. 3)
- 2) paper cutting (fig3.7)
- 3) therapeutty activity (fig3..4)
- 4) paper tearing (fig 3.8)
- 5) Writing practice (fig.3.5)
- 6) pinch activity (fig 3.9)
- 7) small steel pegboards (fig.3.6)

And after 4 weeks same patients were assessed again using the scales used earlier MAS, BBT&WHOQOLBREF



Fig 3.2. Kinesio taping



Fig 3.3 Finger prehension device



Fig 3. 4 .Theraputty activity

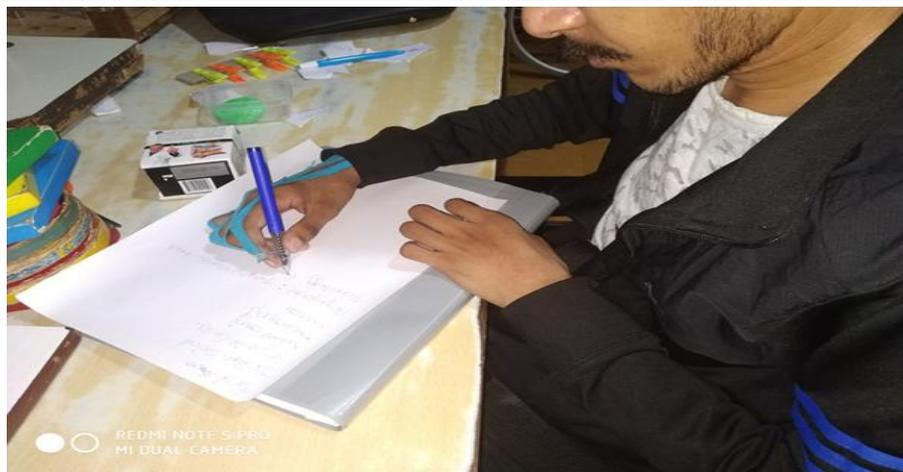


Fig 3. 5. Writing Practise



Fig 3. 6. Small Steel Pegboards



Fig 3.7. Paper cutting



Fig. 3.8 Paper tearing



Fig 3.9 Pinch activity

Result

A total of 30 incomplete SCI subjects participated in the study; these subjects were divided into two groups 15 in each group. Characteristics of the participants of both groups are shown in Table 1. From above Table-1, it shows that there is an almost equal distribution of the number of subjects in both the group (male/female-13/2&9/6). The age range of experimental group is 39.73 ± 4.157 and In control group is 39.60 ± 3.293 . Table 2 show that the group1 from two

well-known tests of normality, namely the Kolmogorov-Smirnov test and Shapiro-Wilk test. The sig. value of AGE, BBT, MAS, DOMAIN1, DOMAIN2, DOMAIN3 and DOMAIN4 is greater than 0.05, the data is normal. Table 3 show that the group2 from two well-known tests of normality, namely the Kolmogorov-Smirnov test and Shapiro-Wilk test. The sig. value of AGE, BBT, MAS, DOMAIN1, DOMAIN2, DOMAIN3 and DOMAIN4 is greater than 0.05, the data is normal. In Table 4 show that the comparison of

pre-intervention and post-intervention of box and block test scores within the groups of Group1 & Group2. Analysis of data by paired t-test indicated that there was a significant difference between the pre-test and the post-test box and block test scores for Group1 ($t = -8.405$), ($p = 0.000$) and Group 2 ($t = -7.991$), ($p = 0.000$). Table 5 show that the comparison of box and block test scores between group1 and group2, analysis of data by independent t-test indicates that there was a significant difference in the scores of box and block test between the two groups ($t = 4.338$), ($p = 0.00$). Table 6 shows the analysis for WHOQOL-BREF test within the group; Comparison of pre-intervention and post-intervention of WHOQOL-BREF Domain1 (physical health) scores within the groups of Group1. Analysis of data by paired T-test indicated that there was a significant difference between the pre-test and the post-test WHOQOL-BREF Domain1 (physical health) scores for Group1 ($t = -7.725$), ($p = 0.000$). comparison of pre-intervention and post-intervention of WHOQOL-BREF, Domain2 (psychological health) scores within the groups of Group1. Analysis of data by paired T-test indicated that there was a significant difference between the pre-test and the post-test WHOQOL-BREF Domain2 (psychological health) scores for Group1 ($t = -6.181$), ($p = 0.000$). Comparison of pre-intervention and post-intervention of WHOQOL-BREF Domain3 (social relationship) scores within the groups of Group 1. Analysis of data by paired T-test indicated that there was no significant difference between the pre-test and the post-test WHOQOL-BREF Domain3 (social relationship) scores for Group1 ($t = -1.601$), ($p = .132$). Comparison of pre-intervention and post-intervention of WHOQOL-BREF Domain (environmental) scores within the groups of Group1. Analysis of data by paired T-test indicated that there was no significant difference between the pre-test and the post-test WHOQOL-BREF Domain4 (environmental) scores for Group 1 ($t = -3.169$), ($p = .132$). Comparison of pre-intervention and post-

intervention of WHOQOL-BREF Domain1 (physical health) scores within the groups of Group 2. Analysis of data by paired T-test indicated that there was a significant difference between the pre-test and the post-test WHOQOL-BREF Domain2 (physical health) scores for Group2, ($t = -3.692$), ($p = 0.000$). Comparison of pre-intervention and post-intervention of WHOQOL-BREF Domain2 (psychological health) scores within the groups of Group2. Analysis of data by paired T-test indicated that there was no significant difference between the pre-test and the post-test WHOQOL-BREF Domain2 (psychological health) scores for Group2 ($t = -1.895$), ($p = 0.79$). Comparison of pre-intervention and post-intervention of WHOQOL-BREF Domain 3 (social relationship) scores within the groups of Group 2. Analysis of data by paired T-test indicated that there was no significant difference between the pre-test and the post-test WHOQOL-BREF Domain3 (social relationship) scores for Group2 ($t = -1.009$), ($p = .334$). Comparison of pre-intervention and post-intervention of WHOQOL-BREF Domain4 (environmental) scores within the groups of Group2. Analysis of data by paired t-test indicated that there was a significant difference between the pre-test and the post-test WHOQOL-BREF Domain4 (environmental) scores for Group2, ($t = -2.494$) ($p = .026$). Table 7 shows that the analysis for WHOQOL-BREF Test Between The Groups; Comparison of WHOQOL-BREF test scores between group1 and group 2, analysis of data by independent t-test indicates that there was a significant difference in the scores of Domain1 physical health ($t = 4.095$) ($p = 0.000$), Domain2 psychological health ($t = 3.859$) ($p = 0.001$), Domain3 social relationship ($t = 3.590$) ($p = 0.001$), between the two groups. But there is no significant difference in the scores of Domain4 environmental ($t = 2.080$) ($p = 0.047$). In Table 8 it shows the Comparison of pre-intervention and post-intervention of MAS scores within the groups of Group1. Analysis of data by chi-square test indicated that there was no significant

difference between the pre-test and the post-test scores for Group1 (p=.083). Comparison of pre-intervention and post-intervention of MAS scores within the groups of Group2. Analysis of data by chi-square test indicated that there was no significant difference between the pre-test and the

post-test scores for Group2 (p=.290). In table 9 shows that the comparison of box and block test scores between group1 and group2, analysis of data by chi-square test indicates that there was no significant difference in the scores of MAS between the two groups (p=0.068)

Table 1 Subject characteristics, group mean and standard deviation (SD) Demographic Data in both experimental and control group

S.NO	BASELINE CHARACTERISTICS	EXPERIMENTAL GROUP 1	CONTROL GROUP 2
1	No. of subjects	15	15
2	Age range (years)	18-65	18-65
3	Mean age (SD)	39.73(4.157)	39.60(3.293)
4	Sex (Male/Female)	13/2	9/6

Table 2- Test of Normality for group1

GROUP1	Kolmogorov-smirnov			Shapiro-Wilk		
	statistic	Df	Sig	Statistic	Df	Sig
Age	.163	15	.200	.886	15	.058
BBT	.264	15	.006	.827	15	.008
MAS	.232	15	.029	.883	15	.052
DOMAIN1	.203	15	.098	.887	15	.060
DOMAIN2	.242	15	.018	.929	15	.265
DOMAIN3	.190	15	.149	.921	15	.201
DOMAIN4	.258	15	.008	.936	15	.336

Table 3- Test of Normality for group 2

GROUP2	Kolmogorov-smirnov test			Shapiro-Wilk test		
	Statistic	Df	Sig.	Statistic	Df	Sig.
AGE	.148	15	.200	.906	15	.119
BBT	.133	15	.200	.956	15	.618
MAS	.290	15	.001	.771	15	.002
DOMAIN1	.261	15	.007	.889	15	.064
DOMAIN2	.263	15	.006	.871	15	.035
DOMAIN3	.139	15	.200	.927	15	.250
DOMAIN4	.258	15	.008	.923	15	.217

Table 4 -Analysis for BBT test within the group

Outcome measures	Group1 Mean ± S.D	Group 2 mean± S.D	P-Value
BBT	-37.733±17.388	-16.333±7.916	0.00*

Table 5- Analysis for BBT test between the groups

BBT	Mean ±S.D	p-value
	21.400±4.933	0.00*

Table 6- Analysis for WHOQOL-BREF test within the group

WHOQOL-BREF	Group 1 mean±S.D	p-value	Group 2 mean±S.D	p-value
Domian 1	-25.067± 12.567	0.00*	-8.667±9.092	.002
Domian 2	-17.533±10.986	0.00*	-3.667±7.490	.079 ^{NS}
Domian 3	-6.333±15.319	.132 ^{NS}	-4.00 ± 1.549	.339 ^{NS}
Domain 4	-12.533±15.320	.007 ^{NS}	-3.467±5.383	.026 ^{NS}

Table 7 - Analysis for Whoqol-Bref Test between the Groups

Domain	Mean \pm S.D	p-value
1	16.400 \pm 4.005	.000*
2	12.933 \pm 3.352	.001*
3	11.000 \pm 3.064	.001*
4	8.667 \pm 4.168	.047 ^{NS}

Table 8- Analysis for mas test within the group

Chi-square	Value	Df	P- value
Group1	6.667	3	.083
Group2	3.750	3	.290

Table 9- Analysis for MAS test between the groups

Chi-square	Value	Df	p-value
	3.333	1	.068

Discussion

This paper investigates the effectiveness of kinesiotope along with the conventional hand therapy effective in improving fine motor hand functions skills in person with incomplete spinal cord injury (tetraplegia). The results suggest that the Kinesio tape may improve fine motor hand function skills (BBT) and quality of life (WHOQOL-BREF) in subjects with incomplete SCI (tetraplegia). The result was significant with the ($p < 0.005$) for the BBT, and D1 (Physical Health), D2 (Psychological), D3 (Social Relationship) D4 (Environment) of WHOQOL. The statistical analysis of the results supported the Experimental hypothesis, which stated that the kinesiotope along with the conventional therapy is better than usual conventional Therapy alone in improving fine motor hand functions skills in person with incomplete SCI (tetraplegia).

Previously various studies were conducted to determine the effects of neuromuscular tapping on cutaneous mechanoreceptors (Garcia 2001; Goo 2001; Halseth et al. 2004; Maruko 1999; Mori 2001; Murray and Husk 2001; Ogura 1998; Vorhies 1999; Wallis 1999) have reported that neuromuscular tapping on select muscles and joints may be improved muscle excitability. According to the literature (Gabriela Lopes 2019), taping applications together with proprioceptive exercise stimulate a greater number of cutaneous receptors, which can enrich stability and joint control. It also suggested that the tape should be applied at the beginning of the therapy session to

generate immediate effects on neuromotor control, which could maximize the gains obtained by motor learning. Hence, taping could be the key to the central nervous system for subsequent motor tasks.

Kinesiotope improves kinesthetic inputs and promotes improved regulation of the forearm and wrist muscles to strengthen volitional control of muscle and tendon movement during exercise, thereby enhancing grip strength and manual skill in the hand, thus enhancing fine motor hand function. (Yasukawa A et al 2006). Since the Kinesio tape was applied to the forearm muscles (extensors group) starting from their origin (the lateral epicondyle of humerus) and extending up to the dorsum of the hand covering the metacarpals and phalanges, we assume that such techniques would have improved stability. This would have facilitated clinically positive changes in the fine motor functions of hands. This comes inconsistent with Hsu et al., who reported that neuromuscular tapping as an adjunct to the therapeutic procedures can improve strength, functional activities, proprioception, control and positioning. This result is following the study done by (Sujoy Roy, Jaya Dixit.etal 2018) have reported that application of kinesiotope along with conventional occupational therapy can enhance & improve fine motor skills among children with spastic diplegic cerebral palsy, so that they can have the functional independence, to meet demands of everyday life.

Conclusion

It can be concluded that application of kinesiotape along with conventional occupational therapy can improve fine motor skills and quality of life but results did not show reducing spasticity of the wrist and figures in the person with incomplete spinal cord injury.

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