



## Effectiveness of Kinesio Taping for Hand on Grip Strength and Upper Limb Function in Subjects with Cervical Radiculopathy: A Randomized Controlled Trial

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### ABSTRACT

Cervical radiculopathy is common condition seen today. It is found to associate with upper limb dysfunction which in turn hinders daily activity due to muscular weakness. Grip strength is found to be reduced in cervical radiculopathy and is taken to be a good measure of upper limb function. Treatment of cervical radiculopathy is mainly concentrated over neck region and very less has been done to improve upper limb function. Kinesio taping is found to improve muscle activity and can be used to improve grip strength and function in cervical radiculopathy. **Method:** 32 subjects with unilateral cervical radiculopathy were randomly divided into 2 groups, experimental and conventional group (n=16). The conventional group was given intermittent cervical traction, hot moist pack, TENS and exercises and experimental group was given conventional treatment along with kinesio taping to extensor aspect of forearm. Pre- and post-values for grip and pinch strength and NDI and DASH were assessed and analysed. **Result:** There was marked improvement seen both groups, but there was significant improvement in grip and pinch strength seen in experimental group while there was improvement seen functional outcomes namely NDI and DASH. This suggests that kinesio taping does not play a role in improving grip strength but can improve upper limb function.

**Keywords:** Cervical radiculopathy, Grip strength, Kinesio taping, Function

**Abbreviations:** BMI: Body Mass Index; DASH: Disability of Arm, Shoulder and Hands; NDI: Neck Disability Index; TENS: Transcutaneous Electrical Nerve Stimulation; KT: Kinesio Taping; SLR: Straight Leg Raising

### INTRODUCTION

Cervical radiculopathy is a common condition seen today. It is classified as a disorder of nerve root and most often results in compression or inflammatory pathology from a space-occupying lesion such as a disc herniation, spondylotic spur or cervical osteophyte. Location and the pattern of symptoms vary depending upon the nerve root involved and can include sensory and/or motor alterations if the dorsal and/or ventral root is involved [1].

Cervical radiculopathy is a dysfunction of nerve root of the cervical spine. The seventh (C7:60%) and sixth (C6:25%) are most commonly affected nerve roots. In younger population, cervical radiculopathy is mostly seen due to disc herniation. In older patients, cervical radiculopathy accounts due to narrowing of foramen from osteophyte formation, decreased disc height and degenerative conditions. Peak incidence of cervical radiculopathy is known to occur at fourth and fifth decade of life [2].

Cervical radiculopathy leads to radiating pain which not only causes discomfort in the neck region but also causes weakness and pain in the hand. It may lead to weakness of interossei muscles in the hand which leads to reduced grip and hand function [3]. Tingling numbness and radiating pain can also cause weakened gripping activity overall. This eventually leads to impaired functionality and hinders the daily activity of an individual.

The management mostly given for this condition is medical, surgical and physiotherapy approaches. Physiotherapy plays an important role in managing the individual's function. Physiotherapy management includes thermotherapy,

electrotherapy like transcutaneous electrical nerve stimulation (TENS), mechanical cervical traction and exercises. Heat helps in relaxing the muscles around the involved area and reducing spasm. TENS helps in pain reduction which is the major complain of individual and helps provide soothing effect. Mechanical cervical traction is common intervention given. Intermittent traction is better used which helps in unloading the components around the spine by stretching muscles, ligaments, and functional units. It decreases the pressure on the disc which overall helps in relieving the pressure on the nerve and is effective in radiculopathy [4]. But during the course of treatment of radiculopathy, the weakness associated with the hand component is neglected. Hence it is vital to intervene treatment for increasing grip strength in cervical radiculopathy to improve grip strength and upper limb function which will in turn improve the quality of life. The treatment for cervical radiculopathy is mostly concentrated on the neck region for treating the cause and very less is studied on improving the functional ability during the course of intervention. Hand grip strength is found to be reduced in individuals with cervical radiculopathy. The reduced strength and grip causes limitations in daily activities and is a cause of concern.

Very less is done to improve the functionality in individuals with reduced strength which will in turn help them in their daily activity and reduce disability. Kinesio taping is a new intervention used in physiotherapy which shows fast and impressive outcomes. It is mostly used in sports field. Kinesio taping uses elastic adhesive tape with elasticity rate similar to that of skin that is used in all kinds of musculoskeletal conditions. It can be used in both inhibiting and facilitating the muscle action in order to normalize the action of moving protagonist. By ultimately adjusting the protagonist, synergist and antagonist is maintained and physical balance is recovered [5]. It does not restrict the motion and can be worn for longer period of time.

Very less has been studied over effect of KT on improving the grip strength in cervical radiculopathy. Kinesio taping can be used by taping the forearm to improve the strength of muscles and improve the grip strength which will help in improving the daily activities and in turn increase the function. Kinesio tape facilitates muscle group which increases grip strength. Study has been done to improve grip strength on normal population and other conditions using kinesio taping [6]. Hence KT can be beneficial for improving overall hand function.

## METHODS

### Study design

The study was a randomized controlled trial. The study was conducted in tertiary care hospital, Belgaum city, province Karnataka, country India. Ethical committee approval was obtained from Institutional Ethical Review Committee.

### Sample size

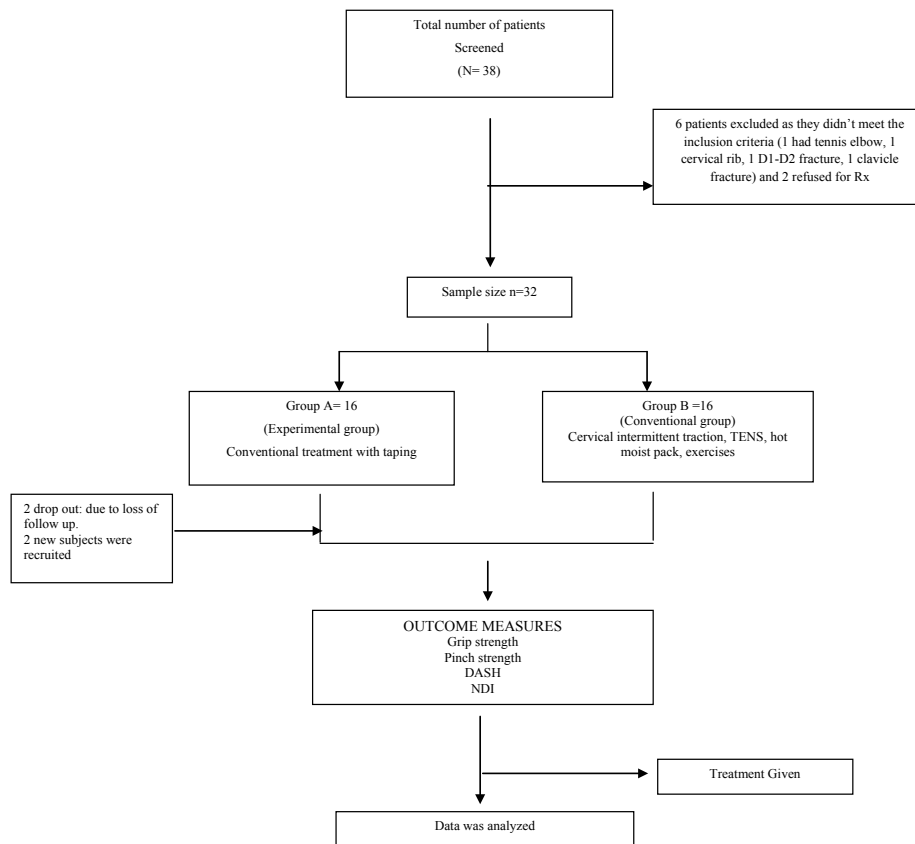
Total 32 subjects were included in the study with 16 subjects in each group (Flow Chart 1).

### Inclusion criteria

- 1) Both males and females clinically diagnosed with unilateral cervical radiculopathy.
- 2) Those who are willing to participate.
- 3) Age between 30-65 years.

### Exclusion criteria

- 1) Individuals with upper limb fracture.
- 2) Individuals with any musculoskeletal condition of upper limb.
- 3) Individuals with diabetic neuropathy.
- 4) Contraindicated for mechanical traction, taping.



Flowchart 1 Study design and methodology

### METHODOLOGY

All the subjects were recruited after meeting the inclusion and exclusion criteria and the demographic data was collected with the initial assessment of the outcome measures, grip strength, pinch strength, NDI questionnaire and DASH questionnaire on the 1<sup>st</sup> day. The individuals were divided into 2 groups: Control group and Taping group randomly.

The conventional treatment was given to both groups:

- 1) Moist pack for 12 mins, in prone position with head resting on the forearm.
- 2) TENS given for 10 mins. Conventional TENS, rectangular wave form with pulse frequency of 10-200 Hz, pulse width 100-250  $\mu$ s, 2 electrodes, given along the radicular pain with and intensity tolerated by the subject.
- 3) Mechanical cervical intermittent traction given for 15 mins with 1/10<sup>th</sup> of body weight, in supine position with approximately 15° of flexion and neck well supported.
- 4) Exercises like static neck exercises and chin tuck with 10 repetitions each will be taken under therapist supervision and stretching of upper trapezius, scalene and levator scapulae muscle for 30 sec hold and 3 repetitions will be given.

The Taping group was given the conventional treatment as mentioned above along with taping to the extensor aspect of forearm, in sitting position with forearm supported and wrist in 15 degrees of extension. Taping was given from the origin of wrist extensors to the carpal row, with 50% stretch in I-shape, a facilitator type of taping [7]. Taping was given after every 3 days.

All the outcome measures were again assessed post completion of treatment on the 10th day. Best of 3 readings were taken for grip and pinch strength. Post treatment score for both DASH and NDI was also taken. Results were analysed.

**Statistical analysis**

SPSS software version 16 software was used for analysis. Wilcoxon matched paired test was used to study pre-and post-measures and Mann-Whitney U test was used to study between group measures. Statistical significance of p value was set at 0.05.

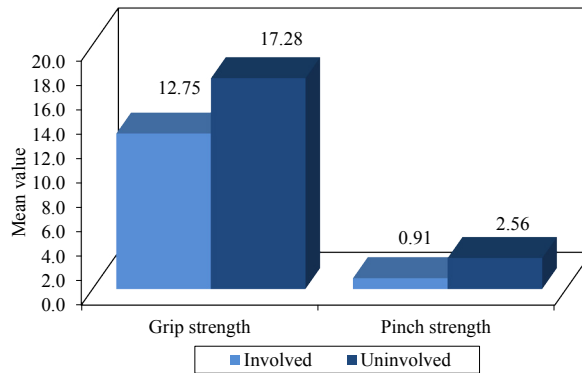
**RESULTS**

There was no statistical difference seen between age, height, weight, and BMI between the two groups. This indicated that both the groups were homogenous in nature (Table 1).

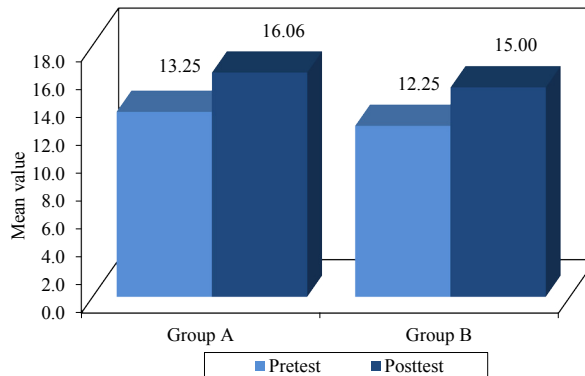
**Table 1 Demographic data compared for both groups**

Parameters	Group A	Group B	P value
Age (mean ± SD)	44.06 ± 10.22	44.31 ± 10.85	0.9470 <sup>a</sup>
Height (mean ± SD)	162.06 ± 6.8	158.88 ± 12.07	0.3677 <sup>a</sup>
Weight (mean ± SD)	64 ± 12.1	60.75 ± 14.86	0.5030 <sup>a</sup>
BMI (mean ± SD)	24.35 ± 4.37	22.19 ± 6.75	0.2800 <sup>a</sup>

In the present study, pre-post intervention comparison done by using Wilcoxon matched paired test done for group A (Expt) showed statistically significant result (p=0.0004) and that for Group B (Convrt) showed statistically significant result (p=0.0003). Post intervention comparison done for grip strength between Group A (Expt) and Group B (Convrt) done by Mann-Whitney U test did not show statistically significant result (p=0.3758). The mean grip strength of all participants included in Group A (Expt) and B (Convrt) was 12.75 ± 5.97 on affected side and 17.28 ± 6.70 on unaffected side (Figure 1). Pair wise comparison done showed statistically significant result (p=0.0001). This signified that there was improvement seen in grip strength post intervention for both groups. But there was no significant difference seen between both the groups and both interventions were equally effective.



**Figure 1 Comparison between involved and uninvolved hand grip strength and pinch strength**



**Figure 2 Comparison of Group A and Group B with respect to grip strength pre-and post-intervention**

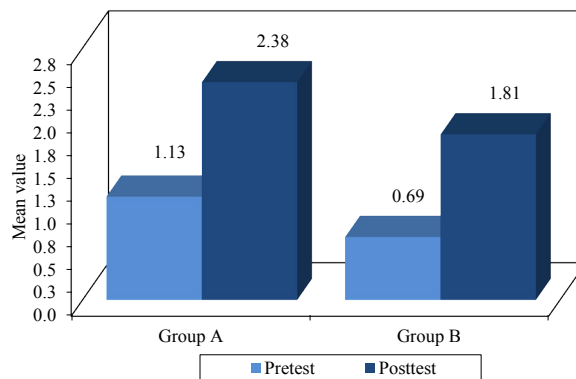


Figure 3 Comparison of Group A and Group B with respect to pinch strength pre-and post-intervention

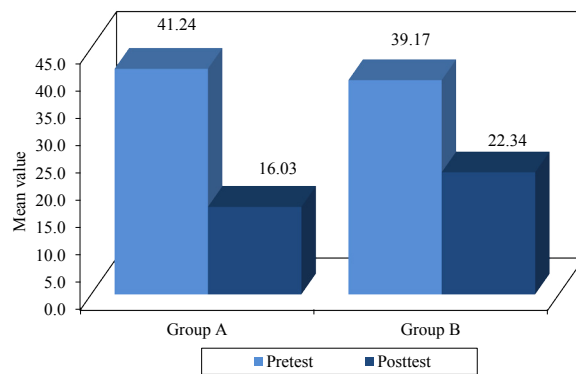


Figure 4 Comparison of Group A and Group B with respect to dash scores pre-and post-intervention

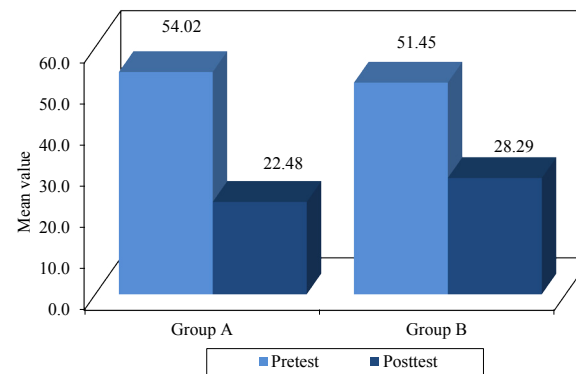


Figure 5 Comparison of Group A and Group B with respect to NDI score pre-and post-intervention

The pre-post intervention comparison done by using Wilcoxon matched pair test done for Group A (Expt) showed statistically significant result ( $p=0.0010$ ) and that for Group B (Convnt) showed statistically significant result ( $p=0.0022$ ). Post intervention comparison done for grip strength between Group A (Expt) and Group B (Convnt) done by Mann-Whitney U test did not show statistically significant result ( $p=0.00830$ ). The mean grip strength of all participants included in Group A (Expt) and B (Convnt) was  $0.91 \pm 0.96$  on affected side and  $2.56 \pm 1.72$  on unaffected side. Pair wise comparison done showed highly statistically significant result ( $p=0.0001$ ). This signified that there was improvement seen in pinch strength post intervention for both groups. But there was no significant difference seen between both the groups and both interventions were equally effective (Figures 2 and 3).

The pre-post intervention comparison done by using Wilcoxon matched pair test done for Group A (Expt) showed statistically significant result ( $p=0.0002$ ) and that for Group B (Convnt) showed statistically significant result

( $p=0.0004$ ). Post intervention comparison done for grip strength between Group A (Expt) and Group B (Convnt) done by Mann-Whitney U test also showed statistically significant result ( $p=0.0067$ ). This signified that there was significant improvement seen in DASH score post intervention for both groups. Also, there was significant difference seen between both the groups and experimental group showed better functional improvement post intervention (Figures 4 and 5).

The pre-post-test comparison done by using Wilcoxon matched pair test done for group A(Expt) showed statistically significant result ( $p=0.0003$ ) and that for Group B (Convnt) showed statistically significant result ( $p=0.0004$ ). Post-test comparison done for grip strength between Group A (Expt) and Group B (Convnt) done by Mann-Whitney U test also showed statistically significant result ( $p=0.0070$ ). This signified that there was significant improvement seen in NDI score post intervention for both groups. Also, there was significant difference seen between both the groups and experimental group showed better functional improvement post intervention.

### DISCUSSION

The present randomized controlled trial was done to compare the effect of kinesio taping for hand on grip strength and upper limb function in subjects with cervical radiculopathy. The common treatment given to both group was conventional physiotherapy i.e., intermittent cervical traction, TENS, hot moist pack and stretching and strengthening exercises. The experimental group was given kinesio taping to wrist extensors.

In the present study, the age of patient ranged from 33-57 years with mean age  $42.21 \pm 10.65$  years which was consistent to the peak estimated age for cervical radiculopathy seen in previous studies. A study showed the peak age of incidence in fifth decade of life [8,9]. Higher incidence was found in developing neck pain between 35-49 years [10].

Both non-specific neck pain and specific causes of neck pain cause upper limb radiculopathy [11-15]. Neck pain impairment is found to be associated with upper limb disability including pain, radiculopathy, tingling numbness and weakness in upper limb muscles. This has been investigated that there is an association between neck pain and upper limb disability. About 151 patients were assessed and study showed positive correlation between neck pain and upper limb disability and concluded that upper limb management should be considered upon [16]. Chronic cases of cervical radiculopathy have marked reduction in grip strength. This has been proved in previous studies [17,18]. A study on grip strength and hand function changes in unilateral cervical radiculopathy concluded that the grip strength as compared to normal or unaffected hand was significantly reduced ( $p=0.028$ ) when compared with hand dynamometer and Jebson-Taylor hand function test [19]. Hence grip strength needs to be assessed and managed in cervical radiculopathy.

Grip strength can be assessed in many ways viz. pressure biofeedback, Rudham hand dynamometer, Jamar hand dynamometer, Myogrip device, hand clamp etc. Among these Jamar hand dynamometer and pinch gauge were used in the present study to measure grip strength and pinch strength. Jamar Hand Dynamometer is a reliable tool to measure grip strength and pinch [20,21]. Comparison of grip strength was done with unaffected side similar to that done in previous study [19]. Hence, in our study grip strength was assessed by comparing the unaffected side in unilateral cervical radiculopathy. In the present study, grip strength and pinch strength of the involved hand was reduced as compared to the uninvolved side. This could be attributed to myotomal weakness along the affected nerve which leads to weakness in muscles and pain which can in turn cause the reduction in grip and pinch strength.

Along with objective measures which are grip and pinch strength, in the present study NDI and DASH were used as functional measures to assess functional impairment. NDI was used as a tool to assess neck disability and DASH was used as a tool to assess upper limb functional impairment. According to a study, patients with non-specific neck disorder commonly report upper limb disability. The author used DASH questionnaire, NDI, pectoral fear of activity scale-cervical and patient specific functional scale and found that 80% patients reported upper limb disability along with neck pain. He also reported moderately high correlation between NDI & DASH scales [22]. Previous studies have shown NDI is a good tool for assessing neck disability [23-25]. DASH has also found to be widely used to assess upper limb dysfunction [16,26,27].

Physiotherapy treatment has found to be very beneficial in improving symptoms in patients with cervical radiculopathy. A study on physical function outcome in cervical radiculopathy patients after physiotherapy alone compared with anterior surgery followed by physiotherapy found that on a 2 year follow up there was no significant difference in function in both groups and physiotherapy can be efficient treatment in patients with cervical radiculopathy [28].

In the present study, conventional treatment comprised of intermittent cervical traction, TENS, hot moist pack along with stretching and strengthening exercises. Cervical traction is found to be effective treatment in cervical radiculopathy. A study on cervical radiculopathy: non-operative management of neck pain and radicular symptoms found that traction was a useful method of treatment in radicular pain. Traction helped in distraction of neural foramen and decompression of affected nerve root [29]. Another study done on cervical spine mobilization versus TENS in management of cervical radiculopathy concluded that TENS and cervical mobilization were equally effective and TENS can be used as an effective treatment for cervical radiculopathy [30]. TENS is thought to be effective via pain gate mechanism which helps in reducing pain and hence function.

A study done on manual physical therapy, cervical traction and strengthening exercises in patients with cervical radiculopathy found that 91% of individuals showed positive outcome in function and pain and treatment was effective even after 6 months of follow up. Study proved that physiotherapy is an effective measure in treatment of cervical radiculopathy [1]. Also, a study on efficacy of forward head correction on nerve root function and pain in cervical spondylotic radiculopathy showed positive result with reduction in pain. This was found to be effective by restoring normal mechanics which corrected biomechanical dysfunction and reduced mechanical load of nerves. It was achieved by stretching tight muscles and strengthening weak muscles [31].

The present study showed improvement in all the outcome measures when compared with pre-and post-intervention values with conventional and experimental group. This could be correlated to similar findings seen in previous literature. There could be improvement in all outcome measures due to distraction effect of traction causing reduction in pressure over the nerves and rapid re-myelination of affected nerves and relaxation of surrounding muscles. TENS and hot pack must have helped in pain and spasm relief. Exercises must have helped in strengthening and proper alignment of biomechanical function. Similar results were found on grip strength in a study on the effect of cervical traction combined with conventional therapy on grip strength on patients with cervical radiculopathy. It was found that cervical traction combined with electrotherapy and exercises showed better result on hand grip. This was seen due to the effect of rapid re-myelination of affected nerve root following decompression seen with traction. Improvement in nerve root conduction and circulation produces increased neuromuscular performance which helps in improving grip strength [32].

Recently, kinesio taping serves as a good adjunct in the field of physiotherapy. It is found to give rapid beneficial effect. It helps by correcting fascia, improving proprioception, increasing blood flow, and correcting muscle action and reducing pain [33]. An author studied the effect of kinesio taping on hand grip strength. The study used I-shaped taping over flexor, extensor and flexor-extensor aspect of forearm and concluded that extensor aspect taping showed better results due to effective stabilization and balanced forces with flexors [34]. Another study on the effect of kinesio taping on explosive muscle power of gluteus maximus in male athletes and concluded that kinesio taping improved muscular strength by both I and Y technique. It was thought to do so by stimulating mechanoreceptors to improve sensory input which stimulates gamma-motor firing which increases muscle tone [35]. Hence, it was hypothesized in the present study that I-shaped kinesio taping used on the extensor aspect of forearm would improve the grip strength.

When comparison was done for all outcome measures between experimental and conventional group, the present study showed mixed type of results. There was equal effect seen in both groups with respect to grip and pinch strength but the experimental group showed significant improvement in functional outcome measures i.e., DASH and NDI over the conventional group. With this type of result it can be inferred that there was significant improvement with subjective measures but not with objective outcomes. This result can be attributed to placebo effect of kinesio taping. It can be attributed to reduced pain, improved proprioception, improved alignment.

Similar results with placebo effects were seen in previous studies. A study on initial effect of kinesio taping in patients with patellofemoral pain syndrome found that there was significant improvement and strength of quadriceps muscle and improved balance after the application of kinesio taping [36]. Another study done on effect of kinesio taping on low back muscle fatigue found that there was improvement in fatigue in both KT and placebo group as compared to control group and was found due to improved proprioception and blood flow [37]. A study done on acute and 48 h effect of kinesio taping on the hand grip strength among university students resulted that there was no improvement in maximal grip strength immediately and 48 hours after application of kinesio taping. But the study reported that there was high level of comfort after wearing KT [38].

Kinesio taping effect on muscular strength is found to be controversial and effect of taping remains varied on different muscle group as seen the study done study on effect of kinesio tape application on hamstring and gastrocnemius muscle in healthy young adults was done to assess to reaction in both muscle group. It was found that there was improved peak force in gastrocnemius muscle immediately and post 2 days of taping. There was also improvement seen in SLR and ankle dorsiflexion immediately after application of tape but the hamstring muscle only showed improvement after 2 days of application. This concluded that all muscle group react differently to application of kinesio tape [39].

Studies have also found that kinesio taping is not effective in improving strength. A study conducted on immediate effect of kinesio taping on muscle response in young elite soccer players and found that kinesio taping did not improve the muscle strength in soccer players. This could be due to the reason that strong afferent stimuli were not generated by taping to enhance muscle strength [40]. Another study also conducted on the effectiveness of kinesio taping for athletes with medial epicondyle tendinopathy found that there was no change in maximal grip strength with or without taping. It was found that kinesio taping improved proprioception which lead to improvement in absolute force sense [41].

Another study done on immediate effect of kinesio taping on neuromuscular performance of quadriceps and balance in individuals submitted to ACL reconstruction. EMG was studied to analyse strength and it was found that there no improvement seen with strength after taping. It was found that taping did not alter the neuromuscular performance in quadriceps muscle [42]. A meta-analysis on effect of kinesio taping on skeletal muscle strength concluded that kinesio taping has some therapeutic beneficial effect but does not improve strength in normal individuals [43]. Most of the studies were performed to measure strength immediately or to assess short term effect of KT. Current study was done to evaluate strength over a period of 10 sessions. Consistent with these studies the present study also does not show improvement in grip and pinch strength attributing to not enough stimulus or neuromuscular enhancement to improve muscle strength.

On the contrary, kinesio taping has also been found to improve muscle strength which was not seen in the present study. A study done on the effect of kinesio taping on hand grip strength showed that kinesio taping improved grip strength which was maintained for 48 hours with dominant hand showing more improvement. It was speculated that the increase in grip strength was due to tactile stimulation of dermis and epidermis and the skin maintained normal mobility [44]. There was more improvement seen in kinesio taping with tension. The present study also used application of taping with tension. Also, a study on effect of kinesio taping on maximal grip strength and key pinch force was done. Grip strength and pinch were assessed immediately and after 30 mins of taping. There was improvement seen with kinesio taping in maximal grip strength and pinch strength [6]. This study used the contra lateral hand as the control group for comparison, similar to the current study which used unaffected hand for comparison of grip and pinch strength. A study on effect of taping on wrist extension and grip strength and pain in patients with lateral epicondylitis showed a marked significant improvement in all parameters. This was found significant due to reduced stress generated in muscles due to taping which reduced pain in turn reducing painful inhibition which improved muscle contraction. Similar results were also found in other literature where kinesio taping was found to improve strength [45-47].

In the present study, both kinesio taping and conventional group showed improvement in all outcome measures when pre-post comparison was done. However, kinesio taping showed significant improvement in functional measures alone with no significant difference in grip and pinch strength as compared to control group.

### CONCLUSION

In the present study both kinesio taping and conventional group showed improvement in all outcome measures when pre-post comparison was done. However, kinesio taping showed significant improvement in functional measures alone with no significant difference in grip and pinch strength as compared to control group. Hence, it can be concluded that kinesio taping demonstrated to have more of placebo effect on functional outcomes as there was no improvement seen in the grip strength assessment. Further studies have to be done to confirm.

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