Original Resarch Article

A Comparative Study to Analyse the Effectiveness of Deep Friction Massage & Deep Friction Massage with Kinesiology Taping in DistalTriceps Tendinitis among Bodybuilders & Weightlifters

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ABSTRACT

Background
The distal triceps tendon is a tough, flexible tissue that attaches the triceps muscle at the back of the upper arm to the elbow bone. It helps triceps muscles to straighten the arm. The distal triceps tendon attaches approximately 12.14mm distal to the olecranon tip, where it has a width of approx. 40mm. The bony footprint is approx. 460mm^2 with an average length of approx. 21mm & a width of 23mm. The caput longum & medial coverage distally & form the superficial part of the triceps tendon, which attaches directly to the medial aspect of the olecranon & laterally partially converges with the superficial fascia of the anconeus muscle. The typical injury mechanism is described as an eccentric force on the contracting muscle, for example, due to a fall on the outstretched arm, during weight-lifting, or due to a direct trauma to the elbow.
Repeated strain on a tendon can cause tiny micro-tears in the tissue. The body will try to heal these tears, but sometimes they are made faster than the body can fix them. As the number of tears increases, they can cause pain from inflammation, weaken the tendon, & cause larger tears in the tissue & also limit the functional activity of that person.

Methods
Forty-two subjects who has been diagnosed as distal triceps tendinitis with mean age 25-35 years were taken as subject in this study. All subjects were randomly divided in two group A& B with twenty-one subjects in each group. Group A underwent received Cyriax Deep Transverse Friction Massage & Group B underwent treatment of received Kinesiological Taping & Cyriax Deep Transverse Friction Massage.

Outcome Measures

The outcome was measured by using Visual Analogue Scale (VAS) to assess the pain & range of motion was assessed by Goniometer for both groups.

Results

The study result showed more statistical significance improvement in elbow extension range of motion & reduced pain in distal triceps tendonitis among bodybuilders & weightlifters of both control group & experimental group. But there is statistical greater improvement in experimental group in which the subjects are given Deep Friction Massage & Kinesiological Taping.

Conclusions

It is concluded That there is statistically significant improvement in elbow extension range of motion & reduced pain in distal triceps tendinitis in bodybuilders & weightlifters of both control group & experimental group. But there is statistically greater improvement in experimental group in which the subjects were received Cyriax Deep Friction Massage & Kinesiological Taping.

KEYWORDS: Distal Triceps tendinitis, Cyriax Deep Transverse Friction Massage, inesiological Taping.

ABBREVIATIONS

KT: Kinesiology Taping, DTFM: Deep Friction Massage, VAS: Visual Analogue Scale, ROM: Range of Motion, ADL: Activities of daily living.

INTRODUCTION

The pennate triceps muscle is made up of the medial, lateral, and long heads of three separate muscle bellies. As the final branch of the posterior cord of the brachial plexus, the radial nerve innervates the triceps. The infraglenoid tubercle of the scapula and the inferior glenohumeral joint capsule serve as the broad origin of the long head of the triceps.[1] The lateral aspect of the spiral groove and the lateral intermuscular septum serve as the distal origin and proximal origin of the lateral head, which extends from the humerus immediately lateral to the teres minor insertion. The medial aspect of the intermuscular septum and the humerus distal to the spiral groove are the sources of themedial head.

There are two different ways that the triceps tendon might insert: the lateral triceps expansion and the central tendon insertion into the olecranon process. Where the medial and long head tendons converge to form a clear rolled edge, the central tendon is thicker medially.[2] The triceps tendon insertion is between 4.0 and 4.2 cm wide overall.[2,3] 6.8 mm is the thickness of the central tendon just proximally to the tip of the olecranon.[2] The tendon insertion of the olecranon is broad and dome-shaped. The triceps insertion is located 12 to 14 mm distal to the olecranon tip, and its dimensions-which correspond to the size of the bony olecranon-are 20.9 mm in breadth and 13.4 mm in length.[2] According to one study, the average footprint insertion area was 466 mm 2,[3] while another study that used a three-dimensional modelling system stated that the average footprint insertion area was 646 mm2.[4] The caput longum and mediale converge distally and form the superficial part of the triceps tendon, which attaches directly to the medial aspect of the olecranon and laterally partially converges with the superficial fascia of the anconeus muscle.[5,6] The exact anatomy of the deep portion of the triceps tendon remains disputed. Masen et al. describe a separate lower insertion tendon of the caput mediale,[7] while Keener et al. depict histologically a confluence of the medial tendon parts with the central tendon.[8]

In the event of a rupture in the central tendon, the lateral triceps expansion can sustain active elbow extension and acts as a crucial reinforcement for the tendon. The tendon covering the anconeus muscle is thicker than the lateral triceps expansion, which is narrower. It merges with the dorsal antebrachial fascia and extensor carpi ulnaris before insertion into the dorsolateral ulna. Thelateral expansion's typical width ranges from 14.4 to 16.8 mm, or around

70% of the core triceps tendon's breadth.[2,3]

Injury Mechanism & Pathophysiology

Throwing athletes and bodybuilders are the main populations affected by triceps tendinitis, which is almost exclusively seen in men.[9] An uncommon cause of posterior elbow pain is triceps tendinosis, which is often observed in athletes who play activities requiring quick or powerful triceps extension, like baseball, weightlifting, gymnastics, and javelin throwing.[10,11] Resisted concentric contraction of the tendon while the elbow is pulled into flexion is the primary cause of most triceps' tendon injuries. Patients with tendinopathies typically report a history of repeated activity, such as manual labour or exercise.[12,13] Tenderness near the triceps muscle's insertion is a hallmark of distal triceps tendinitis, and active or resistant elbow extension aggravates the condition.[9] There may be swelling and/or tenderness to palpation, but strength is typically intact. Conversely, in a partial or complete tendon rupture, elbow extension is diminished or absent and ecchymosis, oedema, and/or a hematoma may be present, especially if acute.[6,14] In complete rupture, a step off may be felt where the tendon would normally insert on the olecranon process. Additionally, a modified Thompson test can be utilized where the patient lies prone with the forearm over the side of the table and elbow flexed. The triceps muscle is squeezed, and the examiner watches for extension of the elbow.[15]

The tendinopathies of various tendons share the same aetiology with triceps tendinopathy. Fibroblast growth results from the tendon's repeated usage. Prostaglandin E2 (PGE2) and other inflammatory and reparative mediators are consequently released by the fibroblasts. PGE2 inhibits collagen synthesis and degrades collagen in tendons. Stretched tendon fibroblasts also secrete substance P, which causes fibrosis and discomfort. PGE2 and substance P both play a role in the thickening of the tendons that is indicative of tendinopathy.[16]

Donaldson et al.[6] report that the origin of triceps tendinopathy is likely the deep portion or medial head insertion based on imaging and operative findings which show that the medial head of the tendon avulses, whereas the lateral portion remains intact. Donaldson et al.[6] also report that complete ruptures most commonly occur at the osteotendinous junction. Partial ruptures of the triceps tendon most often occur at the distal medial aspect of the tendon.[17]

MATERIALS & METHODS

For this study, 42 patients who met the inclusion criteria were included. Using a practical sampling technique, 21 of those patients were assigned to the control group and the remaining 21 patients to the experimental group. Every patient participated in the 6-week study, which was done three times a week. Authorization was signed by the patient to give consent. Pre-intervention variables of pain and range of motion were measured and recorded, along with demographic information.

For eighteen sessions, the control group received deep transverse friction massage. For eighteen sessions, the experimental group received deep friction massage combined with kinesiology taping. After that, measurements and documentation of their post-intervention discomfort and range of motion were made. Regarding their measurement, data analysis was done.

Criteria for selection

- Distal Triceps Tendinitis
- Sex: Male
- Age: 25-35 years
- Side: Unilateral
- BMI: 20-29.9 kg/m2

- No supplemental treatment of the DistalTriceps Tendinitis during the study.
- No increase in training intensity during thestudy.

1. Deep Friction Massage

Deep Friction Massage (DFM) is a specific connective tissue massage that was developed by James Cyriax. The massage is deep enough,as the name implies, & must be applied transversely to the specific structures unlike the superficial massage given in the longitudinal direction parallel to the vessels which enhances circulation & return of fluids. The purpose of DFM is to maintain the mobility within the soft tissue structures like ligament, tendon, & muscle. As friction massage causes a transverse movement of the collagen fibres, it helps in preventing adhesion formation. In situations where adhesions are already formeda more intense friction can help to break them as well. In such cases friction is used to mobilize the scar tissue & break the cross linkages between the connective tissue & the surrounding structures.

Before friction massage can be performed successfully, the correct structure must be found through proper evaluation procedures. The distinction must be made between contractile structures such as the muscle belly, musculotendinous junction, tendon, and tendon-periosteal junction and noncontractile structures such as the joint capsule, bursae, fascia, dura mater, and ligament (Table In addition to finding the right spot, the massage must also be given the most effective way by following these basic principles.

1) The proper location must be found through proper evaluation procedures and palpation ofthe specific tendon, ligament, or muscle.
2) Friction massage must be given across the affected fibers. The thicker and stronger a normal structure, the more important friction is given strictly across the grain.
3) The therapist's fingers and patient's skin must move as one, otherwise moving subcutaneous fascia against muscle or ligament could lead to blister formation or subcutaneous bruising.
4) The friction massage must have sufficient sweep and be deep enough.
5) The patient must be in a comfortable position [18, 19].

The frequency & duration of the treatment varies with the severity & type of the injury. In a recent injury, i.e., ligament sprain, start daily with gentle massage, only for 1-2 minutes to keep mobility. However, it may well take several minutes to be able to get the therapist's fingers on the structure depending on the severity of pain. With DFM, the treatment will last 10-15 minutes. The intensity of pressure applied during DFM is important to reduce the pain. Mean pressure used by physiotherapists have been estimated to be 2.3kg/cm^2. Before DFM can be performed successfully, the correct structure must be found through proper evaluation procedures. The distinction must be made between contractile structures such as the muscle belly, musculotendinous junction, tendon, & tendon-periosteal junction & non-contractile structures such as joint capsule, bursae, fascia, & ligament. Deep Friction Massage (DFM) is also helpful to treat the condition like Distal Triceps Tendinitis by reducing the intensity of pain & improving therange of motion.[20]

The patient is in prone lying position with ipsilateral neck side-flexion. The shoulder isabducted to 90^0, elbow is flexed to 90^0, & a folded towel is placed under the distal arm. The forearm is hanging vertically over the edge of the table. The therapist is in sitting position at the tested side.[21]

The therapist asked the patient to extend the tested forearm against therapist's resistance toidentify the distal triceps tendon. Once thetherapist identifies the tendon, he will flex his both thumbs up to 90^0, & place over the affected tendon, just above the olecranon. The other fingers are clasped to each other, & placein front of the elbow joint to provide stabilization. Now, the therapist will perform Deep Friction Massage across the affected fibres for at least 10-15 minutes. After the treatment, the pain scores & the range of motion should be measured by using

VAS scale & Goniometer. The therapist's fingers & the patient's tissue will move as a single structure, otherwise it could lead to blister formation & subcutaneous bruising.

Image: 1.a

2. Kinesiology Taping:

All the patients in experimental group are treated with Kinesiology Taping with Deep Transverse Friction Massage. It is difficult to apply taping first & then apply Deep Friction Massage over it. So, at first the patient is treated with Deep Friction Massage for 10-15 minutes followed by Kinesiology Taping over the affected region. After the treatment, the pain scores & the range of motion are measured by using VAS scale & Goniometer.

Kinesio Tape has been evolving as a unique treatment tool for trainers, body workers, therapists & medical practitioners since its creation by Chiropractor Dr Kenzo Kase in the early 1970s. Under the directorship of Dr Kenzo Kase, the ethos of the Kinesio Taping Method has been to bring into harmony the physiological systems of the body by restoring 'Ku' (space), 'Do' (movement) & 'Rae' (cooling).[22,23]

Kinesiology tape or KT is an elastic cotton strip with an acrylic adhesive that is purported to ease pain & disability from athletic injuries & a variety of other physical disorders. This tape adheres to the skin with a medically approved, water & sweat proof adhesive. It comes in latex-free & hypoallergenic varieties for people who may be allergic to latex. The elastic tape is capable of stretching up to 130-140% of its resting static length ensuring free mobility of the applied muscle or joint. Dr. Kase claimed that by applying the KT, physiological effects would include a decrease in pain by stimulating the neurological system, restore correct muscle function by supporting weakened muscles, remove congestion of lymphatic fluid or haemorrhages under the skin, & correct misalignment of joints by reducing muscle spasm.[24] After applying the tape, the taped area from convolutions, thus increasing the space between the skin & muscles. Once the skin is lifted, the flow of blood & lymphatic fluid is promoted.[25,26]

The tape can usually stay in place for 3-4 days even while showering or exercising. Positive results are reported to be felt within 24 hours for many users of Kinesiology Tape. The Kinesiology Taping method is based on the science of maintaining support to the body while

allowing blood & other bodily fluids to move freely through & around the injured structure. Kinesiology Tape stabilizes the injured area by lightly adhering to the skin & applying pressure to the tissues the tape is wrapped around. The joint function can be supported using different Kinesiology Tape applications. By influencing the muscle tone, imbalances can be corrected & balance restored to the muscle group. Corrective functional & fascial applications, like passive support, result in improvement of joint function, lead to pain attenuation & consequently to a shorter healing process. The application of tape facilitates the opening of microvalves due to a dynamic pressure variation due to alteration in skin density. This decompression activates lymphatics in the dermis & improves lymphatic flow. The end result is reduction in tissue inflammation &swelling.[22,23]

Kinesiology Taping is also effective in condition like Distal Triceps Tendinitis. It will help to lift the skin from the underlying tissue. This will help in increasing circulation in the affected region & alleviate the discomfort level pf the patient. Kinesiology Taping will provide an extra support to the elbow joint & also improvethe joint function.

Patient Position & Preparation of theTreatment Part

The patient is seated with the hand placed behind the head; the hand is reaching maximally down the spine.

The therapist stands behind the patient. Prepare the treatment part through proper shaving & also through removing the dirt, oil orlotion with the help of cotton & spirit.

Measurement of Tape

Measure a length of tape from posterior acromion process to the olecranon whilst in the lengthen position. Cut the tape to form a long “I” strip. Each of the corners of the tape strips should be rounded with scissors. In this way & by the application of the unstretched base & ends, premature loosening & undesirable rolling of the tape ends can be avoided. Sometimes, for best durability & adhesion a Pre-K Gel, which was specially developed for K-Taping therapy, is applied to the skin prior to taping. Pre-K Gel ensures reliable adhesion despite oily or lightly sweatyskin. It also contains a mild disinfectant.

Tape Application

Apply the starting anchor to the posterior acromion with zero tension. With the tissue in the lengthened position, apply the base of the tape with 25-35% tension. Complete the taping by applying the anchor to the olecranon & ulna with zero tension. Rub the tape to activate the adhesive.[27]

Image: 1.b

Reassessment

After the application of the tape, reassess the patient to find out any changes in range of motion & pain score by using goniometer & VAS Scale.

The tape should be kept in its position for at least 2 days, after that it can be removed & another treatment session can be started.

Removing of K- Taping applications is relatively painless if the tape is wet- e.g., in the shower. The skin is tightened & the tape removed in the direction of hair growth.

DATA ANALYSIS & RESULTS

An evaluation chart is used to document the progression of the treatment. By using the statistical tools & with the help of the evaluation chart, t-test, standard deviation & p- value is calculated to check whether the treatment procedures are statistically significant or not.

Variables	Mean	Standard Deviation	T Value	P Value
PRE-Treatment	8.19	0.7303	23.008	7.327*10-16
POST Treatment	4.52			

Table 1. Paired T test in Control Group for VAS

Variables	Mean	Standard Deviation	T Value	P Value
PRE-Treatment	79.28	4.3232	(-19.181)	2.396*10-14
POST- Treatment	97.38			

Table 2. Paired T test in Control Group for ROM

Variables	Mean	Standard Deviation	T Value	P Value
PRE-Treatment	8.33	0.8135	34.869	2.2*10-16
POST- Treatment	2.14			

Table 3. Paired T test in Experimental Group for VAS

Variables	Mean	Standard Deviation	T Value	P Value
PRE-Treatment	80.71	3.70	(-37.45)	2.2*10-16
POST- Treatment	110.95			
Table 4. Paired T test in Experimental Group for ROM				

Variables	Mean	Pooled Standard Deviation	T Value	P Value
POST-Treatment	4.52	0.8337	9.2529	1.726*10-11
POST- Treatment	2.14			
Table 5. Unpaired T test for VAS between Control & Experimental Group				

Variables	Mean	Pooled Standard Deviation	T Value	P Value
POST-Treatment	97.38	11.8973	(-3.6963)	0.0006556
POST- Treatment	110.95			
Table 6. Unpaired T test for ROM between Control & Experimental Group				

The study's findings demonstrate a statistically significant reduction in elbow joint pain and range of motion in patients with distal tendinitis who are bodybuilders and weightlifters in both the control and experimental groups. However, the experimental group-where patients got Cyriax Deep Friction Massage & Kinesiology Taping-shows a statistically significant improvement.

DISCUSSION

Distal triceps tendon ruptures are uncommon injuries. In case of tendinopathy, most of the cases are treated with conservative approach. Conservative treatment includes rest, ice, sling or brace, and NSAIDs. Yeh et al.[28] suggest tears involving less than half of the tendon should be managed with 4 weeks of splinting in $30°$-45^0 of flexion, but this can lead to stiffness of the elbow joint.[29] Donaldson et al.[6] recommend topical NSAIDs as opposed to oral in order to avoid the well-documented side effects of oral NSAIDs. Evidence is lacking regarding efficacy of PRP injection for distal triceps tendinopathy, with only one case report in the literature. This was a 47-year-old with partial distal triceps tendon rupture who underwent PRP injection followed by physical therapy and was found to have a decrease in pain 2 weeks after the injection.[30]

Surgical excision of the affected tendon also has been suggested, although results regarding efficacy are lacking.[6] Given the evidence that local corticosteroid injection increases the risk for triceps rupture,[6] there does not currently seem to be a place for local steroid injection in the management of triceps tendinopathy. Donaldson et al.[16 found that conservative management for partial tears up to 75% is a reasonable treatment option.

Triceps tendinitis is seen almost exclusively in males and observed in throwing athletes or bodybuilders. It is also observed primarily with sports that require quick triceps contraction, such as off-road mountain biking, motorcycle riding, and jumping. Distal triceps tendinitis is characterized by tenderness at the insertion of the triceps muscle, and pain is exacerbated with active or resisted elbow extension. Pain- relieving modalities such as iontophoresis coupled with dexamethasone, ultrasound to the damaged tissue, and electrical stimulation are used to increase circulation and tissue extensibility. Soft tissue mobilizations to decrease soft tissue restrictions, and friction massage are used to decrease muscle tension and guarding, and are also used if needed.[29] Kinesiological taping is also helpful to reduce the pain & provide an extra support to the injured muscle & helps to maintain joint range of motion with minimal pain.

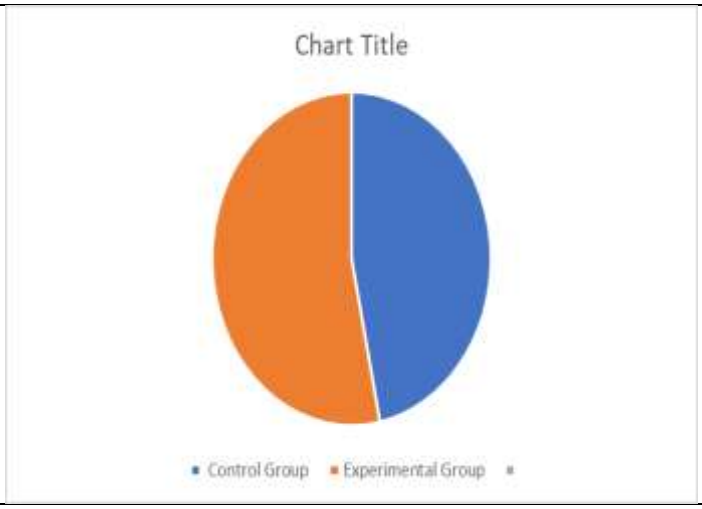
In this study we have focused on two rehabilitation techniques- Cyriax deep transverse friction massage & kinesiological taping. Both these techniques are helpful to reduce the patient symptoms, thus promote healing & when combination of these techniques are used, it will provide more benefit to the patients.

Using of brace & sling in optimal position guarding the range of motion, thus affect the patient's ADL activities. Whereas using of anabolic steroids or corticosteroid injection, increases the chance of rupture of the tendon.

In other hand transverse friction massage, kinesiological taping breaks the adhesion, thus promote healing & also allow pain free joint range of motion.

During the time of return to sports activities, kinesiology taping is much more useful. It provides an extra support to injured muscle & surrounding joint, & allow the person to return in their sports field with minimal pain & damage.[23]

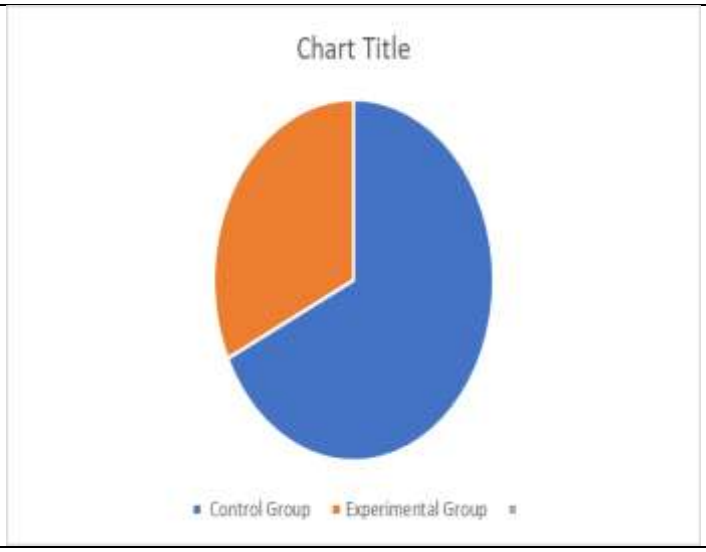
The data analysis and study results indicate that there is a statistically significant improvement in pain and joint range of motion in both the experimental group (Tables 3 & 4) and control group (Tables 1 & 2), where the absolute "t" value (|t|) is greater than the critical value and the "p" value is less than the significance level (α=0.05). When the experimental group-whose participants also received deep friction massage and kinesiology taping-is compared to the control group, the experimental group shows a statistically significant improvement. Thus, it is decided to reject the null hypothesis and embrace the alternative.



Graph1: Comparison of POST- Treatment value for ROM in both Control & Experimental group

The study's findings demonstrate how kinesiology taping combined with deep friction massage increases joint range of motion and lessens elbow joint pain. Therefore, the experimental group outperforms the control group in terms of pain reduction and the functional outcome of joint range of motion.

When combined with deep friction massage, kinesiology taping can improve the range of elbow extension and lessen pain in patients suffering from distal tendinitis. This occurs because Kinesiology Tape adds extra support to the elbow joint in addition to improving flexibility and vascular health during the therapy process.



Graph2: Comparison of POST- Treatment value for VAS in both Control & Experimental group

Relevance in Clinical Practice:

Data analysis & result of the study shows there is statistically improvement in pain & joint range of motion in patients with control group & experimental group. All the patients in control group have received Cyriax Deep Friction Massage & patients in experimental group have received Kinesiology Taping with Cyriax Deep Friction Massage.

As Deep Transverse Friction Massage causes a transverse movement of the collagen fibres, it helps in preventing adhesion formation. In situations where adhesion is already formed, more intense friction can help to break them as well. In such cases friction is used to mobilize the scar tissue & break the cross linkages between the connective tissue & the surrounding structures.

As the friction massage is a forceful & deep movement, it effectively causes increased blood flow to the local area of application through vasodilatation. This assists in the removal of chemical irritants & allow the transportation of endogenous opiates, thus causing pain relief. The analgesic effect of the massage can last up to 24 hours.

In other hand, Kinesiology Taping theory is based on the neurophysiological mechanisms & the effect of mechanical stimuli on various systems in the body. Kinesiology Tape applied on the skin with varying degrees of stretch creates a mechanical stimulus & activates an afferent pathway to central nervous system (CNS).

Kinesiology Tape applied on the skin with a low degree of stretch, changes the density & the concentration of the tissue in the dermis & epidermis. The mechanical stimulus converted into electrical impulses, is called mechanotransduction & can produce cell movement. Kinesiology Tape produces pressure & stretch on the skin that may be able to stimulate mechanoreceptors. This stimulus interacts with CNS & modulates pain responses.[24]

The application of tape changes the tension elements in tissues to encourage homeostasis. The tension imposed from the tape frees the fascia of any movement limitations through the movement of the skin relative to the target tissue.[24]

The application of Kinesiology Tape facilitates the opening of microvalves due to a dynamic pressure variation due to alteration in skin density. This decompression activates lymphatics in the dermis & improves lymphatic flow. The end result is reduction in a tissue inflammation & swelling.[25,26]

The results of this meta-analysis suggest that, there is greater improvement in pain &

joint range of motion in experimental group, in which subjects have received Kinesiology Taping along with Deep Friction Massage.

Data analysis & research of the study shows that, both the treatment protocol has some beneficiary effects in treating the condition like Distal Triceps Tendinitis. There is statistically improvement in pain & joint range of motion in control group & experimental group. While comparing both control group & experimental group, there is greater improvement in experimental group, in which the subjects have received Kinesiology Taping with Deep Friction Massage.

The efficacy of these treatment protocol can be judged more satisfactorily, in case of largersample size, a greater number of variables, & study with relatively longer duration.

LIMITATION OF THE STUDY

- The study consists of small samplesize
- Short Duration
- The study is based on only malepatients
- Age is curtailed
- No long-term follow-up care has done
- The study is based on only two variables, pain & joint range of motion
- Patients are selected from limitedgeographical area
- The effects on various occupation related to Distal Triceps Tendinitis isnot included in this study.

RECOMMENDATION

- Subject population can be increased
- The study can be done for longerduration
- Geographical area can be increased

CONCLUSION

The study's findings indicate that, for both the control and experimental groups of bodybuilders and weightlifters who had distal tendinitis, there was a statistically significant improvement in elbow joint pain and range of motion. However, the experimental group, where patients got Kinesiology Taping and Cyriax deep friction massage, showed a significantly higher recovery.

FUTURE STUDY

a. Future study can be done with large number of samples.
b. Future study may be conducted by using outcome measures like quality oflife, improvement of functional activity, & grip strength.
c. Study could also be conducted to see the effect of intervention in different occupation.

FOOTNOTES: Nil

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHOR'S CONTRIBUTION

Krishnendu Chakraborty: study design, data analysis, drafting manuscript. Dr Sutanu Goswami: study design, data analysis, drafting manuscript. Jitendra Kumar Shriwas: study design, drafting manuscript. Dr Tania Mukherjee: statistical analysis & corresponding author. All authors read

& approved the final manuscript.

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