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# Comparison of effect of taping on PF versus PF and Gastrocnemius taping on pain and function in patients with Plantar fasciitis

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**Abstract**
**Background:** *Increased pressure on the plantar fascia ligaments due to sudden weight gain, excessive standing, prolonged walking periods, limited dorsiflexion range of motion, high body mass index are some predisposing factors for development of plantar heel pain which is one of the common complaints. According to research, improper functioning of gastrocnemius muscle is also responsible for plantarfascitis. So the current study focuses on taping gastrocnemius muscle along with plantarfascia to check its effect on plantarfascia pain using NRS and Foot function index over a period of 5 days.*
**Purpose of the study:** *To compare the effect of kinesio taping on PF versus PF and gastrocnemius taping on pain and function in patients with plantar fasciitis.*
**Materials and Methodology:** *After fulfillment of the inclusion criteria, a total 26 subjects were randomly allocated in plantar fascia taping group and plantar fascia with gastrocnemius taping group, each group consisting of 13 subjects. The total duration of treatment session was of 5 days. Initial 3 days, supervised conservative treatment was given and on 3rd day taping was applied for consecutive 2 days and HEP was given to subjects. Assessment of outcome measures were NRS and FFI done at pre 1st day, 3rd day and post 5th day intervention.*
**Results:** *On the statistical analysis, there was significant reduction of pain but foot function index did not show significant difference in intergroup analysis. However in the intra group, there was significant reduction of pain and improvement in the foot function index.*
**Conclusion:** *Based on the statistical analysis of the present study it can be concluded that kinesiotaping for gastrocnemius and plantar fascia is more effective than plantar fascia taping alone in reduction of pain in inter and intra group analysis but no significant difference was found in foot function index in the intergroup analysis post 5 days of intervention.*
**Keywords:** *kinesiotaping, plantar fascia, Gastrocnemius, foot function index.*

## Introduction

Plantar fasciitis is one of the common and disabling musculoskeletal pathology of foot which accounts for 8 to 15 percent heel pain or foot pain in athletic and as well as non athletic individuals [1]. Those who are at the risks of obesity, those having active job involving being on the feet for long hours, or those having foot problems such as flat foot or high

arches etc develop plantar fasciitis[2]. Plantar fasciitis is the condition involving inflammation of thick band of tissue that runs across the bottom of foot and connects heel bone or calcaneum to meta-tarsals and phalanges.[3] Common etiologies include increased pressure on the plantar fascia ligaments, sudden weight gain, pregnant women etc experience plantar fasciitis symptoms particularly during late stages[4]. Limited dorsiflexion range of motion and high body mass index are other predisposing factors for development of plantar heel pain.[5]

The plantar fascia is thickened fibrous aponeurosis that originates from medial tubercle of the calcaneus, runs forward to insert into the deep , short transverse ligaments of metatarsal heads, dividing into 5 digital bands at metatarsophalangeal joints and continuing forward to form fibrous flexor sheaths on plantar aspect of toes. It is made up of 3 distinct parts : medial, central and lateral bands. The central band is the strongest band and this segment is more likely to get involved in plantar fasciitis[6] .

The pain occurs due to degenerative irritation of plantar fascia insertion on the medial process of the calcaneal tuberosity due to etiologies mentioned above. There is development of micro trauma (micro tears) resulting in damage at the calcaneal fascial interface secondary to repetitive stressing of the arch especially with weight bearing. This excessive loading of degenerative and healing tissue of plantar fascia may cause significant plantar pain, particularly with the few steps after sleep or other periods of activity[7]. Pain associated with plantar fasciitis is throbbing, pearcing kind which occurs usually during first few steps taken in the morning, long periods of standing, or after rising `from sitting position after long time. Walking bare foot on toes, climbing stairs etc all limits daily activities and discomfort occurs with continuation of these activities and the pain may become worse. Patient who are generally on their feet all day reports symptoms of pain at the end of the day.[8] The clinical picture seen is pain, tenderness at the heel, decreased calf muscle flexibility and this may lead to abnormal movement of the foot. A normal plantar fascia has dorsoplantar thickness of 3mm and in plantar fasciitis the thickness may increase upto 15mm.

Walking is the activity which gets affected post plantarfascitis and during terminal stance during heel off, there is a phenomenon call Windlass mechanism which occurs. In this mechanism, gastrocneimus contracts actively which lifting heel off the ground which occurs at MTP joint. The plantar fascia band envelops convex surface of metatarsal heads producing windlass effect.[9] Accumulation of tension in plantar fascia raises longitudinal arch and tends to resist posterior and superior rotation of calcaneus.[10] During walking, just after heel strike in first half of the stance phase of the gait cycle , tibia turns inwards and foot pronates stretching the plantar fascia muscle which flattens the arch and it allows the foot to accommodate to irregularities in walking surface and absorb shock.[11] Therefore a treatment method which focuses on all these clinical features would prove to be more effective for the treatment of plantar fasciitis.

Tightness of Achilles tendon predisposes to plantar fasciitis because of limited dorsiflexion of the foot strains the plantar fascia. Also in plantar fasciitis the foot tends to remain in equines position and the fascial tissues contract in the night which causes in pain in the morning, putting weight on the foot puts plantar fascia under the tension, which causes pain.[12]

Kinesio taping has been widely used in the treatment of plantar fasciitis and results have been found to be positive. It improves the local circulation as well as ankle proprioception through increased stimulation to cutaneous mechanorec-eptors. Kinesio taping technique focus on reducing pain and tenderness at the heel area along with improvement in range of motion. Furthermore, taping in a direction parallel to the longitudinal axis of the foot and the leg can create positive tension to the plantar fascia and negative tension to ankle plantar flexors and reduce muscle pulling force to plantar fascia.[13] Therefore the present study is to

compare the effectiveness of kinesio taping on gastrocnemius muscle along with taping done plantar fascia to reduce pain, in the patients with plantar fasciitis as reduced tension on gastrocnemius reduces plantarfascia loading decreasing pain.

According to majority of the studies, Kinesiotaping is applied mostly for plantar fascia only in plantarfascitis patients. Many studies have found out the effectiveness of the same in treatment of plantarfascitis. But it has been found out that intense muscle contraction of gastrocneimus causes over stretching of the muscles or tightness of these muscles result in effectiveless functioning of gastrocneimus[14]. This increases load on plantasfascia causing it to inflame. There is overstraining of the plantar fascia muscle and causing the pain in the heel area. Passive tension occurs because of increase in dorsiflexion of foot or due to gastrocnemius tightness[15]. Hence in the present study, taping was done to gastrocnemius along with the plantar fascia to reduce the loading on the plantar fascia and reduces the overstraining of plantar fascia .

**Materials and Methodology**

This randomized control trial was conducted in outpatient department setup of tertiary care centres. The study duration was of 5 days and it was approved by the institutional ethical committee. A total of 26 healthy individuals within the age group of 18-45 years with the pain of plantar heel pain from NRS 2-9 were included in the study after screening them. Returned informed consent was taken from all the subjects before participation in the study. Individuals with history of recent surgery of ankle or foot, pathological fractures, autoimmune or inflammatory diseases, impaired circulation of lower extremity, soft tissue abnormalities like fat pad syndrome, plantar fascia rupture, heel bruises, subjects allergic to tape were excluded from the study.[13].A written informed consent including detailed explanation about the purpose and procedure of the study was taken from all the subjects before beginning the intervention. Demographic data was obtained from all the subjects prior.

**Materials used for the study**

Kinesio tape, foot function index scale, ultrasound machine, evaluation sheet, scissors, Microsoft excel sheet.

**Patient allocation**

Patients included in the study were divided into 2 groups, group A and group B by simple random sampling. After allocation in two groups, they were assessed for the outcome measures on Day 1( pre-treatment). Subjects were then given the intervention for five days in total. Outcome measures used were NRS and foot functional index[7] to assess pain and activities respectively. Conservative treatment was given to subjects in both groups for 3 days that is from day 1 to day 3 under supervision. Conservative treatment given with the taping includes ultrasound of 1.2mhz for 6 min over the heel area, stretching of gastro and soleus muscle 3 repitations for 10 sec hold[14] ATMS(ankle toe movements) for 10 repitations, heel raises(10 repitations), strengthening of intrinsic group muscle(towel curls for 10 repitations) ice pack advised for pain relief for 10-15 mins[15] over heel area and ergonomic advice given. This treatment was given for three days and on the 3rd day, outcome measures were assessed again and documented.

On 3rd day after assessing the outcomes, subjects were given taping according their groups allotted. Taping for plantar fascia[7] –palm shaped taping method was given to the subjects for 2 consecutive days with 100 percent stretch.

GROUP A- Taping for plantar fascia-13 participants were included in this group. the original site of taping marked on the posterior margin of the calcaneal bone and the palm shaped taping was applied from the calcaneum to metatarsals with 100 percent stretch to provide negative tension to plantar fascia. The whole plantar fascia muscle from insertion to origin was covered with the kinesio tape.[16]

Group B-Taping for gastrocnemius and plantar fascia- inverted Y shaped taping to gastrocnemius was given with palm shaped taping method was given to the plantar fascia muscle for nearly 2 consecutive days with 100 percent stretch GROUP B- taping for gastro muscle and plantar fascia- 13 participants included in group B for taping on gastro muscle to study the effect on plantar fasciitis. Taping for gastrocnemius and plantar fascia-the reference point marked on the posterior leg and the original site for taping marked on the Achilles tendon at the level of medial and lateral malleoli. Two sites of taping marked on both medial and lateral head of gastro muscle. during taping , the patient is in prone position on the plinth with the feet placed outside the edge of the table with the knee joints fully extended and the ankle joint maintained in neutral position. the procedure of Y shaped applied to gastro muscle . in affected side, the tape cut longitudinally upto 2/3$^{rd}$ of the whole length of the tape and the common end tape firmly adherent to marked the original site on the Achilles tendon and then stretched proximally to stick the two ends of bivalve heads and the original tape about half of the leg length measured from fibular head to lateral malleolus.[7]

Outcome measures used were NRS and foot functional index to assess pain and activities[7] respectively at 1$^{st}$ , 3$^{rd}$ and 5$^{th}$ day (5$^{th}$ day is follow up).

On 3$^{rd}$ day, evaluation of patients was done along with documentation of both the outcome measures( NRS and FFI) done along with taping done and home exercise treatment protocol was given to all the subjects of both groups. The exercises given in home treatment were the same exercises taught from day 1 to day 3. The precautions explained to the patients were - not remove the tape by themselves, in case of skin irritation or in case of any skin irritation or increased pain report to the therapist as soon as possible, if the tape gets wet then avoiding rubbing, dab dry instead[17]

Home exercise protocol includes- self TA stretching for 3 repitations for 10 sec hold, Heel raises for 10 repitations and towel curling for strengthening of intrinsic muscle group for 10 repitations, and ankle toe movements for 10 repitations[18].

On 5$^{th}$ day, the tape was removed again the assessment was done. Outcome measures post values were taken accordingly.

**Gastrocnemius and Plantar Fascia Taping**

Taping for gastrocnemius and plantar fascia. Inverted Y shaped tape applied to gastrocnemius muscle and palm shaped tape is applied to plantar fascia muscle with100 percent stretch for consecutive 2 days.

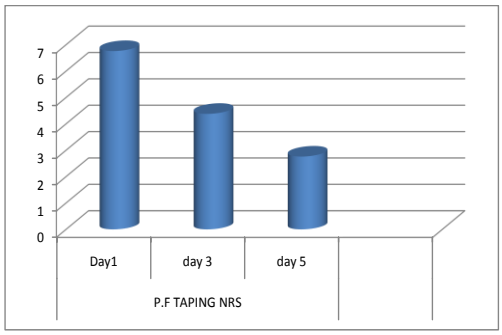
**Plantar Fascia Taping**

Plantar fascia palm shape tape applied to the plantar fascia muscle with 100 percent stretch for 2 consecutive days.

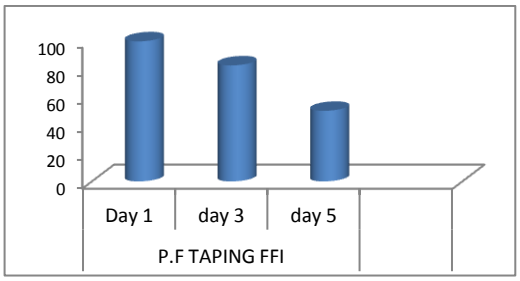
Statistical analysis was done using paired t test was used for within group analysis of pain using NRS and functional disability using FFI

Unpaired t test was used for between two group (Plantar fascia taping versus Plantarfascia and Gastrocnemius taping) analysis post 5 days intervention. Statistics was recorded using instat software. The level of significance was <0.0001.

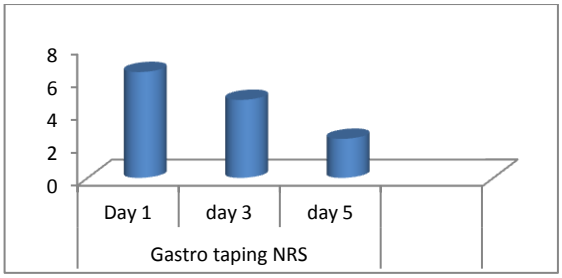
**Graph 1:** Plantar fascia taping NRS for day 1, day 3 and post 5 day intervention. There was significant reduction of pain from day 1 to day 5 post intervention
(p value - <0.0001)



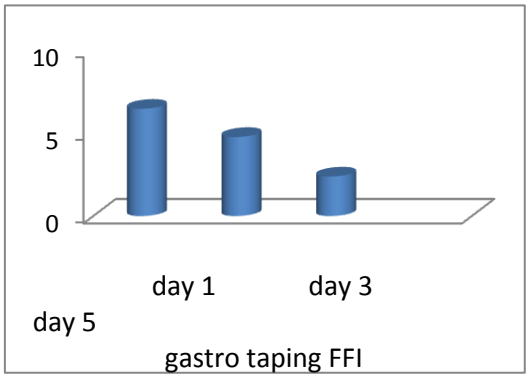

**Graph 2:** plantar fascia taping FFI (foot function index) for day 1, day 3 and post 5 day intervention. There was significant improvement in foot function index from day 1 to day 5 post intervention
(p value - <0.0001)



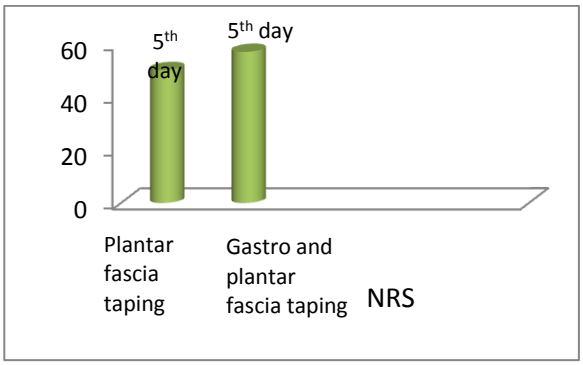

**Graph 3:** gastrocnemius and plantar fascia taping NRS for day 1, day 3 and post 5 day intervention. There was significant reduction of pain from day 1 to post 5 day intervention.
(p value - <0.0001)



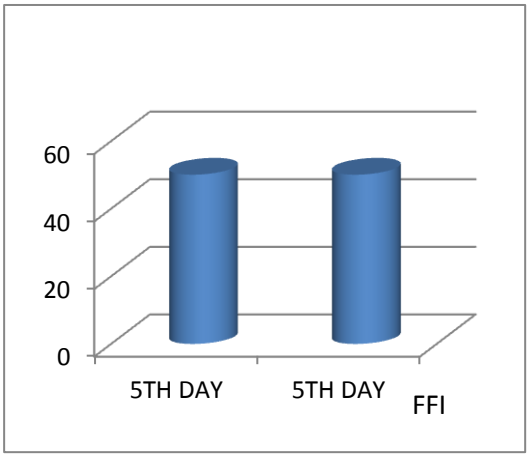

**Graph 4:** gastrocnemius and plantar fascia taping FFI (Foot function index) for day 1, day 3 and day 5. There was significant improvement in foot function from day 1 to day 5 post intervention
(P value - <0.0001)




**Graph 5:** plantar fascia versus gastrocnemius and plantar fascia taping NRS. There was significant difference in pain between two groups.




**Graph 6:** plantar fascia versus gastrocnemius and plantar fascia taping FFI. There was no significant difference in the foot function index between groups.



**Discussion**

This study design was performed to compare the effectiveness of two taping groups in the treatment of plantar fasciitis. In present study on inter-group analysis we found that kinesiotaping for gastrocnemius and plantar fascia is more effective than plantar fascia taping alone in reduction of pain post 5 days of intervention, but no statistical significant difference was found in foot function index. From day 3 to day 5, when taping was done post conventional treatment, it was found out that kinesiotaping for gastrocnemius and plantar fascia is more effective than that of plantar fascia taping in reduction of pain but no significant dfference was found in foot function index as above. A total of 34 subjects were included in the study, of which 26 completed the study. Total 8 dropouts were present in the study which were due to the noncompliance with the treatment intervention for a minimum of 5 days.

In group A, plantar fascia taping group, the intra group statistical analysis revealed that there was significant reduction of pain along with improvement in the foot function index post 5 days intervention. Subjects were taped on day 3, after giving supervised conventional treatment with documentation of outcome measures on day 3(pre taping) and 5(post taping) as well. This intra-group analysis done from day 3 to day 5 also showed significant reduction in the pain and improvement in the foot function index. In group B, gastrocneimus and plantar fascia taping, there was significant reduction in the pain(NRS) and improvement in the foot function index post 5 days of total intervention like group A. Also day 3 – day 5 intra-group analysis showed significant reduction in pain(NRS) with improvement in foot function index.

In a randomized controlled trial of calcaneal taping, sham taping and plantar fascia stretching for the short term management of plantar heel pain, Matthew R, Lior Cohen et al(2006) concluded that calcaneal taping was more effective in the treatment of plantar heel pain than stretching ,sham taping and control group treatment inclusive of ultrasound and exercise intervention. Another study on the effect of short term treatment with kinesiotaping for plantar fasciitis done by Chien – tsung Tsai, Wen-Dien Chang et al (2010) concluded that kinesiotaping helped in reducing pain than therapeutic interventions. These studies supports the result of present study in showing positive effects for pain reduction and foot function improvement with taping post 5 days of total intervention as well as from day 3 to day 5 when tape was applied[7].

The effects of tape reducing the pain and improving foot function could be attributed to pulling force at the fascia created by the tape which helps in treating soft tissue injuries. Plantar fascia taping was given in both the groups. Palm shaped taping method was applied to plantar fascia muscle with 100 percent stretch from calcaneum to metatarsal heads. The direction of taping was parallel to the direction of the fibers of plantar fascia and a pulling force must have generated at the insertion site over the calcaneum due the stretch applied to the tape in opposing direction of the insertion.[7]

A positive correlation between Achilles tendon loading and plantar fascia tension was found to be one of the risk factors developing plantar fasciitis. Increased tension on Achilles tendon causes increased strain on plantar fascia. Similarly, inflexibility of gastrocneimus leads to excessive pronation and overcompensation of the plantar fascia at the first metatarsophalangeal joint , which leads to increase in stress at the medial calcaneal insertion developing plantarfascitis.[6] Hence, by applying kinesio taping on gastrocneimus muscle with plantar fascia, the fascia pulling force which leads to decrease load on Achilles tendon indirectly decreasesing load on plantar fascia muscle. The k taping decreases the intense muscle contraction and passive stretch of the Achilles tendon which reduces overstraining of plantar fascia[16] . Stretching of gastrocnemius also has an effect on windlass mechanism which reduces excessive load on plantar fascia muscle and helps limit microtrauma and facilitates healing[12] . k taping to gastrocnemius along with plantarfascia therefore

must have resulted in additional pain relief that plantarfascia taping alone as per statistical analysis of the present study.

The fascia innervates by free nerve endings that convey nociceptive neural signals. Nociceptive receptors seem to be most abundant in the skin in the outer layer of connective tissue. A pain signal gets transmitted from the fascia to the spinal cord and ultimately to the brain, but the exact pathway for transmission of the pain impulse varies. Improvement in focal circulation had tend to facilitate resolution of injury induced inflammation which helped in pain relief. And by applying kinesio tape on calf muscles and plantar fascia, the pulling force of plantar flexors and plantar fascia got reduced, and the repetitive injury to plantar fascia was avoided and tissue repair was facilitated[10] . According to a study done by Chein Tsung Tsai et al, with ultrasonography findings it was found that the thickness of plantar fascia was increased and margins of fascia were found to be blurred which directly result in granulation formation with haematoma. The thickness at the insertion site at the anterior calcaneal line was found to increase by 0.5cm. However after application of kinesiotape at the insertion site of plantar fascia there was reduction of the inflammatory reaction and there was decrease in thickness of plantar fascia muscle. Thus by the reduction of the inflammatory reaction, the tissue repair was facilitated and there was reduced pulling force of plantar fascia muscle which directly in turn helped for relief of pain supporting findings of present study.[7]

All these factors could have additionally contributed to improvement in foot function index in both the groups post intervention[12]. Components like stepping first steps early morning, while walking for long distance, climbing ascending and descending stairs, getting up from the chair, climbing curbs, while walking fast, or standing on tip toes showed improvement in subjects in both the groups[12]. However on inter-group analysis of FFI, there was no statistical difference found.

Hence we recommend that gastrocnemius and plantar fascia taping is more effective than plantar fascia taping in reduction of pain and therefore can be used more in clinical practice.

**Clinical implications**

Gastrocnemius muscle must also be taped with plantar fascia for the treatment to be more effective in reducing pain and improving function than plantar fascia taping alone in the treatment of plantar fasciitis for reducing pain and improving function.

**Conclusion**

Based on the statistical analysis of the present study it can be concluded that kinesiotaping for gastrocnemius and plantar fascia is more effective than plantar fascia taping in reduction of pain but no significant difference was found in foot function index. However both the groups showed statistically significant improvement in pain and function in the intra group analysis post 5 days of intervention.

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**Conflicts of interest**: none

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