

METHODS

Subjects who were referred to physiotherapy department and diagnosed by certified Orthopedician or Physiotherapist of Krishna Hospital, Karad, as plantar fasciitis were selected. Further, they were screened clinically and diagnosis of plantar fasciitis was confirmed. Considering inclusion and exclusion criteria, they were requested to participate in the study. The nature of study and intervention were explained to the subjects, and those who were willing to participate were included. Before proceeding to intervention, a written consent was obtained from subject. A brief demographic data including name, age, gender, and side affected as per data collection sheet were recorded. Using random sampling method, the participants were divided into two groups by lottery method: Group A and Group B, both groups received a baseline treatment (therapeutic US and exercises) for 1 week. Group A: Therapeutic US, exercises, and mulligan's calcaneal taping. Group B: Therapeutic US, exercises, and kinesiotaping.

For both the groups, therapeutic US [16-20] and exercises [1,16,21,22] were given in common as a part of the conventional treatment.

- Therapeutic US:
 - 3 MHz US set to 1.0 w/cm², continuous for 7 min.
- Exercises
 1. Stretching(30 s hold, 3 sets) - Plantar fascia
 - Gastrocnemius
 2. Strengthening - Foot intrinsic
 - Tibialis posterior

Group A

Two types of tape were used. One was an underwrap and other was brown rigid tape. An underwrap is adhesive cotton material tape which was applied on the structure that was to be taped so as to avoid blister formation or allergic reaction from tape. Brown rigid tape was used in this study was zinc oxide tape approximately 1-2 inches in width, slightly porous, adhesive, and non-elastic in nature.

Patient was seated at the edge of the couch with affected foot off the plinth affected hip in abduction and external rotation to maintain the position with relaxed ankle. An under wrap was put in the same manner as the brown rigid tape but without any pull or tension on the under-wrap while applying it on a clean and dry skin. One end of the brown rigid tape was applied diagonally on the lateral surface of the affected calcaneum. Calcaneum was held into external rotation and adduction with one hand. The tape was pulled and wrapped around the ankle medially while this glide was sustained. Tape was passed medially and superiorly to the tendon of tibialis anterior to avoid problems while walking. First strip was placed obliquely around the back of heel while calcaneum was externally rotated, extended around lower leg. A second strip of tape was used to reinforce the first. The patient was asked to keep the tape in place for 24 h [14].

Group B [23]

The Kinesiotape was waterproof, porous, and adhesive. The tape with a width of 5 cm and a thickness of 0.5 mm was selected for this study.

Taping on the gastrocnemius muscle

The leg length was measured from the lateral malleolus to the fibular head, but the original length of tape was only half of the leg length. The original site of taping was on Achilles tendon at the level of medial and lateral malleoli, and of sliced tape was stretched distally for a total length of three-quarters of the leg length.

Taping on the plantar fascia

The foot length was measured from the posterior margin of calcaneus to the tip of big toe, but the original length of tape was only half of the foot length. The original site of taping was at the proximal one-eighth of foot and the end of sliced tape at the distal one-eighth margin of the foot.

The k tape was given on alternate days for 1 week and US daily for 6 days.



Fig. 1: Mulligan's Calcaneal Taping



Fig. 2: Kinesiotaping (for gastrocnemius muscle)



Fig. 3: Kinesiotaping (for plantar fascia)

RESULT

The data were entered into Microsoft office Excel 2007. The data were analyzed using Instat software. Descriptive statistics were used to analyze baseline data for demographic data. Paired t-test was used to find the significance of parameters between pre- and post-test and $p < 0.05$ was considered to be statistically significant. The unpaired

t-test was used to find the significance of parameters between pre-pre and post-post [Tables 1 and 3].

INTRAGROUP DATA ANALYSIS

In the present study, pre-interventional mean of VAS was 6.88 ± 1.18 in Group A and 7.33 ± 1.80 in Group B, whereas post-interventional mean VAS was 1.90 ± 1.51 in Group A and 3.74 ± 1.68 in Group B. Intragroup analysis of VAS revealed statistically reduction in VAS post-intervention for both groups. This was done by using paired t-test Group A ($p < 0.0001$) and Group B ($p < 0.0001$).

In the present study, the pre-interventional mean of revised-foot function index (FFI-R) was 74.63 ± 9.23 in Group A and 81.33 ± 17.013 in Group B, whereas post-interventional mean (FFI-R) was 45.68 ± 7.69 in Group A and 64.47 ± 13.68 in Group B. Intragroup analysis of FFI-R revealed statistically reduction in FFI-R post-intervention for both groups. This was done using paired t-test Group A ($p < 0.0001$), Group B ($p < 0.0001$) [Table 3].

Intergroup data analysis

In the present study, pre-interventional mean of VAS score was 6.88 ± 1.18 in Group A and 7.33 ± 1.80 in Group B, whereas post-interventional mean VAS was 1.90 ± 1.51 in Group A and 3.74 ± 1.68 in Group B. Intergroup analysis of VAS score was done by unpaired t-test. Pre-intervention analysis showed no significant difference between Group A and Group B ($p = 0.1936$). Post-intervention analysis showed very significant difference between Group A and Group B ($p = 0.0012$). In the present study, pre-interventional mean of FFI-R score was 74.63 ± 9.23 in Group A and 81.33 ± 17.013 in Group B, whereas post-interventional mean FFI-R was 45.68 ± 7.69 in Group A and 64.47 ± 13.68 in Group B. Intergroup analysis of FFI-R score was done by unpaired t-test. Pre-intervention analysis showed no significant difference between Group A and Group B ($p = 0.1011$). Post-intervention analysis showed extremely significant difference between Group A and Group B ($p = 0.0001$).

Table 1: Pre-post comparison Group A

Group A	VAS	FFI-R
Pre-interventional	6.88 ± 1.18	74.63 ± 9.23
Post-interventional	1.90 ± 1.51	45.68 ± 7.69
p	<0.0001	<0.0001
r	0.5569	0.3054
Inference	Extremely significant	Extremely significant

VAS: Visual analog scale, FFI-R: Revised-foot function index

Table 2: Pre-post comparison Group B

Group B	VAS	FFI-R
Pre-interventional	7.33 ± 1.80	81.33 ± 17.013
Post-interventional	3.74 ± 1.68	64.47 ± 13.68
p	<0.0001	<0.0001
r	0.6051	0.9345
Inference	Extremely significant	Extremely significant

VAS: Visual analog scale, FFI-R: Revised-foot function index

Table 3: Pre-pre and post-post analysis between Group A and Group B

???	VAS		FFI-R	
	Pre-Interventional	Post-Interventional	Pre-Interventional	Post-Interventional
Group A	6.88 ± 1.18	1.90 ± 1.51	74.63 ± 9.23	45.68 ± 7.69
Group B	7.33 ± 1.80	3.74 ± 1.68	81.33 ± 17.01	64.47 ± 13.68
P value	0.1936	0.0012	0.1011	0.0001
Inference	Not significant	Very significant	Not significant	Extremely significant

VAS: Visual analog scale, FFI-R: Revised-foot function index

DISCUSSION

The present clinical trial was conducted to find the effect of Mulligan's calcaneal taping versus kinesiotaping in plantar fasciitis. 44 subjects who were clinically diagnosed with plantar fasciitis and fulfilling inclusion and exclusion criteria with the age group between 18 and 58 years were included in the study. They were allocated in two groups, Group A and Group B, each containing 22 subjects. In Group A, 7 males and 15 females, and in Group B, 8 males and 13 females were there. Previous literature showed that females are more affected than males and this study also reveals the same. The plantar fasciitis affects both active and sedentary adults of all ages. Plantar fasciitis is more likely to occur in persons who are obese, who spend most of the day on their feet, or who have limited ankle flexion [24]

The Mulligan's calcaneal taping technique with conventional physiotherapy treatment was given to correct positional faults of calcaneum in Group A subjects, and kinesiotaping for plantar fascia and gastrocnemius muscle with conventional physiotherapy management was given to Group B subject. The outcome measures were visual analog scale for pain and FFI-R for foot function assessment.

The average mean age of participants in Group A was 30.13 ± 12.08 and in Group B was 33.80 ± 12.69 , which showed that there is no significant difference in age of the subjects in both the groups ($t = 0.9718$, $p = 0.3369$). All age groups can be affected by plantar fasciitis, but the more commonly affected age group is 30–35 years and it also supports the literature.

Paired t-test was used to analyze the effect of mulligan's calcaneal taping in plantar fasciitis and showed that there was extremely significant improvement in reduction of pain ($r = 0.5569$, $p < 0.0001$) and FFI-R score ($r = 0.3054$, $p < 0.0001$).

With Mulligan's Calcaneal taping, patient gets instant pain relief and increases the range of motion by maintaining the correction of positional fault, and patient can perform offending/restricted movements in pain-free way. Mulligan taping technique focuses on improving biomechanical position by correcting the positional faults of calcaneum, improving the alignment of the calcaneum, and thereby reducing stress and subsequent microtrauma to the plantar fascia [25]. This helps in reducing pain and FFI-R score in patients with plantar fasciitis.

Paired t-test was used to analyze the effect of kinesiotaping in plantar fasciitis and showed that there was extremely significant improvement in reduction of pain ($r = 0.6051$, $p < 0.0001$) and FFI-R score ($r = 0.9345$, $p < 0.0001$).

It is very likely that application of kinesiotaping on the foot may correct the abnormal movement of the foot to prevent foot injury due to repetitive minor trauma from the abnormal foot movement. It might also facilitate recovery if injured. Furthermore, taping in a direction parallel to the longitudinal axis of the foot and the leg can create a positive tension to the plantar fascia and a negative tension to the ankle plantar flexors and subsequently may reduce the muscle pulling force to the plantar fascia [26,27]. This helps in reducing pain and FFI-R score in patients with plantar fasciitis.

The statistical analysis revealed that there was very significant difference in VAS in both the groups. Group A was more efficient in reducing VAS score ($p=0.0012$) than Group B post-treatment.

The statistical analysis revealed that there was very significant difference in FFI-R in both the groups. Group A was more efficient in reducing FFI-R score ($p=0.0001$) than Group B post-treatment.

The result from the statistical analysis of the present study supported alternative hypothesis which stated that there will be beneficial effect to the subjects treated with Mulligan's calcaneal taping in reducing pain and FFI-R score.

Significantly Mulligan's calcaneal taping was more effective, then kinesiotopeping can be attributed to the proposed mechanism by Robbins *et al.* that taping addresses one of the presumed cause of pathology i.e., poor foot biomechanics. Rationale behind the application of taping is to provide support and protection to the part simultaneously allowing optimal functional movements. In 2006, Hyland and Webber-Gaffney demonstrated that controlling the calcaneus movement can decrease the heel pain more effectively as compared to stretching and sham taping. Many taping techniques are there in literature like low dye taping was used to correct rear foot motion, windlass taping was used correct rear foot motion as well as forefoot motion and also in reducing heel pain. However, the Mulligan's calcaneal taping technique can alleviate pain and improve function better with ease application and it is also cost effective. With only two pieces of tape, it is easier and less time consuming. The most important mechanical cause for plantar fasciitis is excessive pronation. With the mulligan's calcaneal taping, we can prevent excessive pronation by maintaining calcaneum in external rotation in relation to talus and in neutral position by reducing stress to plantar fascia. Therapeutic glide was maintained after application of the tape.

CONCLUSION

Various recent approaches are used in treating subjects of plantar fasciitis, but this study was conducted to compare the effect of mulligan's calcaneal taping versus kinesiotopeping in subjects with plantar fasciitis.

The present study provides evidence to support the use of mulligan's calcaneal taping and kinesiotopeping in reducing VAS score and decreased FFI-R score in subjects with plantar fasciitis. In addition, results supported that mulligan's calcaneal taping was more effective than kinesiotopeping in reducing VAS score and FFI-R score in subject with plantar fasciitis. Thus, the alternative hypothesis is proved.

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