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Original Article

Physiotherapy Section

Comparison of Kinesio Taping and Nerve Flossing Technique on Balance, Gait and Ankle Flexibility in Diabetic Neuropathy

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ABSTRACT

Introduction: Diabetic Neuropathy (DN) is the most frequent neuropathy in developed countries, with a wide spectrum of clinical symptoms. Kinesiology Tape (KT) is a thin, stretchy, elastic cotton strip with an acrylic adhesive almost identical to human skin in both thickness and elasticity. Nerve Flossing Technique (NFT) is an alternation of combined movements of atleast two joints.

Aim: To assess and compare the effects of KT and NFT on diabetic neuropathy patients' balance, gait and ankle flexibility.

Materials and Methods: This experimental study was conducted in Outpatient Department of Physiotherapy at SGT University, Gurugram, Haryana, India, from March to May 2021. Total 20 diabetic neuropathy patients were conveniently included from the hospital environment and were divided into two treatment groups. Group A (KT) included 10 patients, kinesio taping along with conventional physiotherapy and group B (NFT) included 10 patients, nerve flossing technique along with conventional physiotherapy. In both the groups, treatment was provided for three days a week for two weeks to improve their balance, gait and ankle flexibility. Performance Oriented Mobility Assessment (POMA) scores were utilised to assess balance and gait, and a universal goniometer was used to assess ankle Range Of Motion (ROM). Data was analysed by using Independent and Paired t-test.

Results: The mean age in group A was 55.3±5.056 years and in group B was 55±4.714 years and there was no significant difference (t=0.137, p-value=0.892). There was a significant difference in POMA score in both the groups (t=-5.344, p-value <0.001) after two weeks of treatment. Ankle joint ROM was improved in group B than group A.

Conclusion: The study concludes that KT improves balance and gait more than NFT, whereas NFT improves ankle range of motion more than KT in diabetic neuropathic patients.

Keywords: Hyperglycaemia, Joint movement, Nerve injury

INTRODUCTION

Diabetic Mellitus (DM) is a long-lasting metabolic syndrome. Chronic hyperglycaemia, hyperlipidaemia, and a negative nitrogen balance characterise this condition and sometimes glycosuria and ketonemia also occurs due to impaired insulin action and secretion, or it can also result if the functioning of lipid and protein metabolism are impaired [1]. High blood sugar can cause nerve injuries throughout the body [2]. It has become one of the most common non communicable diseases and is the leading cause of death in most developed countries, attributing to 5 million deaths globally in 2019 [3,4]. In India diabetes has gained a fast status with more than 62 million diabetic individuals currently diagnosed [5].

Diabetic Neuropathy (DN) is the most frequent neuropathy and it is linked to a variety of clinical symptoms [6]. Diabetic neuropathy is the most frequent and common symptomatic complication of diabetes and potentially it's one of the most devastating complications [7]. Diabetic peripheral neuropathy has a complicated aetiology that is influenced by both metabolic and vascular variables [8]. Axonal and microvascular damage can be caused by a variety of metabolic events, including hyperglycaemia. Diabetic neuropathies are the most common forms of peripheral neuropathy in the western world; however, the pathological basis for these disorders is unclear [9].

There are a variety of treatment options available conservatively in which physiotherapy treatment improves the balance and risk of falls mainly in diabetic neuropathy [10]. Daily exercise, or atleast not allowing more than two days to elapse between exercise sessions, is recommended to decrease insulin resistance, regardless of diabetes type [11]. The physiotherapy treatments that help the patients are exercises like relaxed deep breathing, range of motion exercises, functional balance training, sit to stand, functional reach sideway, gait training including tandem walking, spot marching [12].

In a research done by Akbaş E et al., suggested that KT normalises muscle function [13]. The stimuli are easier to administer to the brain's motor areas by using Kinesiology Tape (KT) on the skin (somatic sensation induced brain wave) [14]. Nerve Flossing Technique (NFT) as proposed by Shacklock M, is an active procedure that is physiologically and mechanically gives beneficial conservative options of the treatment [15]. If you have severe nerve damage or undiagnosed acute pain, nerve flossing could make your symptoms worse. The theory behind this technique is based on the idea that the entire nervous system is a continuous structure and it moves and slides in the body as the body move and that movement is related to physiological processes very critically [16].

Both the techniques KT and NFT are used in a variety of forms to treat variety of conditions differently. However, there is no evidence for comparing the effectiveness of KT and NFT in improving balance, gait and flexibility of ankle joints in diabetic neuropathic patients. Hence, there is a need to investigate the effect of both the technique in this study. The present study was conducted to evaluate and compare the KT and NFT on balance, gait and ankle flexibility diabetic neuropathy patients, which will help to give a contribution to the treatment of diabetic patients.

MATERIALS AND METHODS

This experimental study was conducted in Outpatient Department of Physiotherapy at SGT University, Gurugram, Haryana, India, from March to May 2021. The study was cleared by the Institutional Ethical Committee (IEC) of SGT University (IEC No. SGT/FOP/2020/36). Written informed consent was taken from all the patient before commencement of the study.

Inclusion criteria: Patient with type 2 diabetes mellitus (diagnosed by the physician), aged between 50-65 years and whose score was >3 on Diabetic Neuropathy Examination (DNE) scale [17], was capable of comprehending and following the verbal instructions, was able to walk without the need of a cane or other aid was able to stand on both feet were included in the study.

Exclusion criteria: Patients with foot ulcers, vision impairment, total or partial amputation of lower extremities, another variant of neuropathy, scars under their feet, injuries to the nervous system or the joints such as stroke, poliomyelitis, rheumatoid arthritis or severe osteoarthritis were excluded from the study.

Sample size: Total 20 subjects, who fulfilled the protocol within the study period, were enrolled in the study. All the subjects were prediagnosed by the specialist. Subjects were equally divided into two groups:

Group A (Kinesio taping along with conventional physiotherapy): Subjects were given conventional physiotherapy which includes [18]:

- Active range of motion exercise: Dorsiflexion, planter flexion, eversion and enversion for five minutes.
- Functional balance training: Sit to stand, standing with shifting weight anteriorly, posteriorly and sideway, functional reach sideway, anterior for touching targets set by the therapist, standing on heels and toes for 15 minutes.
- Gait training: Spot marching, walking over the heels, toes, lateral border of feet with the preferred speed and tandem walking in a straight line for 10 minutes.

Then kinesiology taping was applied over the lateral and medial malleoli and posterior part of leg up to 15 cm for two days on alternative days [Table/Fig-1,2]. The treatment was given three days alternatively in a week for two weeks.

[Table/Fig-1]: Application of KT.

Group B (nerve flossing technique along with conventional physiotherapy): Subjects were given conventional physiotherapy which includes [18]:

- Active range of motion exercise for five minutes.
- Functional balance training for 15 minutes, and
- Gait training for 10 minutes.

Then nerve flossing for the tibial nerve was administered maintaining the glide for five seconds, then repeating 15 times for three sets

[Table/Fig-2]: End position of KT.

[Table/Fig-3,4] [16]. The treatment was given three days alternatively in a week for two weeks.

[Table/Fig-3]: Starting position of NFT.

[Table/Fig-4]: End position of NFT.

Study Procedure

All the patients were assessed on first day of first week of the treatment and last day of second week of treatment procedure for range of motion, balance and gait. Universal goniometer was used to record the range of motion of ankle joint (ankle flexibility) and POMA scale was used to record the balance and gait variables.

Universal goniometer: Patient was made to sit with foot in a neutral position. Fulcrum of goniometer was placed on lateral malleolus of the ankle joint, proximal arm is placed with the lateral midline of the fibula, using the head of the fibula for reference and distal arm parallel to the lateral aspect of the fifth metatarsal and then patient was asked to do dorsiflexion and plantar flexion respectively and the reading were recorded [19].

Performance-Oriented Mobility Assessment (POMA) scale: This scale is a quick and accurate test of both static and dynamic balance. The 195 items are divided into two balance and gait subtests. Static sitting balance, sit-to-stand, and stand-to-sit are all balance test items, as are standing balance (static, with sternal nudge, eyes closed) and dynamic standing balance (rotating 360°). Initiation of gait, path, missing step (trip or loss of balance), turning and timed walk are all gait test components.

Some objects are graded on a 2-point scale (0 or 1), while others are graded on a 3-point range (0 to 2).

A 3-point ordinal scale, ranging from 0-2:

- 0 indicates the highest level of impairment and
- 2 indicates individuals independence.

Total balance score is 16

Total gait score is 12

Total test score is 28.

Interpretation: • 25-28 is low fall risk

- 19-24 is medium fall risk
- <19 is a high fall risk.

Total POMA had Intraclass Correlation Coefficient (ICC) value of 0.96, showing strong test-retest reliability [20,21].

STATISTICAL ANALYSIS

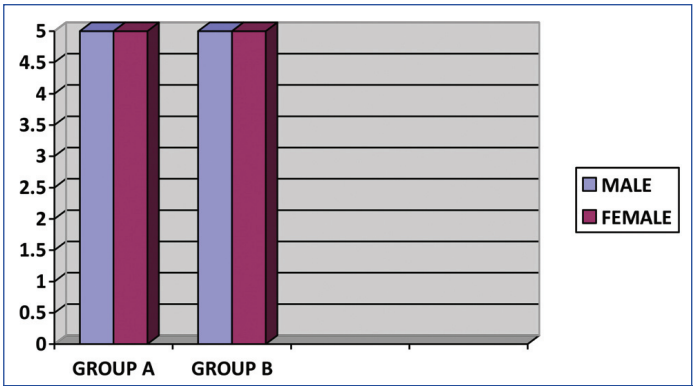
Data analysis was performed by with Statistical Package for Social Sciences (SPSS) version 24.0. Difference between the two groups was calculated by using Independent t-test for all variables of group A and group B. Difference between the Range Of Motion (ROM) within the groups was calculated by using paired t-test. Result was calculated by using p-value ≤0.05 level of significance.

RESULTS

The mean age in group A was 55.3±5.056 years and in group B was 55±4.714 years and there was no significant difference (t=0.137, p-value=0.892) [Table/Fig-5]. Present study include both male and female and there was an equal distribution of gender in both the groups i.e. group A (male=5, female=5) and group B (male=5, female=5) [Table/Fig-6].

Age (years)	Mean	Standard Deviation	t-value	p-value
Group A	55.3	5.056	0.137	0.892
Group B	55	4.714		

[Table/Fig-5]: Comparison of mean and standard deviation of age among group A and B.
Independent t-test, level of significant p-value <0.05



[Table/Fig-6]: Frequency distribution of gender in group A and group B.

The mean for ROM in group A at base line and end of second week for right dorsiflexion, right plantar flexion, left dorsiflexion, left plantar flexion was 9.00±1.89, 26.50±5.87, 9.40±1.65, 29.10±4.12 and 17.90±1.45, 42.30±4.47, 18.20±1.55, 44.30±2.16, respectively. And for group B at base line and end of second week was 9.00±1.41, 25.30±4.62, 8.80±1.32, 27.20±3.79 and 16.30±1.64, 36.30±5.10, 15.30±2.71, 41.30±3.80 respectively. Mean for POMA score in group A at base line and end of second week was 20.40±1.84, 23.70±1.06 and for group B was 21.40±1.90, 26.20±1.03 respectively. There was no signicant difference was found for ROM and POMA scores at baseline, but after intervention significant difference was found between group A and B for all the parameters [Table/Fig-7].

Parameters			Group A (Mean±SD)	Group B (Mean±SD)	t-value	p-value
Range of motion	Preintervention (Baseline)	Rt. Dorsiflexion	9.00±1.89	9.00 ±1.41	0.000^{NS}	1.00
		Rt. Plantarflexion	26.50±5.87	25.30±4.62	0.508^{NS}	0.618
		Lt. Dorsiflexion	9.40±1.65	8.80±1.32	0.900^{NS}	0.380
		Lt. Plantarflexion	29.10±4.12	27.20±3.79	1.072^{NS}	0.298
	Postintervention (End of 2nd week)	Rt. Dorsiflexion	17.90±1.45	16.30±1.64	2.315*	0.033
		Rt. Plantarflexion	42.30±4.47	36.30±5.10	2.797*	0.012
		Lt. Dorsiflexion	18.20±1.55	15.30±2.71	2.938*	0.009
		Lt. Plantarflexion	44.30±2.16	41.30±3.80	2.169*	0.044
POMA	Preintervention (Baseline)		20.40±1.84	21.40±1.90	-1.197^{NS}	0.247
	Postintervention (End of 2nd week)		23.70±1.06	26.20±1.03	-5.344**	0.001

[Table/Fig-7]: Comparison of mean±SD of range of motion and POMA at baseline and end of second week between group A and group B.
Independent t-test, level of significant p-value <0.05; NS=not significant; *Implies significant; **Implies highly significant

The [Table/Fig-8] represents analysis and comparison of mean value of range of motion and POMA within group A and group B. The calculated t-value for ROM and POMA score for group A and B at baseline and end of second week was -21.87,-11.79, -6.95, -11.2, -5.9 and -14.11, -6.45, -7.93, -9.58, -8.1 respectively. There was a significant difference for ROM and POMA scores at baseline and end of second week within the groups (p-value <0.001).

DISCUSSION

In kinesio taping subjects showed more reduction in the risk of fall and able to gain muscle strength to maintain their static as well as their dynamic balance because plantar surface of the foot is

Parameters			Group A			Group B		
			Mean difference	t-value	p-value	Mean difference	t-value	p-value
ROM	Preintervention vs postintervention	Right dorsiflexion	-8.90	-21.87	<0.001	-7.30	-14.11	<0.001
		Right plantar flexion	-15.80	-11.79	<0.001	-11.0	-6.45	<0.001
		Left dorsiflexion	-8.80	-10.81	<0.001	-6.50	-7.93	<0.001
		Left plantar flexion	-15.20	-11.21	<0.001	-14.10	-9.58	<0.001
POMA	Preintervention vs postintervention		-3.30	-5.91	<0.001	-4.80	-8.10	<0.001

[Table/Fig-8]: Analysis and comparison of mean value of range of motion (ROM) and POMA at baseline and end of second week within group A and group B.
Independent t-test, level of significant p-value <0.05

described as a "sensory map", which provides information to Central Nervous System (CNS) regarding the position of the body, based on the distribution of the activated receptors. Loss of sensory cues from the plantar surface of the foot increases sways in standing position [22,23]. The kinesiology tape acts as a passive skin stretch stimuli and gives feedback to the brain to maintain balance and postural stability and hence maintain the gait also.

Nerve flossing technique uses dynamic pressure variation to aid in the evacuation of intraneural edema and the reduction of pressure induced by intraneural and extraneural fibrosis [24]. The theory behind this technique is based on the idea that the entire nervous system is a continuous structure and it moves and slides in the body as the body move and that movement is related to physiological processes very critically [16].

The study was carried out to compare the effectiveness of two group KT and NFT exercises in patients with diabetic neuropathy. The subjects in the study were distributed by simple random sampling and similar baseline values suggesting that both groups had a homogeneous group of patients. The diabetes subjects were diagnosed by a physician, authors confirmed the diabetic neuropathy by DNE scale. The participants were then selected based on inclusion and exclusion criteria and then the treatment protocol was given to the patients. Conventional therapy was common in both the groups, group A received the kinesiology taping technique and group B received the nerve flossing technique for two weeks. The documentation was done on the first day of the treatment and then the post data was recorded on the last day of treatment. The result of the study revealed that both the groups showed improvement, group A showed the KT is more effective in increasing balance and gait in patients with DN and group B shows that NFT is more effective in ROM of ankle in DN patients.

The kinesio taping showed an increase in the mean POMA score from 20.4-23.7. This suggests that the patients in this group showed more reduction in the risk of fall and able to gain muscle strength to maintain their static as well as their dynamic balance. Pressure and vibration trigger plantar skin receptors. The plantar surface of the foot is described as a "sensory map", a map that provides the CNS with information regarding the position of the body, based on the distribution of the activated receptors [23]. Loss of sensory cues from the plantar surface of the foot increases sways in standing position [25]. The kinesiology tape acts as a passive skin stretch stimuli and gives feedback to the brain to maintain balance and postural stability and hence maintain the gait also. This study agreed with Vithoulk I et al., they confirmed that kinesiology tape has a significant effect on the eccentric muscle strength in healthy adults when the tape is applied to ankle muscles [26].

This study came in contrast to a study concluded by Halseth T et al., who reported that the application of kinesio™ tape does not appear to enhance muscle power proprioception or functional performance (in terms of reproduction of joint position sense) in healthy individuals as determined by measures of reproduction of joint position sense at the ankle in the motions of plantar flexion and 20º of plantar flexion with inversion [27].

The NFT in group B showed an increase in the ROM of ankle joint, the mean score of right dorsiflexion changed from 9-16, mean score of right plantar flexion changes from 26-36, mean score of left dorsiflexion changes from 9-15, mean score of left plantar flexion changes from 27-41. This suggests that the ROM of the ankle in this group improved and this helps in better stability as well as mobility. The greater increase in the ROM in this group was observed in this group which might be attributed to the mechanism involved in this group. The NFT involves movements with large amplitude attempting to take the nerve throughout the available range of motion which potentially affects the nerve both mechanically and physiologically. The approach uses dynamic pressure variation to aid in the evacuation of intraneural edema and the reduction of pressure induced by intraneural and extraneural fibrosis [24].

The theory behind this technique is based on the idea that the entire nervous system is a continuous structure and it moves and slides in the body as the body move and that movement is related to physiological processes very critically [16]. NFT technique moves the nerve as well as the tissues proximally and distally to its utmost feasible extent by moving every joint and every section of the nerve's journey through the body. The method is analogous to stretching one end of a cord while the other is slack and then reversing directions. NFT actually applies tension toward the tissue, actively elongating it and breaking scar tissue bonds. It also releases the tension in the nerve and helps in improves mobility.

The present study agreed with Pisz A et al., that evidence is showing that the application of the nerve flossing technique can be beneficial to increase the ROM [28].

Limitation(s)

Sample size was small, which should be revised to a large number of subjects and for a longer duration of the period. This was a short-term study of two weeks and no further follow-up of the subject was carried out. Home programme was not taught to patients.

CONCLUSION(S)

The present study revealed that KT improves balance and gait more than NFT, whereas NFT improves ankle range of motion more than KT. Thus, a therapist can use both the technique as effective management in rehabilitation of the balance, gait and ankle flexibility in patients with diabetic neuropathy. In future the study can be done on a wider sample with different subjects and age groups.

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