Impact of Proprioceptive Neuromuscular Facilitation Versus Non–Weight-Bearing Exercise Programs on Quality of Life in Diabetic Neuropathy Patients."

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Chapter 1 - Introduction

Diabetes Mellitus is a metabolic disorder characterized by hyperglycemia that results from defect in insulin secretion, insulin action on target tissue or both. Different types of diabetes have been identified based on differences in pathophysiology but, with the common indication hyperglycemia. Type 1 Diabetes, Type 2 Diabetes, Gestational Diabetes, Diabetes LADA, Diabetes MODY, Neonatal Diabetes mellitus. Type 1 Diabetes is an autoimmune disease characterized by selective destruction of beta cells of pancreas. Type 1 Diabetes is also referred as insulin dependent or juvenile onset diabetes. Type 2 diabetes is characterized by insulin resistance. Type 2 diabetes is the most common form of diabetes affecting5-7% of world's population and shows close relationship with obesity, family history of diabetes, lack of exercise and old age. Gestational diabetes- women with undiagnosed asymptomatic diabetes whose hyperglycemia diagnosed during pregnancy and women developing diabetes during pregnancy are classified under gestational diabetes. Lot of hormonal changes during pregnancy decreases insulin action in the women body leading to hyperglycemia. Diabetes LADA –Latent autoimmune diabetes of the adults characterized by presence of autoantibodies. Neonatal diabetes mellitus seen in infancy due to presence of gene defect. Causes of diabetes includes following- Obesity, Excess glucocorticoids, excess growth hormone, lack of exercise, Polycystic ovary disease, Mutation of insulin receptor, Lipodystrophy. Signs of diabetes mellitus- Diabetic retinopathy, diabetic neuropathy, diabetic nephropathy associated with polyuria, polyphagia, polydipsia(American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. Diabetes care. 2013) Diabetic retinopathy leads to blurred vision. Neuropathy is characterized by diffuse damage to the nerves which leads to sensory and motor deficits. Distal Sensorimotor Polyneuropathy is the most common complication of diabetes. As a consequence, there is significant deficit in tactile sensitivity, vibration sense, lower limb Proprioception and kinesthesia leads to lower limb weakness and postural sway. Management of Diabetes includes – insulin therapy, weight management, diet modifications, regular physical exercises, quitting smoking(Carley E Johnson et al,2022)

1.1 Aims & Objectives

1.　　To evaluate the impact of P. N. F in improving quality of life of diabetic neuropathy patients.

2.　　To assess the effect of non-weight bearing exercises in improving quality of life of diabetic neuropathy patients.

3.　　To compare the effectiveness of P. N. F and Non weight bearing exercises to improve quality of life of diabetic neuropathy patients.

1.2 HYPOTHESIS

Alternative hypothesis

H_1. = P. N. F and non-weight bearing exercises have unequal impact on diabetic neuropathy patients.

Either P.N.F or Non-weight bearing exercise effectiveness is greater than other to improve sensorimotor functions of diabetic neuropathy patients.

Null Hypothesis

H_0. = Their will be effect of P.N.F and non-weight bearing exercises is equal to improve quality of life of diabetic neuropathy patients.

H1=Their will be No effect of weight bearing exercises and P.N.F equally helps in improving quality of life of diabetic neuropathy patients.

1.3 Need for study

This study has helped to compare the effectiveness of P. N. F and non-weight bearing exercises to improve the quality of life of diabetic neuropathy patients. We know as the disease progresses it leads to several complications including sensorimotor deficits weakness of musculoskeletal system, postural sway, increases risk of fall. P.N.F and non – weight bearing exercises (R. O. M and isometric exercise) both are helpful in preventing further deterioration of diabetes . This study has compared efficiency of one over another.

1.4 Significance of Study

This study has helped to compare the effectiveness of P.N.F and non weight bearing exercises to improve the quality of life of diabetic neuropathy patients and improve health status

Chapter 2 - Review of   Literature

1.　　A. Nikolova, Steliyana Valeva ,Na Bekir (2022) conducted a study to find out role of proprioceptive facilitation and it's application as an indispensable part of practical physiotherapy . P. N. F aims to improve active capacity of affected muscles and muscle groups making it a vital part of rehabilitation practice. Core principle of P. N. F involves stimulating proprioceptive nerve endings which enhances muscle reactions and voluntary impulses. The approach is based on motor learning principles which advocate for a progression from hands on to hands off treatments strategies. The ultimate goal of P. N. F is to produce functional oriented activities and independence in patients.

2.　　Ferreira et al. (2024) conducted a randomized controlled trial : effectiveness of a web -based foot ankle exercises for treating modifiable risk factors for ulcers in people with diabetic neuropathy. A total 62 participants with DPN were randomly assigned to two groups . Control group received usual care and intervention group receiving usual care plus the web based exercise program for 12 weeks. Outcome were measured at 12 weeks and 24 weeks. The study specifically looked at DPN symptoms, functional reach, foot function, foot pain and gait mechanics. The Intervention group showed improvement in functional reach at

12 weeks , better foot function, reduced foot pain, reduced foot pain and greater planter flexion during push off. This program was found to be feasible and safe while it didn't significantly affect DPN related outcomes.

3. Harini et al., (2024) conducted a comparative study of functional strength training and proprioceptive neuromuscular facilitation on balance and gait in diabetic peripheral neuropathy. 30 participants were selected aged between 50-70 years both sexes. These participants were selected from O. P. D of Jkk Munirajah research medical foundation , college of Physiotherapy, Komarapalayam.Participants were divided into two groups. Group A received functional strength training, Group B underwent P. N. F. Effectiveness of interventions was assessed using the Berg Balance Scale and the dynamic gait index scale before and after training sessions. After completing 15 sessions of functional strength training . The study concluded that functional strength training is effective in improving balance and gait in patients with diabetic peripheral neuropathy.

4. Irshad Ahmed ,Shalini Verma, Majumi M Nuhu. (2020) conducted a study to examine how Sensorimotor and Gait training on Proprioception, nerve function and muscle activation in diabetic peripheral neuropathy patients . 38 participants were selected and randomly assigned in two groups . Intervention group received Sensorimotor and gait training for 8 weeks (3days /week). Control group received diabetes and foot care education only . Outcome measures involved proprioception ,nerve conduction studies of peroneal and tibial nerve . Activation of lower limb muscles, multifidus while standing with eyes open and eyes closed and trademil walking . Concluded that Sensorimotor and Gait training is an effective tool for improvement of proprioception and nerve functionit benefits muscle activation around ankle and multifidus during postural control and walking in DPN patients .

5. Kluding et al., (2012) conducted a study to evaluate the effect of exercise on neuropathic symptoms , nerve function and cutaneous innervation in people with Diabetic Peripheral Neuropathy. The pilot study utilized a pre test and post test design . Total 17 participants of average 58.4 age with diabetes duration of 12.4 years. The exercise program lasted for 10weeks including both aerobic and resistancetraining. Pain measured by VAS scale, neuropathic symptoms were evaluated through the Michigan Neuropathy Screening Instrument Questionnaire, intra epidermal nerve fibre density and branching were analyzed using skin biopsies from both distal and proximal lower extremities. Pain level decresed by an average of 18.1 mm on a 100mm scale, neuropathic symptoms were reduced by 1.24 points on the MNSI, there was an increase in IENF branching by 0.11 branch nodes per fibre.

6. Nadi et al. (2019) conducted a study to compare the effect of two therapeutic exercises on the inflammatory and physiological conditions and complications of diabetic neuropathy in female patients. A total of 45 women, aged around 55 years. They were divided into 3 groups :a control group that didn't exercise, a resistance training group and specific exercises for peripheral neuropathy (EPN) group. Each exercise group was trained for 12 weeks , 3 times a week. Researchers measured health indicators including certain inflammatory markers (TNF -alpha, IL-10, CRP) , blood glucose level (FBG, HBA1C) and pain and balance issues. EPN included a total of 12 specific movements (Hamstring stretching, knee swirling, gradual stretching of sciatic nerve, stretching of leg muscles, ankle ROM, bending of the toes, special movements of the big toe , alternate heel-toe movement, inversion- eversion of ankle, squatting with the help of wall, standing on one leg, jumping and moving 4steps back) Both exercise group had significant improvement. Specifically they experienced lower blood glucose levels and inflammation markers compared to the control group. EPN exercises are more effective than traditional resistance training.

7. Nakada et al., (2018) Conducted a study aim to assess effect of P. N. F in patients with a genetic condition known as charcot – Marie –Tooth disease type 1 A. Thirteen patients were selected they received treatment for twice a week for 5 weeks, involving a series of exercises designed to stimulate their muscles. Researchers focused on Tibialis anterior muscle and recorded it's activity using surface electromyography. Study concluded that ipsilateral P. N. F pattern effectively enhance muscle activity in patients with peripheral neuropathy.

8. Singh et al., (2016) Conducted a study on diabetic neuropathy patients affecting the lower limb . The research involved 30 patients aged between 50-70 years all diagnosed with Diabetic sensorimotor

polyneuropathy. Patients were selected from Guru Gobind Singh medical college and hospital. The evaluation of patients was conducted at the start and end of three month interventionperiod. During this period patients participated in P. N. F exercises for one hour a day , three days a week. The findings that P. N. F techniques , specifically the D1 and D2 patterns are effective in enhancing both motor and sensory function in the diabetic patients.

<h2>Chapter 3 -</h2>

Methodology

3.1 Nature of the study : Comparative study

3.2 Sampling Method: Convenient sampling
Sample Size: 30 (15 in each group)

3.3 Source of data collection : Hospitals

3.4 Equipments required:-
- Patient Couch
- Foot Stool
- Pillow
- Stopwatch
- Monofilament
- Tuning Fork (128 Hz)
- Reflex Hammer
- Berg Balance Scale
- SF 36 Questionnaire
- Michigan Neuropathy Screening Instrument
- Modified MRC Scale

Fig 1. Patient Couch

Fig 2. Foot Stool

Fig 3. Pillow

Figure 4. Michigan Neuropathy Screening Instrument

Figure 5. Berg Balance Scale

Figure 6. Modified MRC Scale

Figure 7. SF-36 Questionnaire

3.5 Variables

- **Independent Variables:**

1. Age
2. Gender
3. Type of Diabetes

- **Dependent Variables:**
1. Muscle strength
2. Sensorimotor deficit
3. Balance

3.6 Inclusion and Exclusion Criteria

- **Inclusion Criteria**: The patients previously diagnosed with diabetic sensorimotor neuropathy were selected

 1. Age – 30-60 years

2. Sex – Both male and female patients

3. Type of D. M – Both type D. M

4. Patients with complications of sensorimotor and have more than 2.5 score (M.N.S.I) in diabetic neuropathic score.

- **Exclusion Criteria** :
1. Foot ulcer.
2. Peripheral vascular disease
3. Recent cardiovascular surgery
4. Mentally retarded
5. B.P greater than 140/90 mm/Hg
6. Spinal surgery
7. Tumour
8. Lower limb surgery

Outcome measures:-

- Muscle strength (Modified MRC Scale used)
- Quality of life (SF 36 Questionnaire used)
- Improving symptoms of diabetic neuropathy (Pain, Paresthesia, Proprioception) (Michigan Neuropathy Screening Instrument used)
- Balance (Berg Balance Scale used)

3.7 Procedure: 30 Patients with diabetic neuropathy (age 30-60) years with diabetic neuropathy score more than 2.5 in Michigan Neuropathy Screening Instrument (patient assessed). Patients were selected and randomly assigned into 2 groups - control group (only weight free exercises – isometric exercises and ROM exercises of both lower limb, were given 3 times /week for 8 weeks) and intervention or experimental group (P.N.F technique was applied on both lower limbs 3 times /week for 8 weeks.) Muscle strength (Quadriceps, Hamstring and calf muscles) Balance, Improvement in diabetic neuropathy symptoms (pain, paresthesia, proprioception) and Quality of life had been assessed in beginning, mid(4 week) and after treatment (8 weeks).

Group A : Proprioceptive Neuromuscular Facilitation technique applied (3 times/week upto 8 weeks)

The pre-set protocols followed. The P.N.F technique was applied on bilateral lower extremity in D1 (Flex./Ext.) and D2 (Flex./Ext.) pattern.

D1 moving into Flexion		
	Stationary Position	Terminal Position
Toes	Flexed	Extended
Ankle and Foot	Planter Flexed, Everted	Dorsiflexed, Inverted
Knee	Extended	Flexed

Hip	Extended, Abducted, Internally Rotated	Flexed, Adducted, Externally Rotated

Img.1 D1 moving into Flexion

D1 moving into Extension		
	Stationary Position	Terminal Position
Toes	Extended	Flexed
Ankle and Foot	Dorsiflexed, Inverted	Planter Flexed, Everted
Knee	Flexed	Extended
Hip	Flexed, Adducted, Externally Rotated	Extended, Abducted, Internally Rotated

Img.2 D1 moving into Extension

D2 moving into Flexion		
	Stationary Position	Terminal Position
Toes	Flexed	Extended
Ankle and Foot	Planter Flexed, Inverted	Dorsiflexed, Everted
Knee	Extended	Flexed
Hip	Extended, Adducted, Externally Rotated	Flexed, Abducted, Internally Rotated

Img.3 D2 moving into Flexion

D2 moving into Extension		
	Stationary Position	Terminal Position
Toes	Extended	Flexed
Ankle and Foot	Dorsiflexed, Everted	Planter Flexed, Inverted
Knee	Flexed	Extended
Hip	Flexed, Abducted, Internally Rotated	Extended, Adducted, Externally Rotated

Img.4 D2 moving into Extension

The patients were examined and evaluated using Michigan Neuropathy Screening Instrument, B.B.S, SF-36 Ques. and Modified M.R.C Scale initially, mid (4 weeks) and at end of treatment (8 weeks).

Group B : Non weight bearing exercises (Isometric and R.O.M exercises of bilateral lower limb) 3 times/week upto 8 weeks.

Isometric exercises of Quadriceps, Hamstring and Calf muscles in supine position.
12 reps. of each with 10 second hold.

Img.5 Static Hamstring

Img.6 Static Quad

1. Alternate toe raise and heel raise (20 reps)
2. Toe curls (3-5 min.)
3. Ball massage (2 min.)
4. Toe standing (10 reps)

Img. 7 Toe curl

Img. 8 Alternate Heelraise and toe raise

Patients were examined and evaluated at the beginning, mid and end of treatment using B.B.S, Michigan N.S.I (M.N.S.I), Modified M.R.C scale and SF-36 Questionnaire.

3.8 Statistical Analysis :

Analysis of data collection of the B.B.S, Michigan N.S.I (M.N.S.I), Modified M.R.C scale and SF-36 Questionnaire of 30 subjects was analyzed by the SPSS software version 28.0 and Microsoft Excel 10. The result was considered significant if the p value is <=0.05. Tests used for analysis was paired t-test, the data were presented through column, graphs and tables.

Chapter 4 - Data Analysis

Analysis and interpretation of data

Analysis and interpretation was done in accordance with the objectives laid down for the study. The purpose of analysis is to reduce the data into an interpretable and meaningful form so that the result can be compared and significance can be identified.This chapter deals with the analysis and interpretation of data collected. The data was analyzed by calculating the score in terms of frequency, percentage , mean, standard deviation, chi- square, etc.

Plan of Analysis: Analysis and interpretation of data was done according to the objectives using descriptive and inferential statistics. The level of significance chosen was at p≤0.05. Analysis of data collection of the B.B.S, Michigan N.S.I (M.N.S.I), Modified M.R.C scale and SF-36 Questionnaire of 30 subjects was analyzed by the SPSS software version 28.0 and Microsoft Excel 10.

Section A - Within Group Analysis (Repeated ANOVA

Table No:1

.	Group A		
Repeated ANOVA	Berg Balance Scale		
	1st Week	4th Week	8th Week
Mean	48.47	49.53	52.73
S.D.	3.563	3.182	2.120
Median	50	50	54
Number	15	15	15
Maximum	54	55	55
Minimum	42	44	48
DF1	2		
DF2	28		
F Test	56.34		
Table Value	3.340		
P value	<0.001		
Result	Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>		1.07Sig	4th Week
	4th Week		
	8th Week	4.27Sig	3.2Sig

The table shows a steady increase in mean Berg Balance Scale scores for Group A from 48.47 (SD 3.56) at 1st week, to 49.53 (SD 3.18) at 4th week, and 52.73 (SD 2.12) at 8th week after PNF exercises. Repeated ANOVA revealed this improvement is statistically significant (F = 56.34, p < 0.001). Tukey's test confirms significant changes between all time points.

Table No:2

.	Group B		
Repeated ANOVA	Berg Balance Scale		
	1st Week	4th Week	8th Week
Mean	49.53	49.93	50.07
S.D.	3.441	3.453	3.555
Median	50	51	52
Number	15	15	15
Maximum	54	55	55
Minimum	43	43	44
DF1	2		
DF2	28		
F Test	5.69		
Table Value	3.340		
P value	0.008		
Result	Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>		0.4Sig	4th Week
	4th Week		
	8th Week	0.54Sig	0.13NSig

The table shows that mean Berg Balance Scale scores in Group B increased slightly from 49.53 (SD 3.44) at 1st week to 49.93 (SD 3.45) at 4th week and 50.07 (SD 3.56) at 8th week after non-weight bearing exercises. Repeated ANOVA showed a significant difference over time (F = 5.69, p = 0.008). Tukey's test found significant improvement from week 1 to week 4 (0.4) and week 1 to week 8 (0.54), but no significant difference between weeks 4 and 8.

Table No:3

Repeated ANOVA	Group A		
	Quadriceps Right Leg		
	1st Week	4th Week	8th Week
Mean	4.87	5.00	5.20
S.D.	1.246	1.195	1.082
Median	5	5	5
Number	15	15	15
Maximum	7	7	7
Minimum	3	3	3
DF1	2		
DF2	28		
F Test	4.75		
Table Value	3.340		
P value	0.017		
Result	Significant		

Tukey's method for Pairwise comparison

Mean Difference & Result>	1st Week	4th Week
4th Week	0.13NSig	
8th Week	0.34NSig	0.2NSig

The table shows mean quadriceps strength (right leg) in Group A improved from 4.87 (SD 1.25) at 1st week to 5.00 (SD 1.20) at 4th week and 5.20 (SD 1.08) at 8th week after PNF exercises. Repeated ANOVA indicates a significant overall difference (F = 4.75, p = 0.017), but Tukey's test found no significant pairwise differences between time points.

Table No:4

Repeated ANOVA	Group B		
	Quadriceps Right Leg		
	1st Week	4th Week	8th Week
Mean	5.33	5.40	5.80
S.D.	1.175	1.056	0.941
Median	5	6	6
Number	15	15	15

Maximum	8	7	8
Minimum	4	4	5
DF1	2		
DF2	28		
F Test	6.53		
Table Value	3.340		
P value	0.005		
Result	Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>	4th Week	0.07NSig	4th Week
	8th Week	0.47Sig	0.4NSig

The table shows mean quadriceps strength (right leg) in Group B increased from 5.33 (SD 1.18) at 1st week to 5.40 (SD 1.06) at 4th week and 5.80 (SD 0.94) at 8th week after non-weight bearing exercises. Repeated ANOVA showed a significant difference over time (F = 6.53, p = 0.005). Tukey's test found a significant improvement from week 1 to week 8 (0.47), but not between other time points.

Table No:5

.	Group A		
Repeated ANOVA	Quadriceps Left Leg		
	1st Week	4th Week	8th Week
Mean	4.87	5.00	5.20
S.D.	1.246	1.195	1.082
Median	5	5	5
Number	15	15	15
Maximum	7	7	7
Minimum	3	3	3
DF1	2		
DF2	28		
F Test	4.75		
Table Value	3.340		
P value	0.017		
Result	Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>	4th Week	0.13NSig	4th Week
	8th Week	0.34NSig	0.2NSig

The table shows mean quadriceps strength (left leg) in Group A improved from 4.87 (SD 1.25) at 1st week to 5.00 (SD 1.20) at 4th week and 5.20 (SD 1.08) at 8th week after PNF exercises. Repeated ANOVA revealed a significant overall change (F = 4.75, p = 0.017), but Tukey's test showed no significant pairwise differences between time points.

Table No:6

.	Group B		
Repeated ANOVA	Quadriceps Left Leg		
	1st Week	4th Week	8th Week
Mean	5.40	5.40	5.93
S.D.	1.183	0.986	1.033
Median	5	6	6
Number	15	15	15
Maximum	8	7	8
Minimum	4	4	5
DF1	2		
DF2	28		
F Test	5.09		
Table Value	3.340		
P value	0.013		
Result	Significant		

Tukey's method for Pairwise comparison

Mean Difference & Result>

	1st Week	4th Week
4th Week	0NSig	
8th Week	0.54Sig	0.53NSig

The table shows mean quadriceps strength (left leg) in Group B increased from 5.40 (SD 1.18) at 1st week to 5.40 (SD 0.99) at 4th week and 5.93 (SD 1.03) at 8th week after non-weight bearing exercises. Repeated ANOVA found a significant overall change (F = 5.09, p = 0.013). Tukey's test showed significant improvement from week 1 to week 8 (0.54), but not between other intervals.

Table No:7

.	Group A		
Repeated ANOVA	Hamstring Right Leg		
	1st Week	4th Week	8th Week
Mean	5.07	5.20	5.33
S.D.	1.280	1.146	1.047
Median	5	5	5
Number	15	15	15
Maximum	7	7	7
Minimum	3	3	4
DF1	2		
DF2	28		
F Test	3.50		
Table Value	3.340		
P value	0.044		
Result	Significant		

Tukey's method for Pairwise comparison

Mean Difference & Result>

	1st Week	4th Week
4th Week	0.13NSig	
8th Week	0.27NSig	0.13NSig

The table shows mean hamstring strength (right leg) in Group A improved from 5.07 (SD 1.28) at 1st week to 5.20 (SD 1.15) at 4th week and 5.33 (SD 1.05) at 8th week after PNF exercises. Repeated ANOVA showed a significant overall change (F = 3.50, p = 0.044), but Tukey's test found no significant pairwise differences between time points.

Table No:8

.	Group B		
Repeated ANOVA	Hamstring Right Leg		
	1st Week	4th Week	8th Week
Mean	5.33	5.53	5.80
S.D.	1.291	1.187	1.014
Median	5	5	5
Number	15	15	15
Maximum	8	8	8
Minimum	4	4	5
DF1	2		
DF2	28		
F Test			
Table Value	3.340		
P value	1.000		
Result	Not Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>	4th Week	0.2NSig	4th Week
	8th Week	0.47Sig	0.27NSig

The table shows mean hamstring strength (right leg) in Group B increased slightly from 5.33 (SD 1.29) at 1st week to 5.53 (SD 1.19) at 4th week and 5.80 (SD 1.01) at 8th week after non-weight bearing exercises. Repeated ANOVA found no significant overall change (p = 1.000). Tukey's test showed no significant pairwise differences between time points.

Table No:9

.	Group A		
Repeated ANOVA	Hamstring Left Leg		
	1st Week	4th Week	8th Week
Mean	5.13	5.36	5.33
S.D.	1.407	1.008	1.047
Median	5	5	5
Number	15	14	15
Maximum	8	7	7
Minimum	3	4	4
DF1	2		
DF2	28		
F Test	0.74		

Table Value	3.340	
P value	0.486	
Result	Not Significant	
Tukey's method for Pairwise comparison	1st Week	

Mean Difference & Result>		1st Week	
	4th Week	0.22NSig	4th Week
	8th Week	0.2NSig	0.02NSig

The table shows mean hamstring strength (left leg) in Group A changed from 5.13 (SD 1.41) at 1st week to 5.36 (SD 1.01) at 4th week and 5.33 (SD 1.05) at 8th week after PNF exercises. Repeated ANOVA found no significant overall change (F = 0.74, p = 0.486), and Tukey's test showed no significant pairwise differences between time points.

Table No:10

.	Group B		
Repeated ANOVA	Hamstring Left Leg		
	1st Week	4th Week	8th Week
Mean	5.27	5.60	5.80
S.D.	1.163	1.121	1.014
Median	5	5	5
Number	15	15	15
Maximum	7	8	8
Minimum	4	4	5
DF1	2		
DF2	28		
F Test	6.79		
Table Value	3.340		
P value	0.004		
Result	Significant		
Tukey's method for Pairwise comparison	1st Week		

Mean Difference & Result>		1st Week	
	4th Week	0.33NSig	4th Week
	8th Week	0.54Sig	0.2NSig

The table shows mean hamstring strength (left leg) in Group B increased from 5.27 (SD 1.16) at 1st week to 5.60 (SD 1.12) at 4th week and 5.80 (SD 1.01) at 8th week after non-weight bearing exercises. Repeated ANOVA found a significant overall change (F = 6.79, p = 0.004). Tukey's test showed significant improvement from week 1 to week 8 (0.54), but not between other intervals.

Table No:11

.	Group A		
Repeated ANOVA	Calf Muscle Right Leg		
	1st Week	4th Week	8th Week
Mean	4.93	5.13	5.27
S.D.	1.223	1.187	1.163
Median	5	5	5
Number	15	15	15

Maximum	7	7	7
Minimum	3	3	3
DF1	2		
DF2	28		
F Test	4.75		
Table Value	3.340		
P value	0.017		
Result	Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>	4th Week	0.2NSig	4th Week
	8th Week	0.34NSig	0.13NSig

The table shows mean calf muscle strength (right leg) in Group A changed from 4.93 (SD 1.22) at 1st week to 5.13 (SD 1.19) at 4th week and 5.27 (SD 1.16) at 8th week after PNF exercises. Repeated ANOVA found a significant overall difference (F = 4.75, p = 0.017), but Tukey's test found no significant pairwise differences between time points.

Table No:12

.	Group B		
Repeated ANOVA	Calf Muscle Right Leg		
	1st Week	4th Week	8th Week
Mean	5.20	5.40	5.53
S.D.	1.146	1.056	0.834
Median	5	5	5
Number	15	15	15
Maximum	8	8	8
Minimum	4	4	5
DF1	2		
DF2	28		
F Test	3.09		
Table Value	3.340		
P value	0.061		
Result	Not Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>	4th Week	0.2NSig	4th Week
	8th Week	0.34NSig	0.13NSig

The table shows mean calf muscle strength (right leg) in Group B changed from 5.20 (SD 1.15) at 1st week to 5.40 (SD 1.06) at 4th week and 5.53 (SD 0.83) at 8th week after non-weight bearing exercises. Repeated ANOVA found no significant overall change (F = 3.09, p = 0.061), and Tukey's test showed no significant pairwise differences.

Table No:13

.	Group A		
Repeated ANOVA	Calf Muscle Left Leg		
	1st Week	4th Week	8th Week
Mean	4.93	5.13	5.20
S.D.	1.223	1.187	1.146
Median	5	5	5
Number	15	15	15
Maximum	7	7	7
Minimum	3	3	3
DF1	2		
DF2	28		
F Test	2.36		
Table Value	3.340		
P value	0.113		
Result	Not Significant		

Tukey's method for Pairwise comparison

Mean Difference & Result>

	1st Week	4th Week
4th Week	0.2NSig	
8th Week	0.27NSig	0.07NSig

The table shows mean calf muscle strength (left leg) in Group A increased from 4.93 (SD 1.22) at 1st week to 5.13 (SD 1.19) at 4th week and 5.20 (SD 1.15) at 8th week after PNF exercises. Repeated ANOVA found no significant overall change (F = 2.36, p = 0.113), and Tukey's test showed no significant pairwise differences between time points.

Table No:14

.	Group B		
Repeated ANOVA	Calf Muscle Left Leg		
	1st Week	4th Week	8th Week
Mean	5.13	5.33	5.47
S.D.	1.125	1.047	0.834
Median	5	5	5
Number	15	15	15
Maximum	8	8	8
Minimum	4	4	5
DF1	2		
DF2	28		
F Test	3.09		
Table Value	3.340		
P value	0.061		
Result	Not Significant		

Tukey's method for Pairwise comparison

Mean Difference & Result>

	1st Week	4th Week
4th Week	0.2Sig	
8th Week	0.34Sig	0.13Sig

The table shows mean calf muscle strength (left leg) in Group B increased from 5.13 (SD 1.13) at 1st week to 5.33 (SD 1.05) at 4th week and 5.47 (SD 0.83) at 8th week after non-weight bearing exercises. Repeated ANOVA found no significant overall change (F = 3.09, p = 0.061), though Tukey's test indicated some significant pairwise differences.

Table No:15

Repeated ANOVA	Group A		
	SF 36 Questionnaire		
	1st Week	4th Week	8th Week
Mean	64.33	68.67	76.67
S.D.	13.741	14.075	10.118
Median	60	70	75
Number	15	15	15
Maximum	85	95	95
Minimum	40	40	60
DF1	2		
DF2	28		
F Test	40.21		
Table Value	3.340		
P value	0.000		
Result	Significant		
Tukey's method for Pairwise comparison			

Mean Difference & Result>		1st Week	
	4th Week	4.33Sig	4th Week
	8th Week	12.34Sig	8Sig

The table shows mean SF-36 quality of life scores in Group A increased from 64.33 (SD 13.74) at 1st week to 68.67 (SD 14.08) at 4th week and 76.67 (SD 10.12) at 8th week after PNF exercises. Repeated ANOVA showed a significant improvement (F = 40.21, p < 0.001). Tukey's test confirmed significant differences between all time points.

Table No:16

Repeated ANOVA	Group B		
	SF 36 Questionnaire		
	1st Week	4th Week	8th Week
Mean	59.67	61.67	62.67
S.D.	11.872	12.344	13.478
Median	60	60	60
Number	15	15	15
Maximum	75	85	85
Minimum	35	40	40
DF1	2		
DF2	28		
F Test	6.68		
Table Value	3.340		
P value	0.004		
Result	Significant		
Tukey's method for Pairwise comparison			

Mean Difference & Result>		1st Week	
	4th Week	2NSig	4th Week
	8th Week	3Sig	1NSig

The table shows mean SF-36 quality of life scores in Group B increased from 59.67 (SD 11.87) at 1st week to 61.67 (SD 12.34) at 4th week and 62.67 (SD 13.48) at 8th week after non-weight bearing exercises. Repeated ANOVA showed a significant overall change ($F = 6.68$, $p = 0.004$), but Tukey's test showed significant improvement only from week 1 to week 8.

Table No:17

.	Group A		
Repeated ANOVA	MNSI Patient Evaluation		
	1st Week	4th Week	8th Week
Mean	6.33	5.47	4.53
S.D.	0.976	1.125	1.060
Median	6	5	4
Number	15	15	15
Maximum	8	7	7
Minimum	5	4	3
DF1	2		
DF2	28		
F Test	48.47		
Table Value	3.340		
P value	0.000		
Result	Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>	4th Week	0.87Sig	4th Week
	8th Week	1.8Sig	0.93Sig

The table shows mean MNSI patient evaluation scores in Group A decreased from 6.33 (SD 0.98) at 1st week to 5.47 (SD 1.13) at 4th week and 4.53 (SD 1.06) at 8th week after PNF exercises. Repeated ANOVA showed a significant improvement ($F = 48.47$, $p < 0.001$). Tukey's test confirmed significant differences between all time points.

Table No:18

.	Group B		
Repeated ANOVA	MNSI Patient Evaluation		
	1st Week	4th Week	8th Week
Mean	5.67	5.47	5.00
S.D.	1.234	1.125	1.069
Median	6	5	5
Number	15	15	15
Maximum	8	8	7
Minimum	4	4	3
DF1	2		
DF2	28		
F Test	12.86		
Table Value	3.340		
P value	0.000		
Result	Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>	4th Week	0.2NSig	4th Week
	8th Week	0.67Sig	0.47Sig

The table shows mean MNSI patient evaluation scores in Group B decreased from 5.67 (SD 1.23) at 1st week to 5.47 (SD 1.13) at 4th week and 5.00 (SD 1.07) at 8th week after non-weight bearing exercises. Repeated ANOVA showed a significant overall change (F = 12.86, p < 0.001), with Tukey's test indicating significant improvement only from week 1 to week 8.

Table No:19

.	Group A		
Repeated ANOVA	MNSI Physical Assessment		
	1st Week	4th Week	8th Week
Mean	3.23	2.60	2.07
S.D.	0.799	0.806	0.417
Median	3	2.5	2
Number	15	15	15
Maximum	5	5	3
Minimum	2	2	1
DF1	2		
DF2	28		
F Test	30.06		
Table Value	3.340		
P value	0.000		
Result	Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>	4th Week	0.63Sig	4th Week
	8th Week	1.17Sig	0.53Sig

The table shows mean MNSI physical assessment scores in Group A decreased from 3.23 (SD 0.80) at 1st week to 2.60 (SD 0.81) at 4th week and 2.07 (SD 0.42) at 8th week after PNF exercises. Repeated ANOVA showed a significant improvement (F = 30.06, p < 0.001), with Tukey's test confirming significant differences between all time points.

Table No:20

.	Group B		
Repeated ANOVA	MNSI Physical Assessment		
	1st Week	4th Week	8th Week
Mean	3.83	3.47	3.37
S.D.	0.939	1.187	1.125
Median	4	3	3
Number	15	15	15
Maximum	6	6	6
Minimum	2.5	2	2
DF1	2		
DF2	28		
F Test	13.66		
Table Value	3.340		
P value	0.000		
Result	Significant		

Tukey's method for Pairwise comparison		1st Week	
Mean Difference & Result>			
	4th Week	0.37Sig	4th Week
	8th Week	0.47Sig	0.1NSig

The table shows mean MNSI physical assessment scores in Group B decreased from 3.83 (SD 0.94) at 1st week to 3.47 (SD 1.19) at 4th week and 3.37 (SD 1.13) at 8th week after non-weight bearing exercises. Repeated ANOVA showed a significant overall change (F = 13.66, p < 0.001), with Tukey's test indicating significant improvement from week 1 to weeks 4 and 8.

Section - B : Between Group

Table No:21

Unpaired T Test	Berg Balance Scale					
	1st Week		4th Week		8th Week	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	48.47	49.53	49.53	49.93	52.73	50.07
S.D.	3.563	3.441	3.182	3.453	2.120	3.555
Number	15	15	15	15	15	15
Maximum	54	54	55	55	55	55
Minimum	42	43	44	43	48	44
Range	12	11	11	12	7	11
Mean Difference	1.07		0.40		2.67	
Unpaired T Test	0.834		0.330		2.495	
P value	0.4113		0.7439		0.0188	
Table Value at 0.05	2.05		2.05		2.05	
Result	Not-Significant		Not-Significant		Significant	

This table presents a comparison of Berg Balance Scale scores between Group A (proprioceptive neuromuscular facilitation exercises) and Group B (non-weight bearing exercises) at the 1st, 4th, and 8th weeks using the unpaired t-test.

At baseline (1st week), Group A had a mean score of 48.47 (SD 3.56), while Group B had a mean of 49.53 (SD 3.44). The difference in means was 1.07, and the unpaired t-test value was 0.834, with a p-value of 0.4113, indicating no significant difference between groups at the start.

By the 4th week, mean scores were 49.53 (SD 3.18) for Group A and 49.93 (SD 3.45) for Group B. The mean difference was 0.40, t-test value 0.330, and p-value 0.7439, again showing no significant difference between the two groups after four weeks of intervention.

At the 8th week, Group A demonstrated a higher mean score of 52.73 (SD 2.12), compared to Group B's mean of 50.07 (SD 3.56). The mean difference was 2.67, and the t-test value was 2.495. The p-value was 0.0188, which is below the 0.05 threshold, indicating a statistically significant improvement in balance scores for Group A over Group B at the end of the intervention.

These results suggest that while both interventions led to improvements, PNF exercises (Group A) resulted in significantly greater balance improvement compared to non-weight bearing exercises (Group B) by the 8th week.

Table No:22

| Unpaired T Test | Quadriceps Right Leg | | | | | |
| | 1st Week | | 4th Week | | 8th Week | |
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	4.87	5.33	5.00	5.40	5.20	5.80
S.D.	1.246	1.175	1.195	1.056	1.082	0.941
Number	15	15	15	15	15	15
Maximum	7	8	7	7	7	8
Minimum	3	4	3	4	3	5
Range	4	4	4	3	4	3
Mean Difference	0.47		0.40		0.60	
Unpaired T Test	1.055		0.972		1.620	
P value	0.3003		0.3396		0.1164	
Table Value at 0.05	2.05		2.05		2.05	
Result	Not-Significant		Not-Significant		Not-Significant	

This table compares quadriceps strength (right leg) between Group A (PNF exercises) and Group B (non-weight bearing exercises) at the 1st, 4th, and 8th weeks using the unpaired t-test.

- **At 1st week**, Group A had a mean quadriceps strength of 4.87 (SD 1.25) and Group B had 5.33 (SD 1.18). The mean difference was 0.47, with a t-value of 1.055 and p-value of 0.3003. This indicates no significant difference in quadriceps strength between the groups at baseline.

- **At 4th week**, Group A's mean was 5.00 (SD 1.20) and Group B's mean was 5.40 (SD 1.06). The mean difference was 0.40, t-value 0.972, and p-value 0.3396, again showing no significant difference after four weeks.
- **At 8th week**, Group A had a mean of 5.20 (SD 1.08) and Group B had 5.80 (SD 0.94). The mean difference was 0.60, with a t-value of 1.620 and p-value of 0.1164. This also did not reach statistical significance.

Conclusion:

Throughout the intervention period, there were no statistically significant differences in right quadriceps strength between the PNF group and the non-weight bearing exercise group at any measured time point, as all p-values were greater than 0.05.

Table No:23

Unpaired T Test	Quadriceps Left Leg					
	1st Week		4th Week		8th Week	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	4.87	5.40	5.00	5.40	5.20	5.93
S.D.	1.246	1.183	1.195	0.986	1.082	1.033
Number	15	15	15	15	15	15
Maximum	7	8	7	7	7	8
Minimum	3	4	3	4	3	5
Range	4	4	4	3	4	3
Mean Difference	0.53		0.40		0.73	
Unpaired T Test	1.202		1.000		1.898	
P value	0.2394		0.3259		0.0680	
Table Value at 0.05	2.05		2.05		2.05	
Result	Not-Significant		Not-Significant		Not-Significant	

This table compares quadriceps strength (left leg) between Group A (PNF exercises) and Group B (non-weight bearing exercises) at the 1st, 4th, and 8th weeks using the unpaired t-test.

- **At 1st week**, Group A had a mean strength of 4.87 (SD 1.25), while Group B had 5.40 (SD 1.18). The mean difference was 0.53, t-value 1.202, and p-value 0.2394, indicating no significant difference at baseline.
- **At 4th week**, Group A's mean was 5.00 (SD 1.20) and Group B's mean was 5.40 (SD 0.99), with a mean difference of 0.40, t-value 1.000, and p-value 0.3259, also not significant.
- **At 8th week**, Group A showed a mean of 5.20 (SD 1.08) and Group B 5.93 (SD 1.03), with a mean difference of 0.73, t-value 1.898, and p-value 0.0680, which approached but did not reach statistical significance.

Conclusion:

No statistically significant differences were found between Group A and Group B in left quadriceps strength

at any time point (p > 0.05), though the difference at 8th week was close to significance. Both interventions resulted in improvements over time within groups, but inter-group differences were not significant.

Table No:24

Unpaired T Test	Hamstring Right Leg					
	1st Week		4th Week		8th Week	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	5.07	5.33	5.20	5.53	5.33	5.80
S.D.	1.280	1.291	1.146	1.187	1.047	1.014
Number	15	15	15	15	15	15
Maximum	7	8	7	8	7	8
Minimum	3	4	3	4	4	5
Range	4	4	4	4	3	3
Mean Difference	0.27		0.33		0.47	
Unpaired T Test	0.568		0.782		1.240	
P value	0.5745		0.4406		0.2252	
Table Value at 0.05	2.05		2.05		2.05	
Result	Not-Significant		Not-Significant		Not-Significant	

This table compares hamstring strength (right leg) between Group A (PNF exercises) and Group B (non-weight bearing exercises) at the 1st, 4th, and 8th weeks using the unpaired t-test.

- **At 1st week**, Group A had a mean hamstring strength of 5.07 (SD 1.28) while Group B had 5.33 (SD 1.29). The mean difference was 0.27, t-value was 0.568, and p-value was 0.5745, showing no significant difference at baseline.
- **At 4th week**, Group A had a mean of 5.20 (SD 1.15) and Group B had 5.53 (SD 1.19). The mean difference was 0.33, t-value was 0.782, and p-value was 0.4406, indicating no significant difference at four weeks.
- **At 8th week**, Group A had a mean of 5.33 (SD 1.05) and Group B had 5.80 (SD 1.01). The mean difference was 0.47, t-value was 1.240, and p-value was 0.2252, showing no significant difference at eight weeks.

Conclusion:

There were no statistically significant differences in right hamstring strength between Group A and Group B at any time point during the study (all p-values > 0.05). Both groups showed improvements over time, but inter-group differences remained non-significant throughout.

Table No:25

Unpaired T Test	Hamstring Left Leg					
	1st Week		4th Week		8th Week	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	5.13	5.27	5.36	5.60	5.33	5.80
S.D.	1.407	1.163	1.008	1.121	1.047	1.014
Number	15	15	14	15	15	15
Maximum	8	7	7	8	7	8
Minimum	3	4	4	4	4	5
Range	5	3	3	4	3	3
Mean Difference	0.13		0.24		0.47	
Unpaired T Test	0.283		0.612		1.240	
P value	0.7794		0.5458		0.2252	
Table Value at 0.05	2.05		2.06		2.05	
Result	Not-Significant		Not-Significant		Not-Significant	

This table compares hamstring strength (left leg) between Group A (PNF exercises) and Group B (non-weight bearing exercises) at the 1st, 4th, and 8th weeks using the unpaired t-test.

- **At 1st week**, Group A had a mean strength of 5.13 (SD 1.41) and Group B 5.27 (SD 1.16). The mean difference was 0.13, t-value 0.283, and p-value 0.7794, indicating no significant difference at baseline.
- **At 4th week**, Group A's mean was 5.36 (SD 1.01) and Group B's was 5.60 (SD 1.12). The mean difference was 0.24, t-value 0.612, and p-value 0.5458, also not significant.
- **At 8th week**, Group A had a mean of 5.33 (SD 1.05) and Group B 5.80 (SD 1.01). The mean difference was 0.47, t-value 1.240, and p-value 0.2252, which was not statistically significant.

Conclusion:

No statistically significant differences were observed in left hamstring strength between Group A and Group B at any time point (all p-values > 0.05). Both groups improved over time, but there were no significant inter-group differences during the study.

Table No:26

Unpaired T Test	Calf Muscle Right Leg					
	1st Week		8th Week		4th Week	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	4.93	5.20	5.13	5.40	5.27	5.47
S.D.	1.223	1.146	1.187	1.056	1.163	0.834
Number	15	15	15	15	15	15
Maximum	7	8	7	8	7	8
Minimum	3	4	3	4	3	5
Range	4	4	4	4	4	3

Mean Difference	0.27	0.27	0.20
Unpaired T Test	0.616	0.650	0.541
P value	0.5428	0.5209	0.5926
Table Value at 0.05	2.05	2.05	2.05
Result	Not-Significant	Not-Significant	Not-Significant

.This table compares calf muscle strength (right leg) between Group A (PNF exercises) and Group B (non-weight bearing exercises) at the 1st, 4th, and 8th weeks using the unpaired t-test.

- **At 1st week**, Group A had a mean calf strength of 4.93 (SD 1.22) and Group B 5.20 (SD 1.15). The mean difference was 0.27, t-value was 0.616, and p-value was 0.5428, indicating no significant difference at baseline.
- **At 4th week**, Group A's mean was 5.13 (SD 1.19) and Group B's was 5.40 (SD 1.06). The mean difference was 0.27, t-value 0.650, and p-value 0.5209, showing no significant difference after four weeks.
- **At 8th week**, Group A had a mean of 5.27 (SD 1.16) and Group B 5.47 (SD 0.83). The mean difference was 0.20, t-value 0.541, and p-value 0.5926, which was not statistically significant.

Conclusion:

There were no statistically significant differences in right calf muscle strength between Group A and Group B at any measured time point (all p-values > 0.05). Both interventions produced comparable improvements in muscle strength.

Table No:27

Unpaired T Test	Calf Muscle Left Leg					
	1st Week		8th Week		4th Week	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	4.93	5.13	5.13	5.33	5.20	5.47
S.D.	1.223	1.125	1.187	1.047	1.146	0.834
Number	15	15	15	15	15	15
Maximum	7	8	7	8	7	8
Minimum	3	4	3	4	3	5
Range	4	4	4	4	4	3
Mean Difference	0.20		0.20		0.27	
Unpaired T Test	0.466		0.489		0.729	
P value	0.6448		0.6283		0.4723	
Table Value at 0.05	2.05		2.05		2.05	
Result	Not-Significant		Not-Significant		Not-Significant	

This table compares calf muscle strength (left leg) between Group A (PNF exercises) and Group B (non-weight bearing exercises) at the 1st, 4th, and 8th weeks using the unpaired t-test.

- **At 1st week**, Group A had a mean calf strength of 4.93 (SD 1.22), and Group B 5.13 (SD 1.13). The mean difference was 0.20, t-value was 0.466, and p-value was 0.6448, indicating no significant difference at baseline.
- **At 4th week**, Group A's mean was 5.13 (SD 1.19) and Group B's was 5.33 (SD 1.05). The mean difference was 0.20, t-value 0.489, and p-value 0.6283, showing no significant difference after four weeks.
- **At 8th week**, Group A had a mean of 5.20 (SD 1.15) and Group B 5.47 (SD 0.83). The mean difference was 0.27, t-value 0.729, and p-value 0.4723, which was also not statistically significant.

Conclusion:

No statistically significant differences were observed in left calf muscle strength between Group A and Group B at any measured time point (all p-values > 0.05). Both exercise interventions led to similar changes in muscle strength over the study period.

Table No:28

| Unpaired T Test | SF 36 Questionnaire | | | | | |
| | 1st Week | | 8th Week | | 4th Week | |
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	64.33	59.67	68.67	61.67	76.67	62.67
S.D.	13.741	11.872	14.075	12.344	10.118	13.478
Number	15	15	15	15	15	15
Maximum	85	75	95	85	95	85
Minimum	40	35	40	40	60	40
Range	45	40	55	45	35	45
Mean Difference	4.67		7.00		14.00	
Unpaired T Test	0.995		1.448		3.217	
P value	0.3281		0.1587		0.0033	
Table Value at 0.05	2.05		2.05		2.05	
Result	Not-Significant		Not-Significant		Significant	

This table compares the SF-36 quality of life scores between Group A (PNF exercises) and Group B (non-weight bearing exercises) at the 1st, 4th, and 8th weeks using the unpaired t-test.

- **At 1st week**, Group A had a mean SF-36 score of 64.33 (SD 13.74), while Group B had 59.67 (SD 11.87). The mean difference was 4.67, with a t-value of 0.995 and a p-value of 0.3281, indicating no significant difference at baseline.
- **At 4th week**, Group A's mean was 68.67 (SD 14.08) and Group B's was 61.67 (SD 12.34). The mean difference was 7.00, t-value 1.448, and p-value 0.1587, showing no significant difference after four weeks.
- **At 8th week**, Group A had a mean of 76.67 (SD 10.12), while Group B had 62.67 (SD 13.48). The mean difference was 14.00, t-value 3.217, and p-value 0.0033, which is statistically significant.

Conclusion:

There were no significant differences in quality of life scores between the two groups at the beginning and after four weeks of intervention. However, by the 8th week, Group A (PNF exercises) showed a

significantly greater improvement in quality of life compared to Group B (p = 0.0033), indicating superior effectiveness of PNF exercises in enhancing quality of life among diabetic neuropathy patients.

Table No:29

Unpaired T Test	MNSI Patient Evaluation					
	1st Week		8th Week		4th Week	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	6.33	5.67	5.47	5.47	4.53	5.00
S.D.	0.976	1.234	1.125	1.125	1.060	1.069
Number	15	15	15	15	15	15
Maximum	8	8	7	8	7	7
Minimum	5	4	4	4	3	3
Range	3	4	3	4	4	4
Mean Difference	0.67		0.00		0.47	
Unpaired T Test	1.641		<0.001		1.200	
P value	0.1120		1.0000		0.2400	
Table Value at 0.05	2.05		2.05		2.05	
Result	Not-Significant		Not-Significant		Not-Significant	

This table compares MNSI (Michigan Neuropathy Screening Instrument) patient evaluation scores between Group A (PNF exercises) and Group B (non-weight bearing exercises) at the 1st, 4th, and 8th weeks using the unpaired t-test.

- **At 1st week**, Group A had a mean score of 6.33 (SD 0.98), while Group B had 5.67 (SD 1.23). The mean difference was 0.67, t-value 1.641, and p-value 0.1120, showing no significant difference at baseline.
- **At 4th week**, both groups had a mean of 5.47 (SD 1.13). The mean difference was 0.00, t-value <0.001, and p-value 1.0000, indicating no difference after four weeks.
- **At 8th week**, Group A had a mean of 4.53 (SD 1.06), while Group B had 5.00 (SD 1.07). The mean difference was 0.47, t-value 1.200, and p-value 0.2400, again showing no significant difference.

Conclusion:

The present study concludes that both Proprioceptive Neuromuscular Facilitation techniques and non-weight bearing exercises are effective in improving balance, muscle strength, neuropathy symptoms, and quality of life in patients with diabetic neuropathy. However, Proprioceptive Neuromuscular Facilitation techniques were found to be more effective in producing significant and sustained improvements in balance, quality of life, and functional outcomes over an eight-week intervention period.

The findings suggest that PNF techniques can be considered a valuable and effective physiotherapeutic intervention in the rehabilitation of patients with diabetic neuropathy and may be incorporated into routine clinical practice to enhance functional independence and overall quality of life.

Table No:30

Unpaired T Test	MNSI Physical Assessment					
	1st Week		8th Week		4th Week	
	Group A	Group B	Group A	Group B	Group A	Group B
Mean	3.23	3.83	2.60	3.47	2.07	3.37
S.D.	0.799	0.939	0.806	1.187	0.417	1.125
Number	15	15	15	15	15	15
Maximum	5	6	5	6	3	6
Minimum	2	2.5	2	2	1	2
Range	3	3.5	3	4	2	4
Mean Difference	0.60		0.87		1.30	
Unpaired T Test	1.885		2.339		4.195	
P value	0.0698		0.0267		<0.0012	
Table Value at 0.05	2.05		2.05		2.05	
Result	Not-Significant		Significant		Significant	

This table compares MNSI (Michigan Neuropathy Screening Instrument) physical assessment scores between Group A (PNF exercises) and Group B (non-weight bearing exercises) at the 1st, 4th, and 8th weeks using the unpaired t-test.

- **At 1st week**, Group A had a mean score of 3.23 (SD 0.80) and Group B had 3.83 (SD 0.94). The mean difference was 0.60, t-value 1.885, and p-value 0.0698, indicating no significant difference at baseline.
- **At 4th week**, Group A had a mean of 2.60 (SD 0.81) while Group B had 3.47 (SD 1.19). The mean difference was 0.87, t-value 2.339, and p-value 0.0267, showing a significant difference, with Group A having lower (better) scores.
- **At 8th week**, Group A had a mean of 2.07 (SD 0.42) and Group B 3.37 (SD 1.13). The mean difference was 1.30, t-value 4.195, and p-value <0.0012, indicating a highly significant difference, again favoring Group A.

Conclusion:

At baseline, no significant difference was found between groups. However, by the 4th and especially the 8th week, Group A (PNF exercises) showed significantly greater improvement in physical assessment scores compared to Group B ($p < 0.05$), highlighting the superior effectiveness of PNF exercises for improving neuropathy-related physical assessment in diabetic neuropathy patients.

Chapter 5 - Result

5.1 Demographic Data
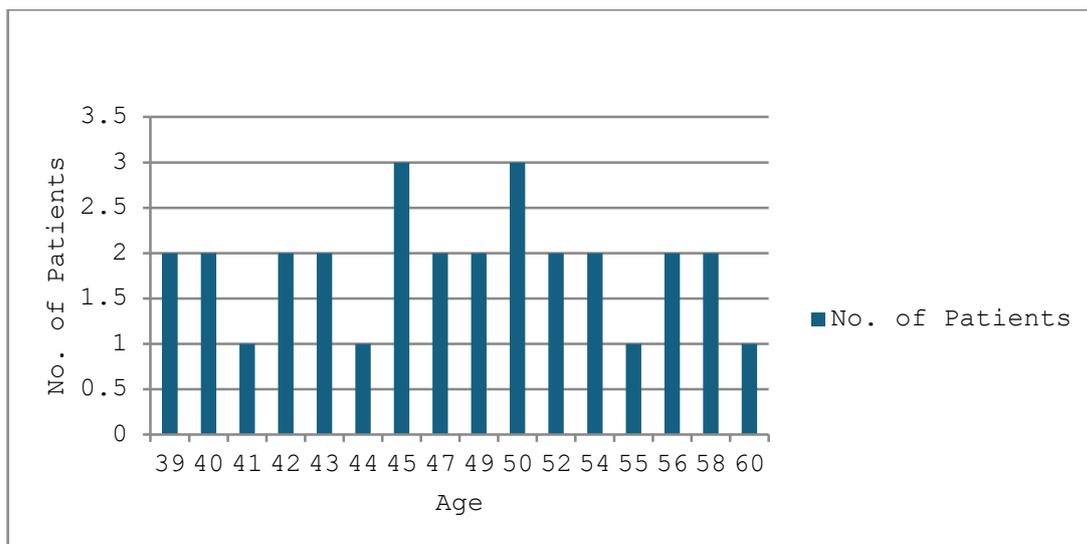
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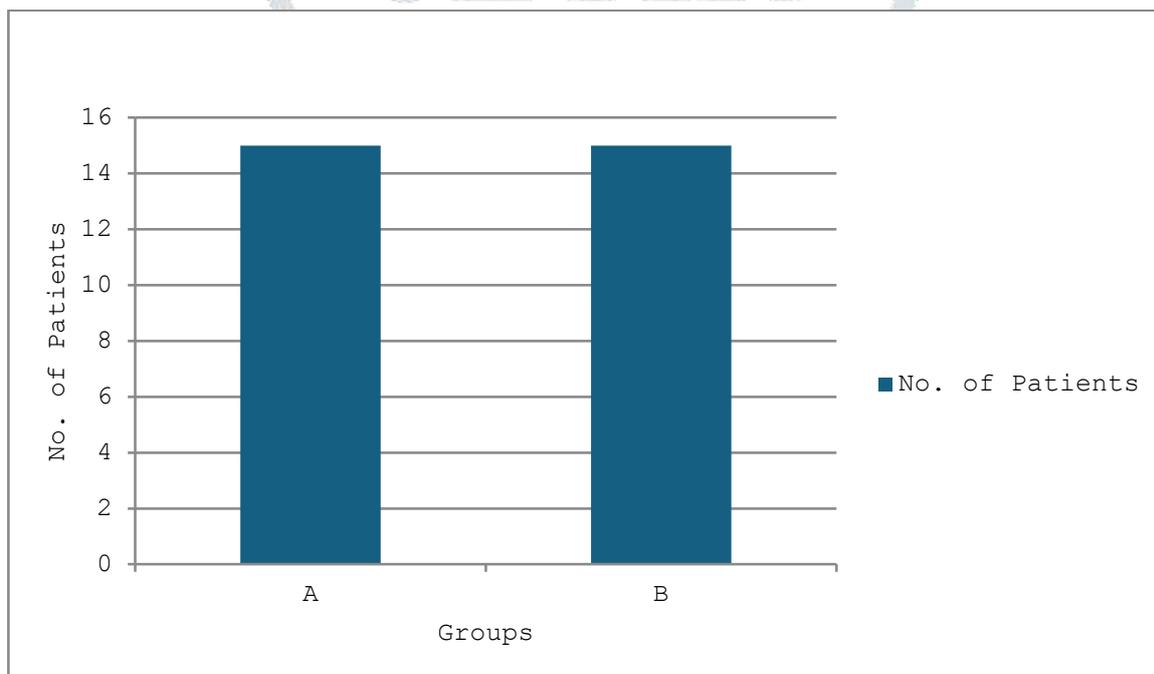
Graph No.2

Organization of Analyzed Data: The analyzed data was organized according to the objectives and presented under the following sections:

5.2 Graphs of Result

SECTION-A <mark>Within Group Analysis (Repeated ANOVA)</mark>
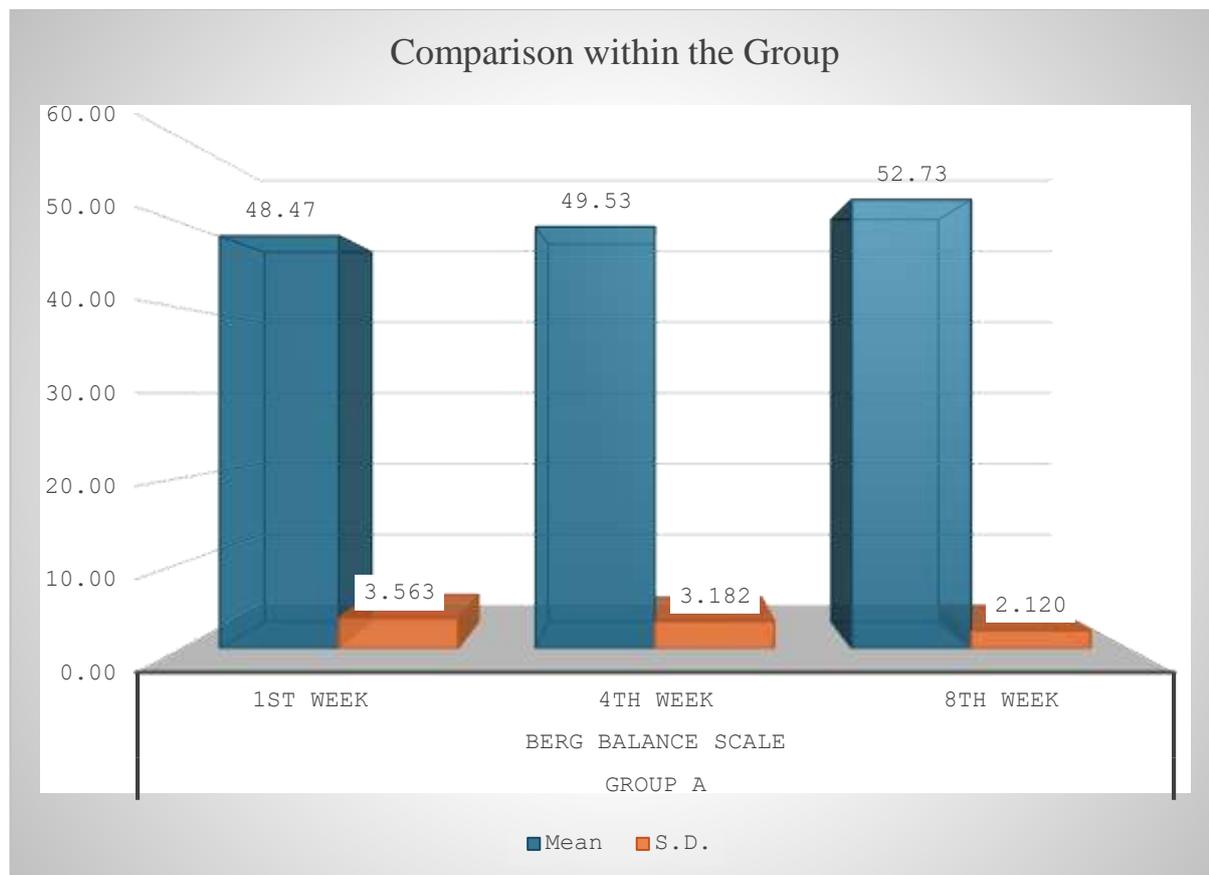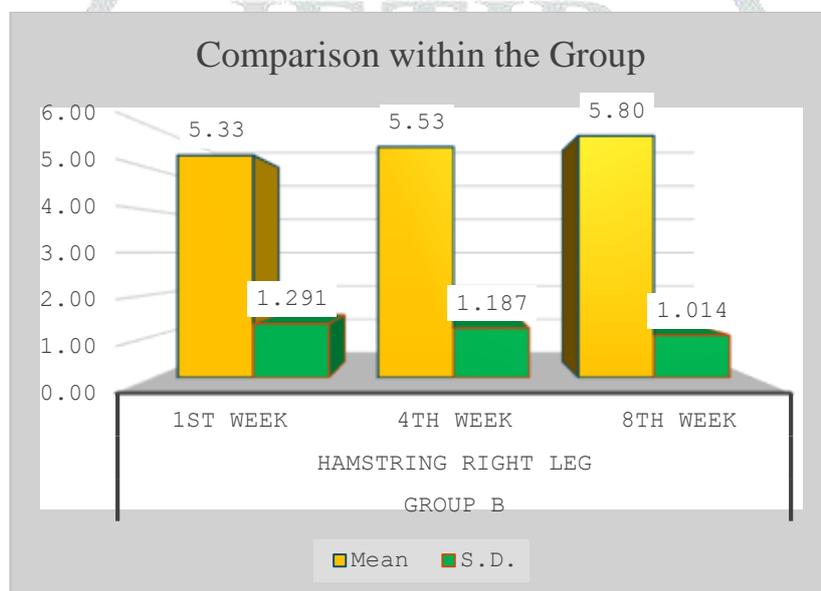

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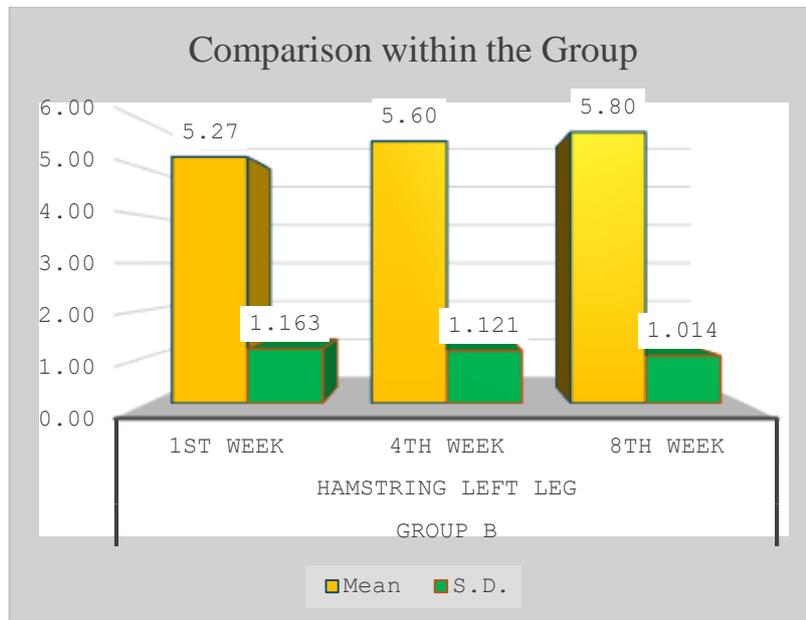

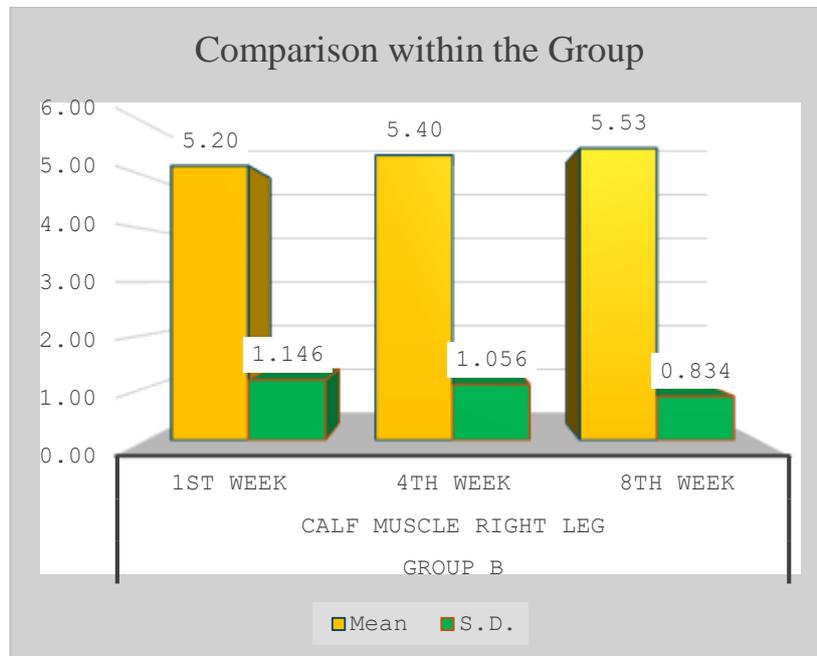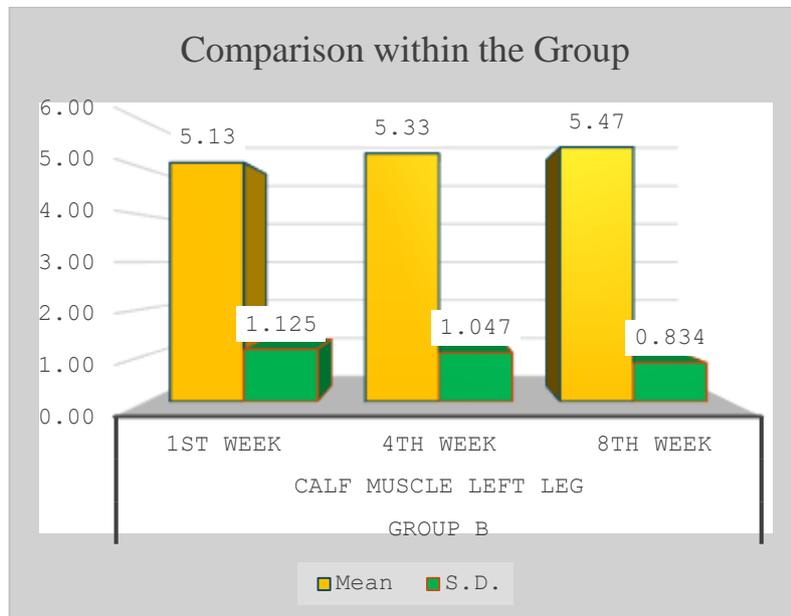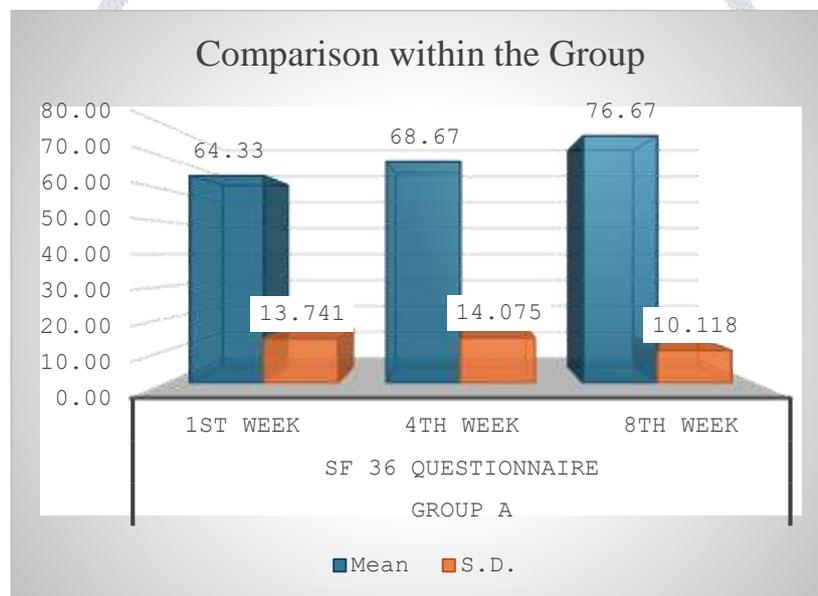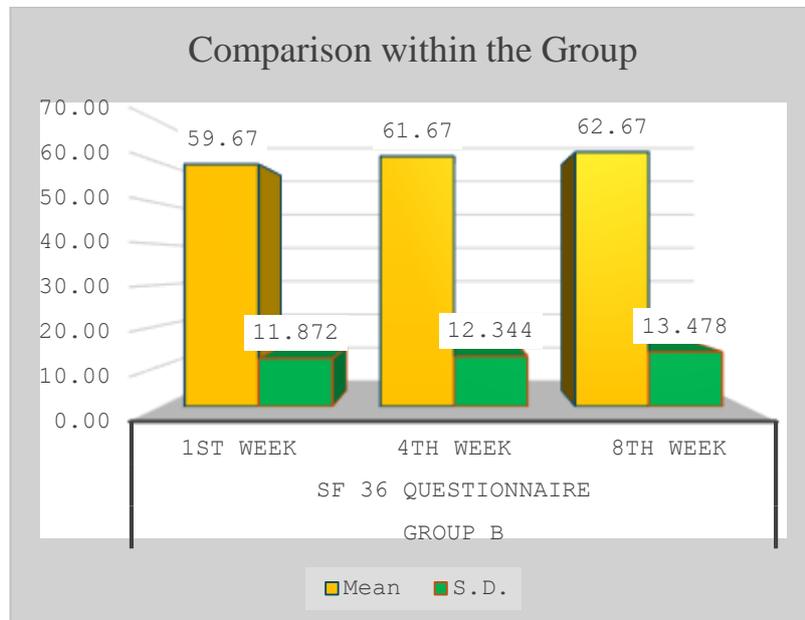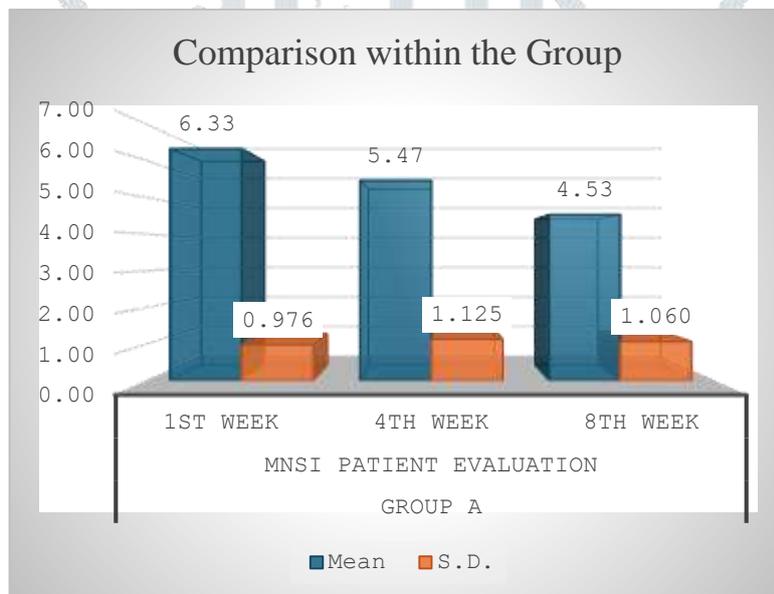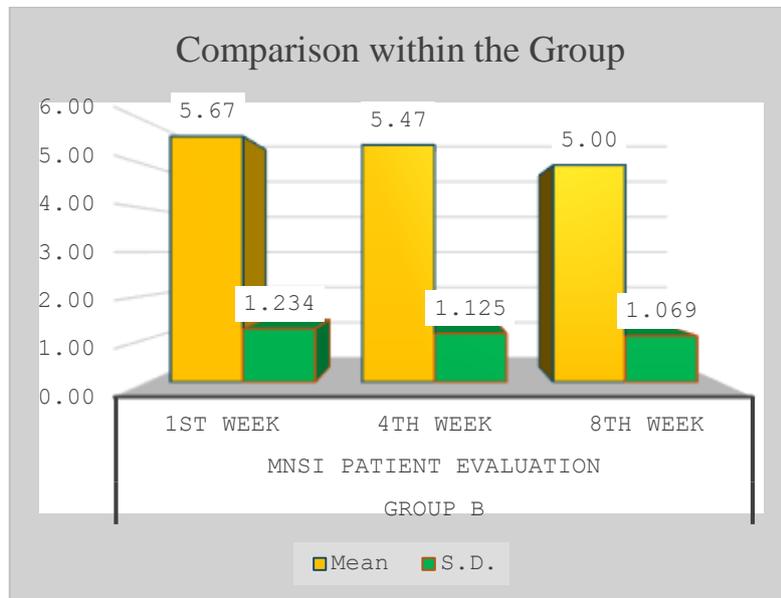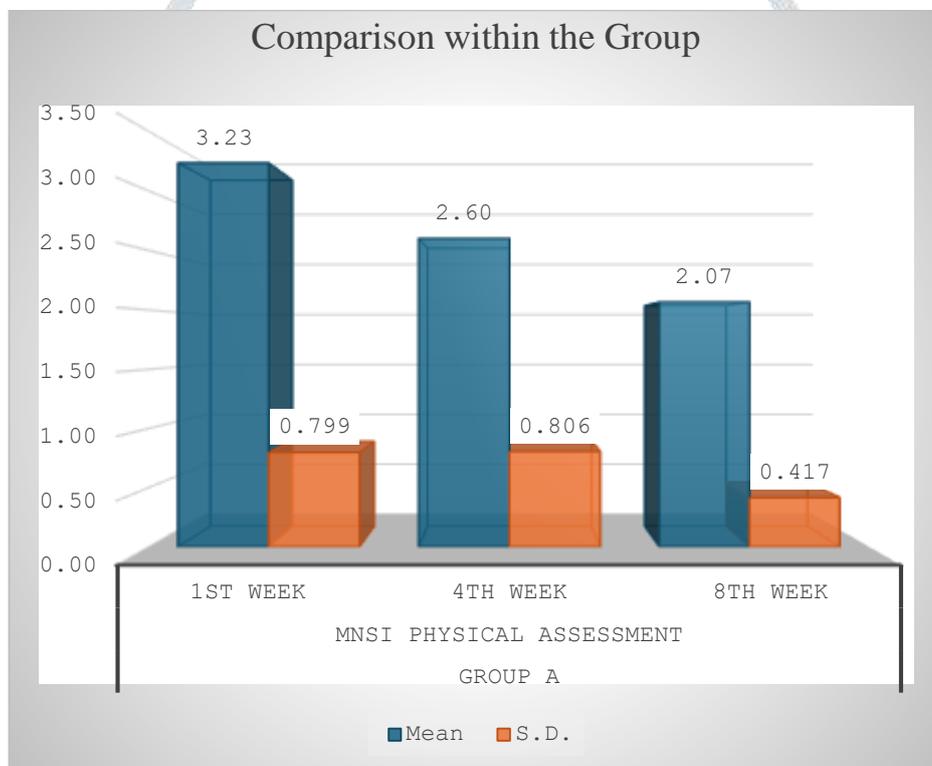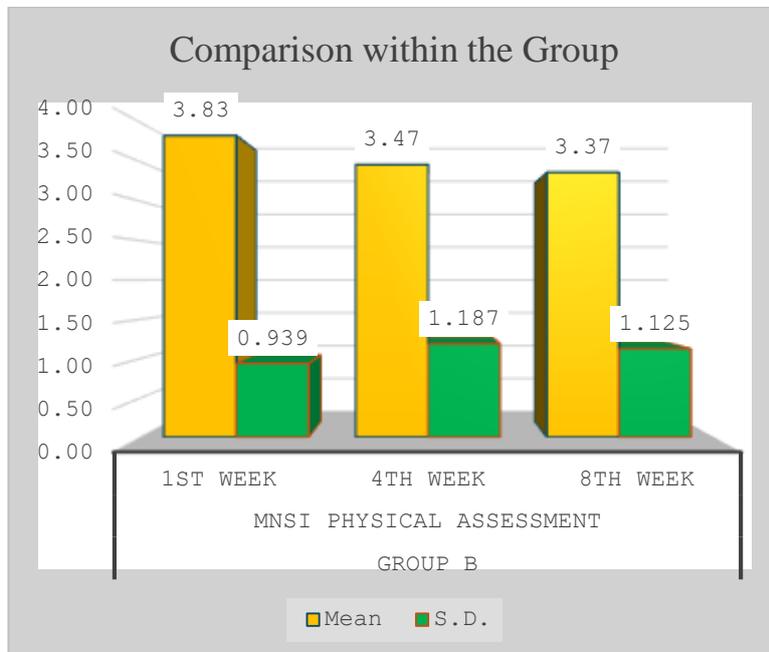Graph No.4
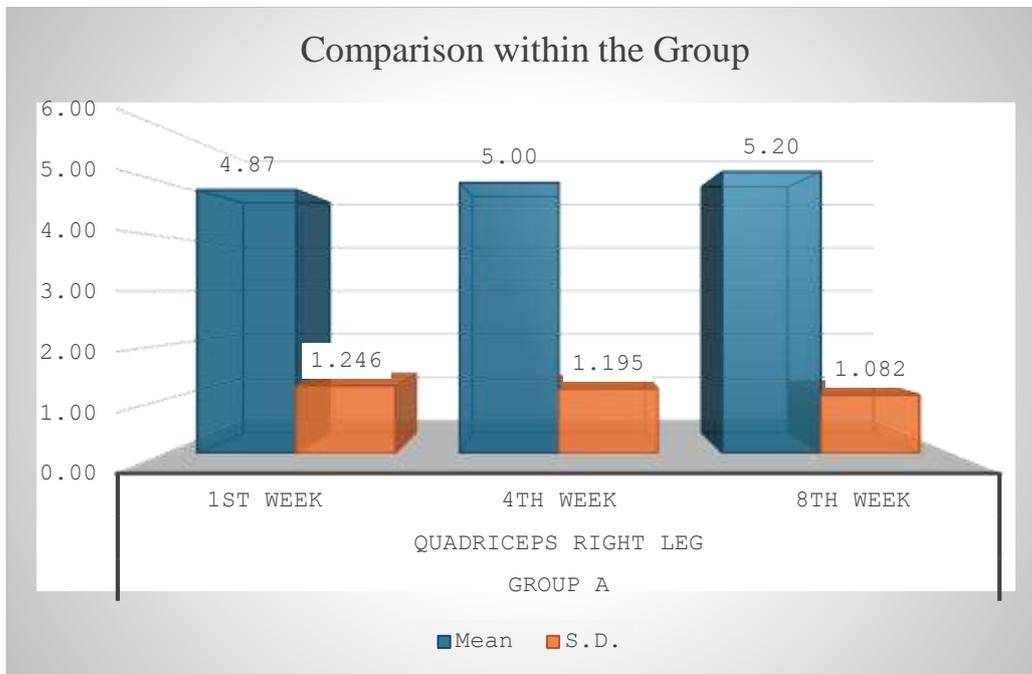
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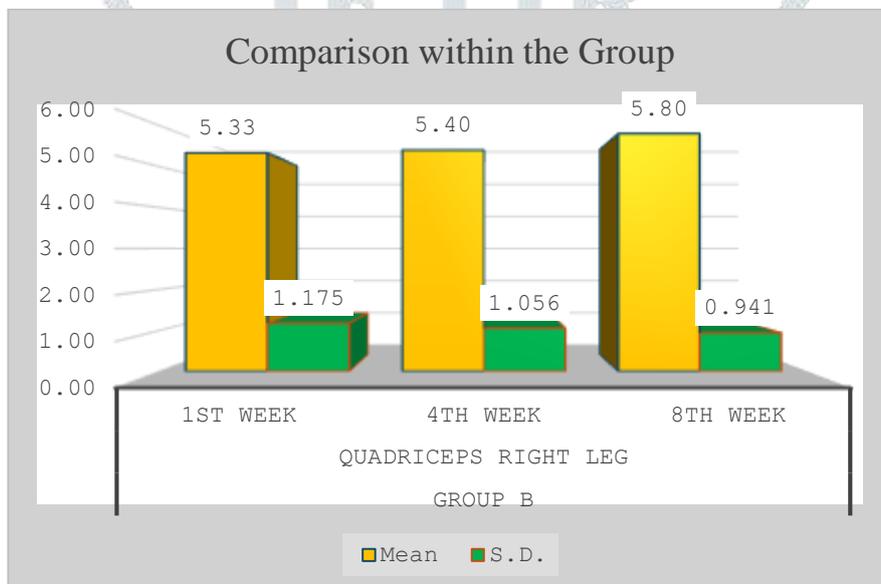
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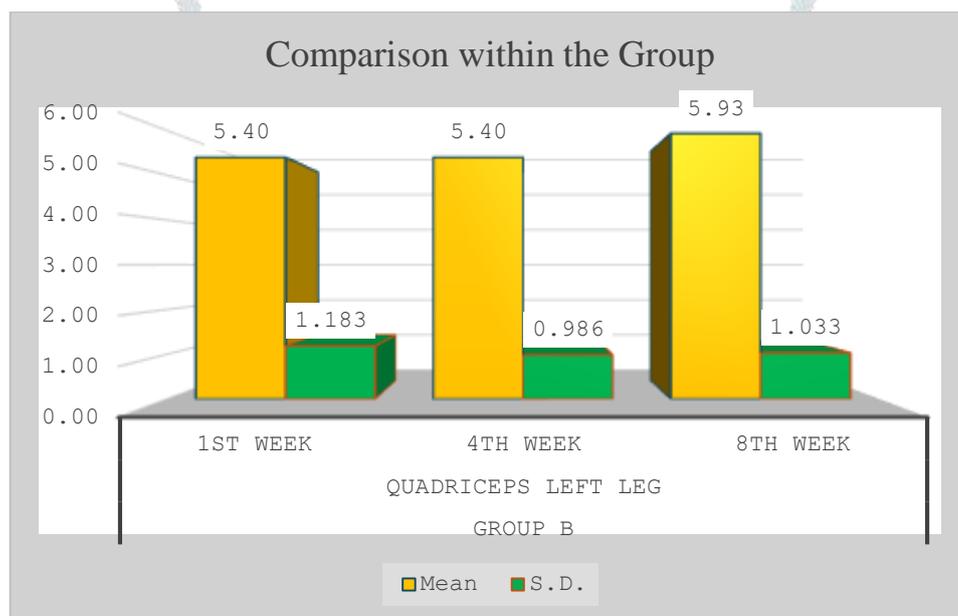
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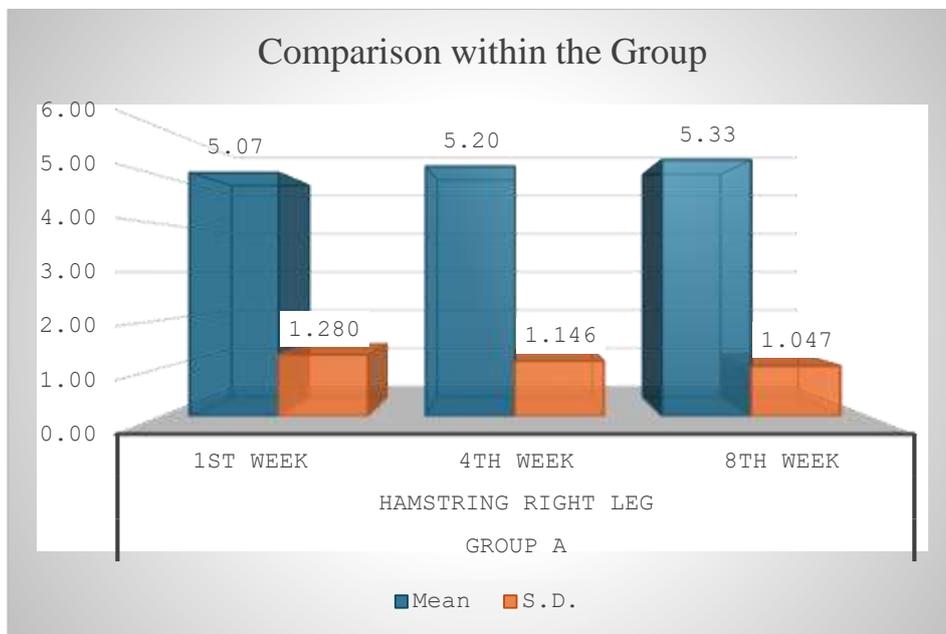
Graph No.9

Graph No.10

Graph No.11

Graph No.12

Graph No.13

Graph No.14

Graph No.15

Graph No.16

Graph No.17

Comparison within the Group

SF 36 QUESTIONNAIRE

GROUP B

Graph No.18

Comparison within the Group

MNSI PATIENT EVALUATION

GROUP A

Graph No.19

Comparison within the Group

MNSI PATIENT EVALUATION
GROUP B

Graph No.20

Comparison within the Group

MNSI PHYSICAL ASSESSMENT
GROUP A

Graph No.21

Graph No.22

Section - B : Between Group

Graph No:21
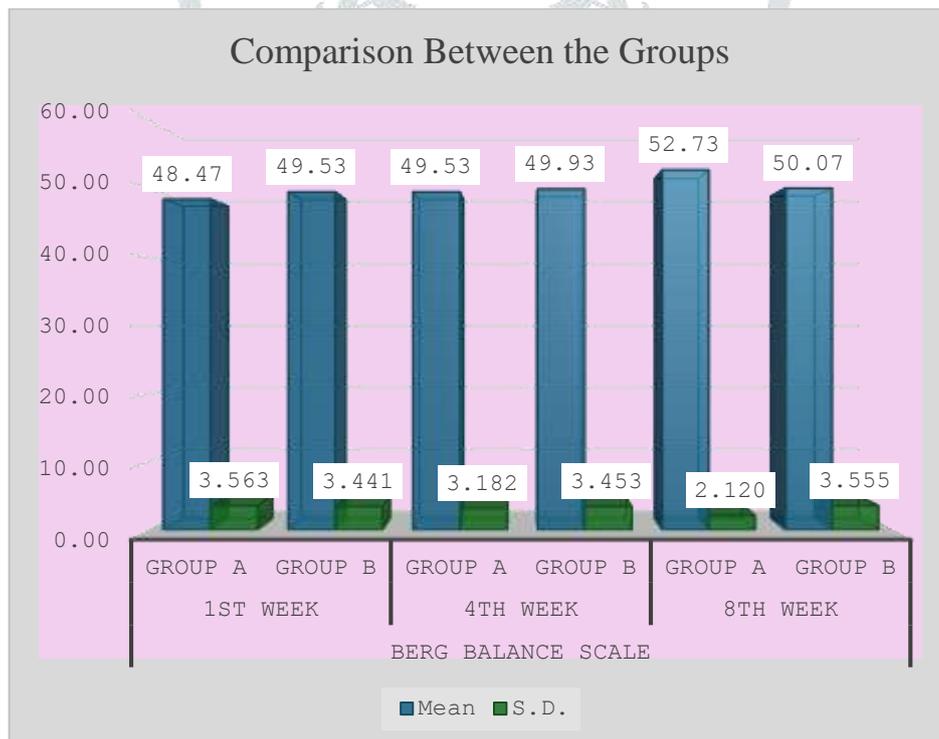
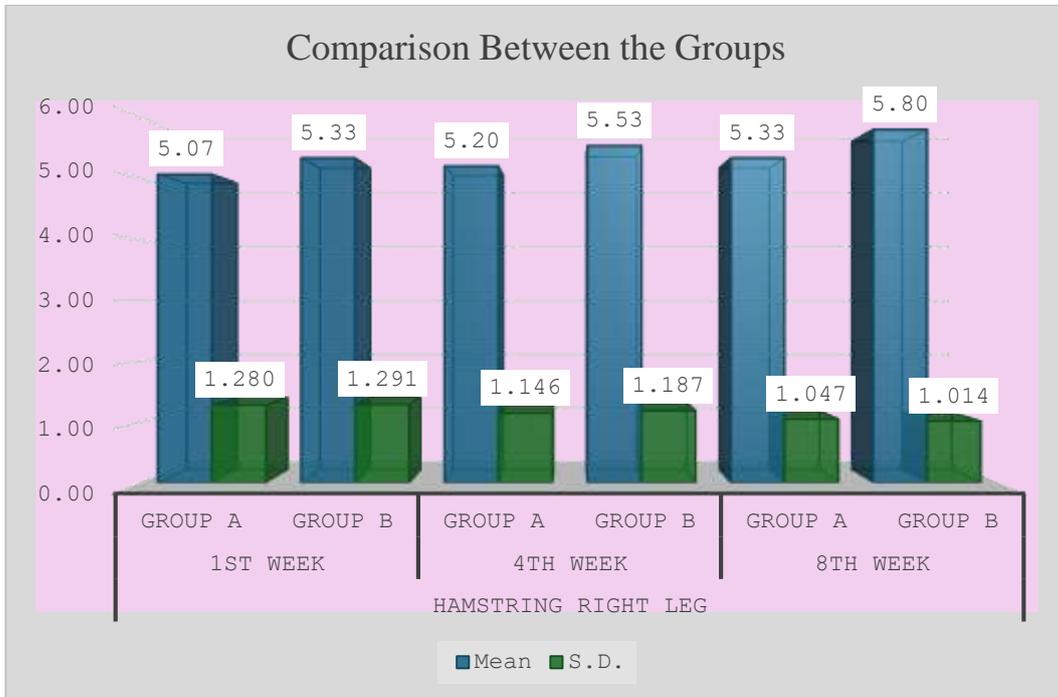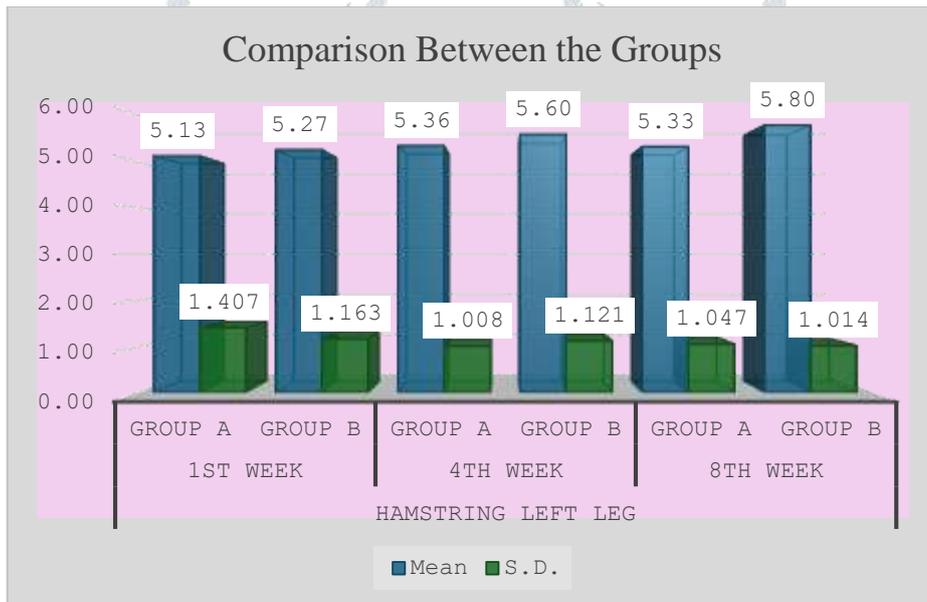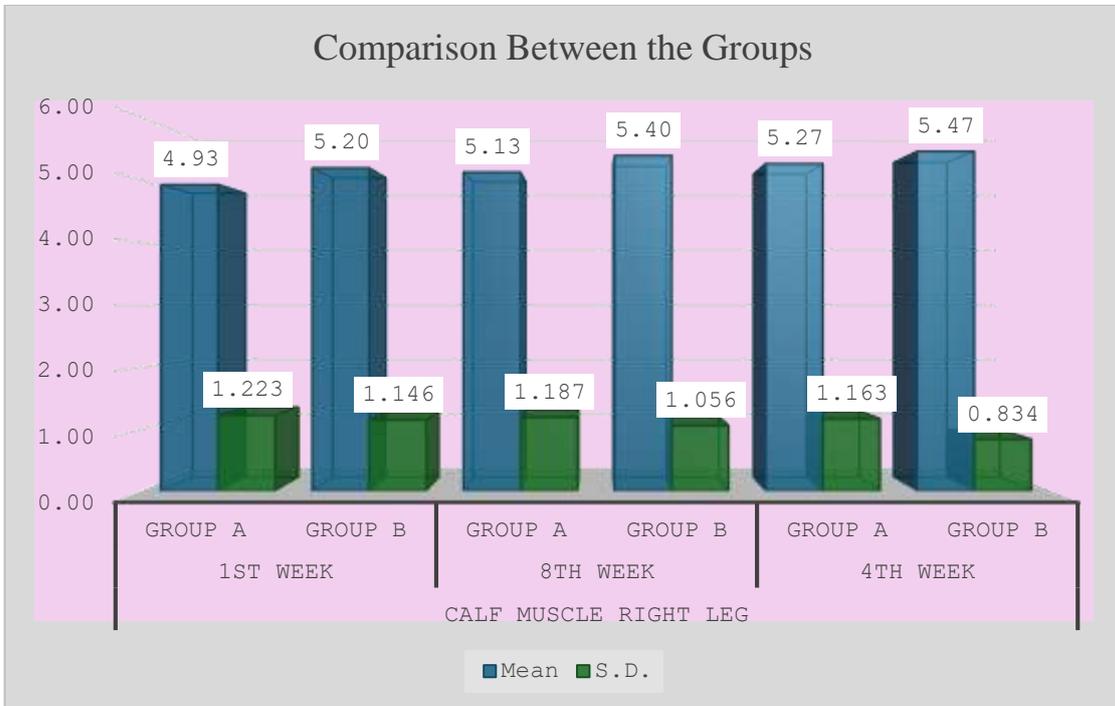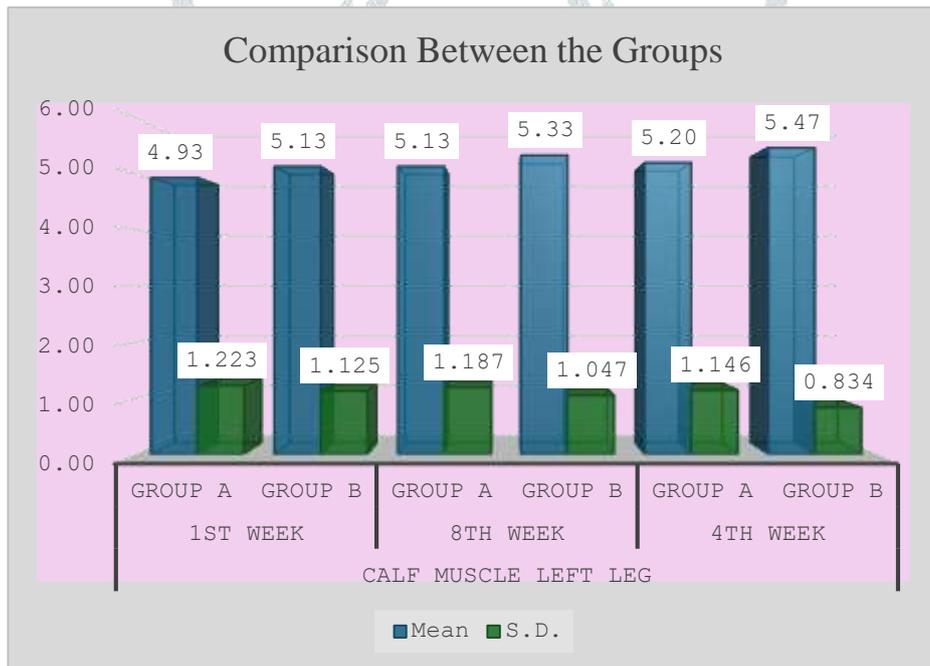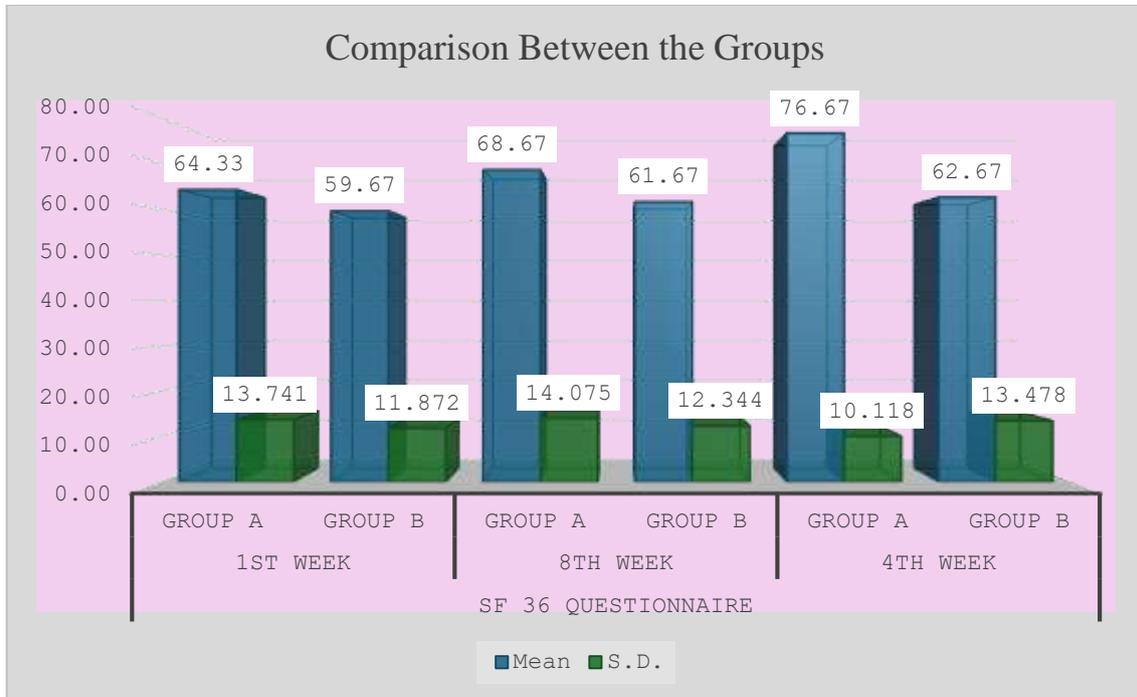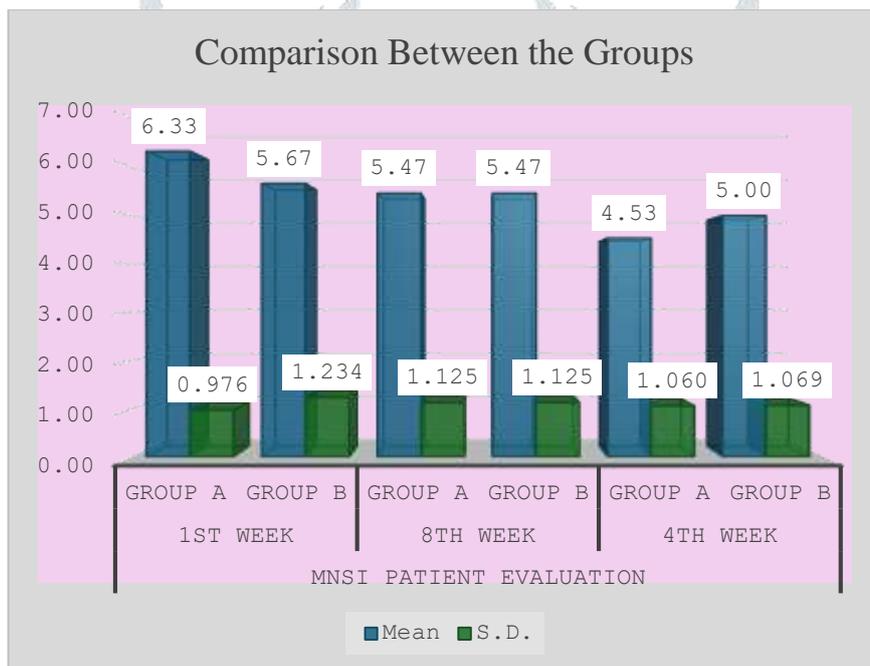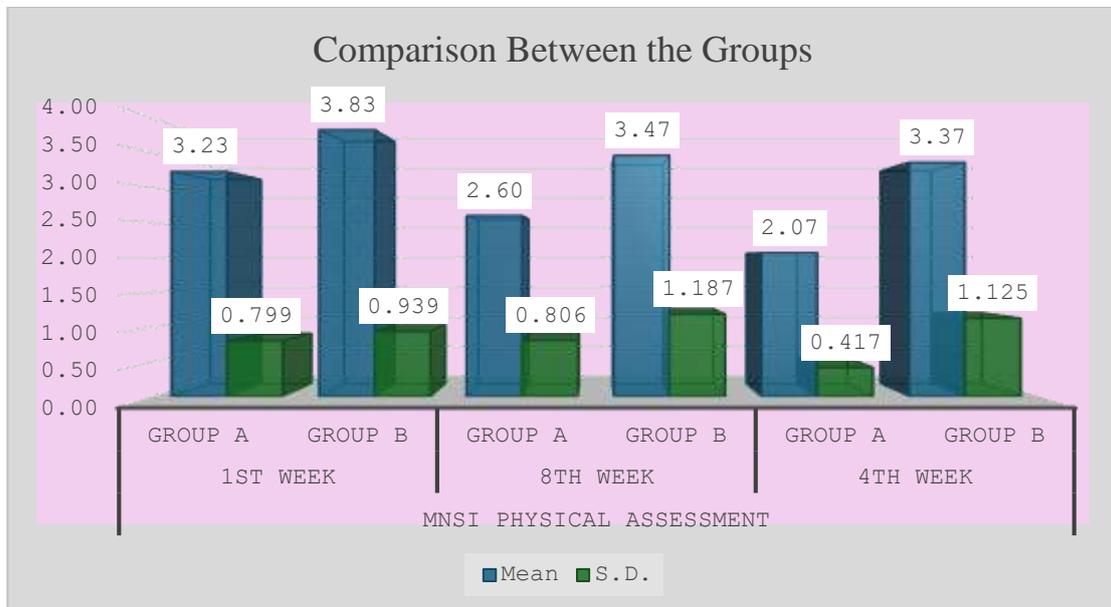Graph No:22
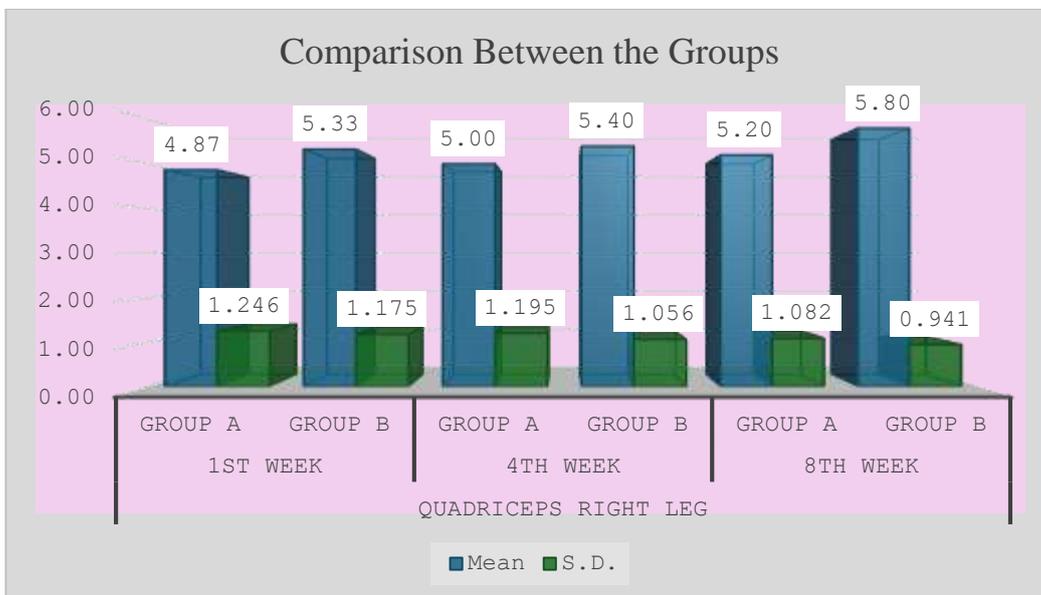
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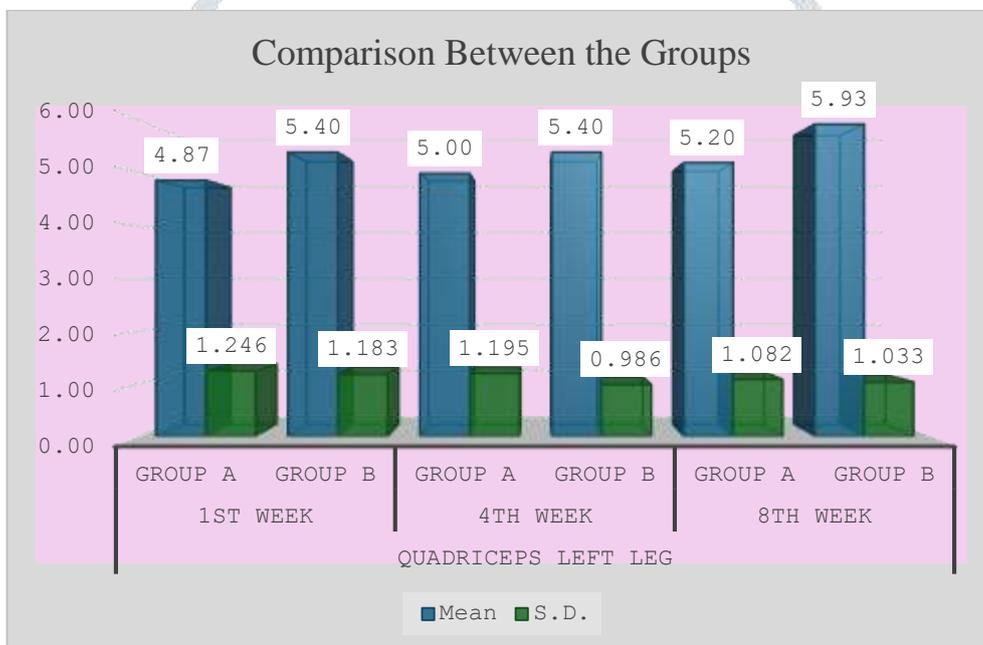
Graph No:24

Graph No:25

Graph No:26

Graph No:27

Graph No:28

Graph No:29

Graph No:30

Comparison Between the Groups — MNSI Physical Assessment. Mean and S.D. values for Group A and Group B at 1st Week (3.23 / 0.799 and 3.83 / 0.939), 8th Week (2.60 / 0.806 and 3.47 / 1.187), and 4th Week (2.07 / 0.417 and 3.37 / 1.125).

Overall Result

The present study compared the effects of proprioceptive neuromuscular facilitation (PNF) techniques and non-weight bearing exercises on balance, muscle strength, and quality of life in diabetic neuropathy patients over 8 weeks, using validated tools (Berg Balance Scale, SF-36, Modified MRC Scale, and Michigan Neuropathy Screening Instrument).

Within-Group Findings

- ### Group A (PNF):

Significant improvements were observed in balance (Berg Balance Scale), quality of life (SF-36), and neuropathy scores (MNSI), as well as some lower limb muscle groups. The greatest gains were noted by week 8, with statistical significance found in most measures ($p < 0.05$).

- ### Group B (Non-weight Bearing Exercises):

Also showed significant but generally smaller improvements over time in balance, quality of life, and neuropathy scores, with the most progress seen in the first four weeks, but some measures plateaued by week 8.

Between-Group Findings

- ### Balance (Berg Balance Scale):

By week 8, Group A showed a significantly greater improvement than Group B ($p = 0.0188$).

- ### Quality of Life (SF-36):

At 8 weeks, Group A demonstrated significantly higher quality of life scores compared to Group B ($p = 0.0033$).

- ### Neuropathy (MNSI):

Significant differences in physical assessment scores (not patient evaluation) were found at weeks 4 and 8, favoring Group A ($p < 0.05$).

- **Muscle Strength:**

While both groups improved, no statistically significant differences were found between groups for quadriceps, hamstring, or calf muscle strength in either leg at any time point (all p > 0.05).

Summary

- **PNF exercises were superior to non-weight bearing exercises** in improving balance, quality of life, and some aspects of neuropathy (physical assessment), with greater and more sustained improvements seen in the PNF group by 8 weeks.
- Both interventions were beneficial for diabetic neuropathy patients, but PNF provided additional clinically and statistically significant advantages for functional outcomes.

Chapter 6 – Discussion

From last few years D.M. and its complications are major cause of morbidity and mortality in the world. Our country has also a high prevalence of D.M. in the past few years. In 2019 according to IDF, 77 million Indians were suffering from D.M. with an estimated prevalence of 8.9% among adults. There are several associated complications of D.M. including neuropathy, retinopathy, polyphagia, etc. P.N.F and non-weight, bearing both type of exercises are helpful to reduce the secondary complications. This study has been compared the effectiveness of proprioceptive neuromuscular facilitation technique versus non - weight bearing exercises in improving quality of life of diabetic neuropathy patients and concluded that P.N.F is more effective in improving quality of life of D.M. patients. The present study was undertaken to compare the effectiveness of Proprioceptive Neuromuscular Facilitation (PNF) techniques and non-weight bearing exercises in improving balance, muscle strength, neuropathy symptoms, and quality of life in patients with diabetic neuropathy. The findings of the study demonstrated that both intervention groups showed improvements in various outcome measures following the eight-week intervention period. However, the magnitude of improvement was greater in the group that received Proprioceptive Neuromuscular Facilitation techniques(Irshad Ahmad et al,2020) Within-group analysis revealed significant improvements in balance, quality of life, and neuropathy scores in the PNF group. These improvements can be attributed to the ability of PNF techniques to enhance neuromuscular coordination, proprioceptive feedback, and motor control through diagonal and rotational movement patterns. Stimulation of proprioceptors during PNF may have facilitated improved postural control and functional stability, leading to better balance performance. The non-weight bearing exercise group also showed improvements, particularly in balance and quality of life. These changes may be associated with increased muscle activation, joint mobility, and circulation resulting from regular exercise. However, the improvement in this group was comparatively less and appeared to plateau after the fourth week, suggesting limited long-term effectiveness when compared to PNF techniques. Between-group analysis revealed statistically significant differences favoring the PNF group in balance, quality of life, and physical assessment components of the Michigan Neuropathy Screening Instrument at the end of the eighth week. These findings support the superior effectiveness of PNF techniques in addressing functional impairments associated with diabetic neuropathy(Janahavi Jagdish Atre et al,2020)

Conclusion:

The present study concludes that both Proprioceptive Neuromuscular Facilitation techniques and non-weight bearing exercises are effective in improving balance, muscle strength, neuropathy symptoms, and quality of life in patients with diabetic neuropathy. However, Proprioceptive Neuromuscular Facilitation techniques were found to be more effective in producing significant and sustained improvements in balance, quality of life, and functional outcomes over an eight-week intervention period.

The findings suggest that PNF techniques can be considered a valuable and effective physiotherapeutic intervention in the rehabilitation of patients with diabetic neuropathy and may be incorporated into routine clinical practice to enhance functional independence and overall quality of life.

6.1 Limitation of the Study

Despite the positive findings, the study had certain limitations:

1. The sample size was relatively small, which may limit the generalizability of the results.
2. The duration of the intervention was limited to eight weeks, which may not reflect long-term effects.
3. The study focused only on patients with diabetic neuropathy and did not include other types of peripheral neuropathies.
4. Long-term follow-up was not conducted to assess the sustainability of the improvements.
5. Psychological factors such as motivation and adherence were not objectively measured.
6. The study was not extended more than 8 weeks for patients due to time constraints.

6.2 Future Study

Based on the findings and limitations of the present study, the following recommendations are suggested for future research:

- Studies with a larger sample size may be conducted to enhance the external validity of results.

- Long-term follow-up studies can be carried out to determine the sustained effects of PNF techniques.

- Comparative studies including weight-bearing, balance-specific, or combined exercise programs may provide additional insights.

- Future research may include objective gait analysis and advanced proprioceptive assessment tools.

- Studies may also explore the effects of PNF techniques on psychological well-being and fall prevention in diabetic neuropathy patients.

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