

Diabetic Peripheral Neuropathy- 6 Months Follow up Using Resisted Exercises and Proprioceptive Training - With Evidence

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Abstract:

Introduction: An alarming global increase in type 2 diabetes, with second maximum known diabetic subjects in India, peripheral neuropathy which remain unfocussed with complications such as falls, ulcers, amputation, decreased mobility, dependence for ADL and disability associated along with.

Aims and Objectives of This Research: To analyse obesity, glycemic control and neuropathy on a diabetic subject.

Materials and Methodology: This original study was on a subject for 30 years with known type 2 diabetes and for 10 years with peripheral neuropathy, where the impact of resisted exercises and Proprioceptive training were analysed for 6 months period from October 2016 to March 2017.

Results: A marginal reduction in obesity and improved glycemic control by 0.5% and slight lowering of Toronto clinical scoring system for diabetic neuropathy were recorded.

Conclusion: The findings of this study could implicate benefits of larger population in the society as nearly 50% of diabetic develop neuropathy. Also this was an innovative and first research study among diabetic neuropathy subjects using RET and proprioceptive exercises.

Key Words: HbA_{1c} – Glycosylated Hemoglobin, IDF - International Diabetes Federation, TCSS - Toronto clinical scoring system, BMI – Body Mass Index, WC – Waist Circumference, UKPDS – United Kingdom Prospective Diabetes Study, NCV – Nerve Conduction Velocity, ACSM – American College of Sports Medicine, TENS – Transcutaneous Electrical Nerve Stimulation, VAS – Visual Analogue Scale, ADL – Activities of Daily Life

I. Introduction

With an estimated global prevalence of diabetes at 8.8% (415 million) and India about 69.2 million known diabetes. (Anjana et al, 2011) with global undiagnosed diabetic population of 193 million, predisposing them to the development of several long term complications of untreated chronic hyperglycemia (IDF, 2015). Approximately one half of the people with diabetes have some form of neuropathy (Dyck et al, 1993). Peripheral neuropathy an important risk factor for falls (UKPDS, 2000).An Iran based study of both sex among type 2 diabetic subjects with 52% having diabetic neuropathy (IrajHydaria et al, 2010).Tunis based study with 24% (Harzallah et al, 2006) and 29% of Srilankan diabetic subjects with diabetic neuropathy (WeeraSuriya et al, 1998)whereas among Indian diabetic population 29% of north Indians have diabetic neuropathy with 15.3% of New Delhi diabetic to have diabetic neuropathy (Chawlah et al, 2015). Peripheral neuropathy affects extremities, particularly the lower legs & feet, hyperglycaemia causing nerve toxicity, leading to nerve damage and apoptosis which causes microvascular damage and loss of perfusion (Smith et al, 2008). Symptoms of neuropathy include loss of sensation neuropathic pain, poor blood flow, increase risk of foot injuries and ulcerations. (P Marchettini, 2006). 60% of lower extremity amputations in Americans are related to diabetes (Lemaster et al, 2008). Diabetic neuropathy has resulted in more than 80% amputation after foot injury and ulceration (Chawla et al, 2015).Physical activity both aerobic and resisted exercises are highly recommended to improve glycemic control by ACSM, 2010. Shanewaz, 2014 has recorded among 30 diabetic neuropathic subjects with TENS and VAS score reduction from 8 to 2. Pieber et al, 2004 have evaluated the effects of TENS to improve microcirculation and increase oxidative capacity in muscles. Cohen et al, 2007 have recorded that aerobic and resistance exercise training to improve endothelial function and also mild to moderate exercises may help to prevent the onset of peripheral neuropathy (Balucci et al, 2004). This is an innovative research using closed kinematic exercises to promote proprioception and strengthening exercises using Physioball for diabetic neuropathy and glycemic control.

Aims and Objectives:

- To evaluate efficacy of exercises on obesity in type II diabetes.
- To analyse glycemic control with specific exercises using Physioball.
- To study closed kinematic chain on a subject with diabetic peripheral neuropathy using TCSS (Toronto clinical scoring system)

Study design: Experimental case study, Sampling technique: Convenient sampling, Duration: October 2016 till March 2017

II. Materials And Methodology

- Type 2 diabetic known subject since 30 years, a graduate, vegetarian, non alcoholic with sedentary lifestyle on T.Dianorm 30 mg, T.Cardace, T.Aquazide, T.Clopilet, T.Trajenta 500 mg and T. Multivitamin, complains of numbness of the feet with balance disturbances while walking.

On observation as on October 2016:

- Ambulant with a quadripod but requires monitoring for falls prevention; Transfers and ADL- independent partially

On Examination:

- From Jan-Oct 2016 number of falls were 5-6 times with decreased balance and peripheral neuropathy; Balance in sitting: Good; Standing balance: Unilateral stance with single hand support able to stand for a count of ten
- ROM of peripheral joints full except knee, foot, ankle & toes:
 - a. Spine: Flexion restricted
 - b. Knee: Extreme ranges painful and restricted
 - c. Ankle and foot: Ankle, subtalar joints mildly painful and tender
- Bilateral tendoachilles tightness (Right is greater than left); Bilateral hamstring tightness; Exaggerated lumbar lordosis with abdominal muscle grade II / V; Bilateral vastus medialis lag +ve; Grade 1 dorsal oedema of the feet

Muscle power (Bilateral):

- Quadriceps – 3/5; Hip abductors – 3/5; Hip extensors -3/5; Bilateral Ankle reflexes- ++; Bilateral Knee reflexes- ++
- Positive trendelenberg sign; Bilateral proprioception of ankle- Moderate; Bilateral Vibration & pain prick sensation- unaffected; Superficial sensation of sole of the feet mild impaired; Occasional paresthetic sensation of feet; NCV has shown peripheral neuropathy of both feet

Provisional Diagnosis:

- Diabetic peripheral neuropathy

INVESTIGATIONS:

Tests	12/12/2016	14/03/2017
FBS	117mg	135 mg
P.P	197	215
HbA1c	7.7%	7.2%
Ankle brachial index	Not taken	1.23
Biothesiometry	Ankle :45, Great toe:47 Normal-20	Not taken
NCV	Right-45, Left-47 (Normal>20)	

TREATMENT:

- Strengthening exercises of both lower extremities, Closed kinematic chain exercises in supine, sitting and half lying to lower extremities, Passive stretching of foot and ankle, Foot care, Specific resisted exercises to whole body using physioball to improve glycemic control.
- Each session lasting for 20-25 minutes with 60-70% of maximum heart rate as intensity and a weekly twice frequency.
- Found have a moderate exercise tolerance with exercises.

CLOSED KINEMATIC CHAIN EXERCISES:



HIGH SITTING



SUPINE LYING

III. Results

CLINICAL PROGNOSIS:

- Motor power of bilateral quadriceps and hip adductors and extensors have improved from 3/5 to 4/5
- Subject is able to walk for short distance in closed environment unaided
- Social activities of him were increased
- Self confidence has increased
- Also the balance has moderately improved
- Number of falls have shown a sharp decline from 5-6 last year to no fall during this 6 months period

Table 1 showing results of pre and post physiotherapy on HbA1c, BMI, WC, cadence and TCSS.

Test	HBA ₁ C	BMI kg/m ²	WC (cm)	TCSS
Pre	7.7%	28	106	4
Post	7.2%	26	98	3

Note: TCSS -Toronto clinical scoring system is a two point scale of 10 items related to diabetic neuropathy

IV. Discussion

- The risk factors for diabetic neuropathy include poor glycemic control (Sumner et al, 2003). **This subject with reduction of HbA1C by 0.5% has benefited with an improved glycemic control.** Also a strict glycemic control seems to be critical for stabilization and even to improve diabetic neuropathy (Tesfaye et al, 2010).
- Peripheral neuropathy strongly associated with obesity and decreased muscle strength (Thomas et al, 2008) **as shown in table 1 of this study with reduction in obesity with an improved glycemic control and improved muscle strength as mentioned in clinical prognosis subject benefits with exercises against reduction of muscle strength.** Richardson et al, 2001 have shown with strengthening exercises of lower extremities an improved clinical measures of balance. **No falls were recorded during this 6 months period, whereas previously 5-6 falls per year was recorded.**
- Weight bearing exercises improves reduced forefoot plantar pressure evaluated with mat foot scan among diabetic neuropathy subjects (Mousa et al, 2005). Exercises of weight bearing for the lower extremities maximized firing of I a muscle spindle afferents thought to mediate joint proprioception and stimulate nociceptive afferents (Schneider and Ruderman, 2004). Also Hicksan et al, 1997 have demonstrated that full motor activation occurs in multijoint exercises, thus the large gains of strength and functional activities observed in closed kinematic chain exercises. Also closed kinematic chain was proved to improve motor performances than open kinematic chain exercises (Sleivert et al, 1998). **This subject was treated along with resisted exercises, specific Proprioceptive exercises using Physioball has benefited in line with the above studies as shown in the photographs pasted above the results.**
- Among diabetic patients with neuropathy a significant decrease in quality of life and functional capacity, development of micro vascular complications increases hospitalization and cardiovascular mortality rates in diabetic patients (Nascimento et al, 2016). **But based on Toronto clinical scoring system on a two point scale of weakness, ataxia, reflexes, sensory tests of 10 items the patient has shown only marginal improvement with physiotherapy as shown in the table.**

Limitations And Further Recommendations:

Though no specific physical therapy reports on diabetic neuropathy previously done, this study where a single subject was evaluated with physical, laboratory and functional means before and after physiotherapy, is a major limitation. Further studies on a larger subjects for longer duration period and other variables on neuropathy could be carried out.

V. Conclusion:

The findings of this research though innovative and first of its kind to be validated with larger sample size and other variables for benefit of diabetic subjects for preventive and promotive health means. With huge diabetic subjects in our country likely to suffer from diabetic neuropathy. With due physical therapy measures to improve glycemic control and complications arising from diabetic neuropathy such as falls, restricted morbidity, balance, lack of sensation in the feet, amputation, ulcers needs to be identified, prevented and treated.

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