THE OUTCOME MEASURES OF PNEUMATIC COMPRESSION VERSUS HIGH-FREQUENCY VIBRATION ON QUALITY OF LIFE IN DIABETIC POLYNEUROPATHY PATIENTS

BY

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CHAPTER I

INTRODUCTION

Neuropathy is nerve injury that starts with the longest nerves that innervate the toes and progresses proximally. Common symptoms are numbness, tingling, pain and/or weakness starting in the distal lower extremities. Diabetes is well established as the most important metabolic risk factor for neuropathy, but treatment of hyperglycaemia is not enough to prevent neuropathy in those with type 2 diabetes (**Callaghan et al., 2020).**

According to the International Diabetes Federation, 382 million people worldwide are currently affected by diabetes, one of the leading causes of neuropathy. The distal symmetrical polyneuropathy (DSPN) is the commonest clinical form of diabetic neuropathy, affecting more than 90% of the patients. Generally, DSPN affects the toes and distal foot, but slowly progresses proximally to involve the feet and legs in a stocking distribution. It is also characterized by a progressive loss of nerve fibers affecting both the autonomic and somatic divisions, thereby diabetic retinopathy and nephropathy can occur. Foot ulceration and painful neuropathy are the main clinical consequences of DSPN, linked with higher morbidity and mortality, patients look for medical help only when pain appears, a symptom that affects 10% to 26% of this population**. (Schreiber et al., 2015)**

According to international statistics, around one third of the diabetic patients have painful DPN. Several studies revealed that DPN is more common in T2DM than T1DM and is more prevalent in females than males. In addition, several studies conducted in Europe (United Kingdom) proved that racial differences affect the neuropathic pain levels of DPN **(Amara el al., 2019).**

There is clear evidence of the effect of intermittent pneumatic compression (IPC) in reducing the risk of DVT and improving of survival of inpatients, it also has positive effect on lymphedema, edema, balance and sensation**. (Zhang et al., 2018) also,** it can effectively improve the clinical symptoms of patients with diabetic peripheral neuropathy like neuropathy severity, Vibration sensation and dynamic stability. (**Jiang et al., 2018**).

Vibratory stimuli applied to the plantar region have beneficial effects on balance, blood supply, tactile sensation and whole body functions. Local vibration applied to the plantar region, immediate (within 5 min) significant improvements in postural stability and fall risk values were detected. **(Önal et al., 2020)**

Statement of the problem:

Is there any effect of pneumatic compression or high-frequency vibration quality of life in diabetic polyneuropathy patients .

Purpose of the study:

The purpose of the study is to compare the effect of pneumatic compression and high-intensity vibration on quality of life in diabetic polyneuropathy patients

Significance of the study:

National data in Egypt confirmed that 29.3% of Egyptian diabetic patients suffer from peripheral neuropathy **(Amara el al., 2019).** Diabetic neuropathy has a negative impact on postural balance and gait kinematics combined with increased fall risk. **(Macaré Maurik et al., 2015)**

Diabetic polyneuropathy is characterized by severe pain, loss of ambulation, and balance problems. It is considered to be a risk of falls and an increased risk of foot ulceration and amputation. Falls present a substantial health problem among the elderly population. Approximately one-third of community-dwelling people over 65 years of age will experience one or more falls each year (**Khan et al., 2022**)

In addition to the severity of neuropathic pain and its cognitive processing, the severity of diabetic polyneuropathy and demographic factors are key independent contributors to emotional distress in diabetic individuals**. (Kec et al., 2022)**

Early diagnosis and intervention have a high prevalence of preventing or slowing the progression of DPN. So, this study will compare the impact of high-frequency vibration and intermitted pneumatic compression on the amplitude and velocity of sensory & motor nerves of lower limbs in subjects with diabetic polyneuropathy. The results of this study may shed light on which of the two methods is better combined with the protocol of treatment for diabetic polyneuropathy. To our knowledge, there are no previous similar studies.

Hypothesis

There will be no significant effect of high-frequency vibration nor intermitted pneumatic compression on the amplitude and velocity of nerve conduction study in patients with diabetic polyneuropathy.

Delimitation:

This study delimited to the following respects:

-Sixty patients will be included in this study.

-Their ages ranged from 50-60 years old.

Basic Assumption:

- Every patient will follow the instructions and some of advice given to him.
- Every patient will adhere to the same regular treatmentsessions.
- The psychological status of the patients will not affect thestudy.
- The evaluating equipment will be accurately calibrated.
- All treatment sessions will be conducted at the same level ofaccuracy.

CHAPTER II

REVIEW OF LITERATURE

The phenotype of DN is heterogeneous. The most common form of DN is a chronic symmetrical length-dependent sensorimotor polyneuropathy, termed diabetic polyneuropathy (DPN), which accounts for 75–90% of all DN cases. Other types of DN include autonomic neuropathy, diabetic radiculoplexopathy (formerly called diabetic amyotrophy), mononeuropathies and treatment-induced neuropathies. In the following, we will focus on DPN, which can be either painful (PDPN) or non-painful. DPN is among other factors attributable to hyperglycemia, hyperglycemia-associated metabolic derangement, dyslipidemia and micro-vessel alterations. A broad and simple definition of DPN is "the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes". According to the International Association for the Study of Pain, neuropathic pain is pain caused by a lesion or disease of the somatosensory system. Along these lines, PDPN can be defined as "pain caused by a lesion of the somatosensory system attributable to diabetes". **(Gylfadottir et al., 2019).**

The International Diabetes Federation (IDF) has identified Egypt as the ninth leading country in the world for the number of patients with T2D. The prevalence of T2D in Egypt was almost tripled over the last 2 decades. This sharp rise could be attributed to either an increased pattern of the traditional risk factors for T2D such as obesity and physical inactivity and change in eating pattern or other risk factors unique to Egypt. These include increased exposure to environmental risk factors like pesticides and increased prevalence of chronic hepatitis C. **(Hegazi et al., 2015).**

Diabetes prevalence ranged from 2.6% in rural Sudan to 20.0% in urban Egypt. Diabetes prevalence was significantly higher in urban areas than in rural areas. Undiagnosed diabetes is common in Northern Africa with a prevalence

ranging from 18% to 75%. The prevalence of chronic diabetes complications ranged from 8.1% to 41.5% for retinopathy, 21% to 22% for albuminuria, 6.7% to 46.3% for nephropathy and 21.9% to 60% for neuropathy. **(Bos et al ,2013).**

The reported risk factors for PDN include being female, increasing age, high alcohol intake, cigarette smoking, duration of diabetes mellitus, obesity and elevated glycated hemoglobin (HbA1c) levels, The HbA1c level has been reported to be strongly associated with vascular complications of diabetes and is recommended as the "gold standard" for long-term glycemic control **(yang et al., 2021).**

Four main types of neuropathy can impact on the nervous system, including:

- **Peripheral symmetric neuropathy:** This affects the feet and hands. It is the most common form of diabetic neuropathy.
- **Autonomic neuropathy:** This occurs in the nerves that control involuntary functions of the body, such as digestion, urination, or heart rate.
- **Thoracic and lumbar root, or proximal, neuropathy**: This damages nerves along a specific distribution in the body, such as the chest wall or legs.
- **Mononeuropathies**: These can affect any individual nerve. **(Levine et al., 2018).**

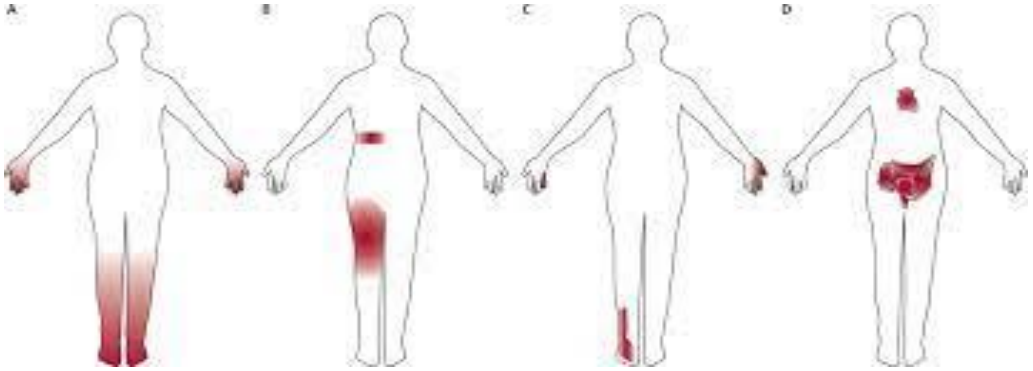


Figure (1)Types of neuropathy

Diagnosis

Diabetic neuropathies are complex diseases, and no robust definition or gold standard exist that fully encompass the complexity and changing course of nerve fiber damage in DPN. The hierarchical classification of DPN by the Toronto criteria into possible, probable or definite addresses this issue. By these criteria, possible DPN requires **symptoms** of decreased sensation (e.g., numbness or pricking feeling in the toes, feet or legs) or **signs** (i.e., symmetric decreased sensation or decreased or absent ankle reflexes). Definite DPN requires abnormal **nerve conduction studies** or an abnormal validated measure of small fiber damage in combination with a symptom or a sign. Importantly, these criteria permit for the changing course of nerve fiber damage in DPN, but at the same time they also illustrate the clinical challenge that there is no specific measure to diagnose DPN in any individual at all times throughout the course of DPN.

The examination for DPN starts at the "bedside" with simple assessments of signs of neuropathy. The bedside tools for testing cutaneous sensation, the large fiber function: 10-g monofilament, vibration with a 128-Hz tuning fork, touch and joint position, and small-fiber function: cold and warm sensation, and pinprick.

In addition, the examination should include foot inspection, joint mobility, testing and evaluation of motor function. The following Table summarizes a list of symptoms and clinical signs and assessments proposed for the clinical evaluation of DPN. **(Gylfadottir et al., 2019).**

Characteristics of large and small fiber function and their assessment.

	Large fiber neuropathy	Small fiber neuropathy
Symptom	Numbness, tingling, gait instability	Burning pain, electrical shock, stabbing pain
Examination	Reflexes, proprioception, vibration	Temperature, pinprick sensation
Function	Pressure, balance, muscle strength	Pain sensation, protective sensation
Diagnostic test	• Nerve conduction studies • DPN Check™ (point-of-care device assessing sural nerve conduction) • Neurothesiometer • Vibrameter • Tuning fork (128 Hz)	• Quantitative sensory testing (QST) • Intradermal nerve fiber structure • Cornea confocal microscopy • Laser Doppler imaging after noxious stimulus • Sudomotor function • Skin conductance measurement • Microneurography

Testing sensory and motor nerves by nerve conduction studies (NCS) using EMG devices characterizing the most distal sensory nerve fibers at lower limbs. Thus, whole plantar nerve (WPN) may represent an extremely useful diagnostic tool for diabetic PN early detection. **(Galiero et al., 2021).**

NCS using computer-based electro diagnostic equipment was a suitable tool for the diagnosis of DPN. For over 70% of the patients, the specific diagnostic question of the presence of DPN was addressed by NCS with evidence-based criteria **(kong et al., 2008)**

Effect of intermitted compression on circulation, vascularity and blood flow, hand intermittent pneumatic compression evokes transitory hypoxic stimuli in distal finger skin microcirculation inducing vasodilation of arterial inflow vessels, enhanced perfusion, and maximum capillary recruitment in young and older subjects and older subjects with type 2 diabetes mellitus. Enhanced shear stress in the microcirculation did not appear to induce local skin vasodilation**. (Thorn et al., 2021).**

The effect of whole body vibration on balance in patients with diabetic polyneuropathy in combination with the balance exercise program, the short-term WBV therapy is beneficial in improving balance, muscle strength and HbA1c, in elderly patients with diabetic neuropathy who are at high risk for suffering falls**. (Sabziparvar et al., 2021).**

CHAPTER III
SUBJECTS AND METHOD

I- Subjects:

Sixty female patients have diabetic polyneuropathy, and their ages will range from 50 to 60 years old. They will be selected from internal clinic of kafr el sheikh general hospital.

Study Design:

This experimental comparative study will be performed in the outpatient clinics of Kafr El-sheikh general hospital -After clinical assessment they will be randomly allocated into three groups:

Group A (experimental group A): twenty patients will receive plantar &ankle and cuff vibration of both lower limbs program for diabetic polyneuropathy for 12 weeks (3 sessions/ week) combined with medical treatment.

Group B (experimental group B): twenty patients will receive program containing pneumatic compression for both lower limbs for diabetic polyneuropathy 12 weeks (3 sessions/ week) combined with medical treatment.

Group C (Control group): twenty patients will receive conventional program for diabetic polyneuropathy 12 weeks (3 sessions/ week) combined with medical treatment.

Inclusion Criteria: all the following criteria should be found.

1- Sixty female patients.

2- Their ages will range from 50 to 60 years old.

3- Their HbA1c is more than 7% and less than 9 %.

4- Bilateral lower limb chronic DPN.

5- They suffer mild diabetic polyneuropathy for at least three months.

6- All the patients have significant decrease in the sensory (sural &superficial peroneal) lower limb nerve conduction velocity (from 20 m/s to 30 m/s).

7- All the patients have significant decrease in the motor (tibial &deep peroneal) lower limb nerve conduction velocity (from 20 m/s to 30 m/s).

8- All the patients have score more than in 20 Norfolk QOL-DN.

9- They all have score more than 8 on Toronto scoring system.

10- They have willingness to participate in this study.

Exclusion criteria:

Patients with one of the following criteria will be excluded from the study:

1. Chest diseases (either obstructive or restrictive).
2. Smoker patient.
3. Clinical signs of a severe cardiac event. (eg, congestive heart failure),
4. Severe psychiatric or cognitive impairment, who unable to follow comment.
5. Neurological disorders affecting respiratory muscles or any muscular dystrophies (cervical disc or bulge).
6. Other type of polyneuropathy (Alcoholic, hereditary…..).

a) Any patient that suffer from lower limb pathology that may interfere with the results like:
b) Cellulitis.
c) Lower limb pressure or diabetic ulcer.
d) Atherosclerosis.
e) Deep venous thrombosis.

Ethical consideration:

A-Faculty Ethical committee:

Ethical Committee approval of the faculty of physical therapy, CairoUniversity will be achieved before starting the study.

B- Patient consent form:

All subjects enrolled in the study will be informed about the aim, technique, and experimental protocol of this study before participation. A written informed consent will be assigned prior to participation as shown in **(APPENDIX I).**

II Measuring and equipment:

A- Evaluative Equipment:

1. **weight and height scale:** To measure body weight and height to calculate BMI

2. **Quo Lab HbA1c Analyzer: For measuring hemoglobin A1c.**

3. **EMG-DYEMD TRUTRACE PT:** made in checz republic**:** Electromyographic device used for measuring nerve conduction velocity and other nerve abnormalities to detect different pathologies and manifestations.

4. **The Norfolk Quality of Life Questionnaire-Diabetic Neuropathy (Norfolk QOL-DN):** A validated comprehensive questionnaire designed to capture the entire spectrum of DN related to large fiber, small fiber, and autonomic neuropathy not captured in existing instruments **(Veresiu et al, 2015).** **APPENDIX II**

5- Brief Pain Inventory scale for painful diabetic peripheral neuropathy (Zelman et al., 2005). **APPENDIX III**

The Brief Pain Inventory (BPI) is a worksheet made up of 15 questions. You're asked to numerically rate the effect of your pain in categories such as:

- How you relate with other people
- How well you can walk
- How you've slept over the last 24 hours

This pain scale captures more nuance in terms of how your pain is affecting your day-to-day life.

6-Toronto clinical scoring system (TCSS): **APPENDIX VII.**

Also called the Toronto clinical neuropathy score (TCNS), the system was first adopted by a research group in Toronto for the screening of DPN. The TCSS consists of three parts: symptom scores, reflex scores and sensory test scores. The maximum score is 19 points .The criteria of classification for DPN have also been proposed according to the TCSS score: zero to five points, without DPN; six to eight points, mild DPN; nine to 11 points, moderate DPN; and 12 to 19 points, severe DPN .The TCSS has been employed in people with type 2 diabetes to assess the prevalence of painful DPN. **(Yang et al., 2018).**

7-The Berg Balance Scale (BBS) APPENDIX VI.

Is is used to objectively determine a patient's ability (or inability) to safely balance during a series of predetermined tasks. It is a 14 item list with each item consisting of a five-point ordinal scale ranging from 0 to 4, with 0 indicating the lowest level of function and 4 the highest level of function and takes approximately 20 minutes to complete. It does not include the assessment of gait.

B- Treatment Equipment:

Compression limb and circulation therapy system: Model name: power q 2000.

Made in korea

Phoenix Massage Gun, Massager

- Brand: Phoenix
- Premium Quality
- Power Source: Cordless Electric
- Model Number: A2
- Type: Multi Usage
- Messaging Technique: Percussion
- DC:24 volt.
- Intensity:1500 mA.

II- Procedures:

The following procedure will be applied before and after the treatment program.

Evaluating Procedure:

1- Weight and height:

The height and weight were measured for each patient. Weight-Height scale was calibrated. The subject will be stand on the scale 2 times and the average weight was taken. Weight was measured in the morning not wearing shoes and with the minimum clothing possible (tops and bottoms). Height was measured to the nearest 0.1 cm with the subject standing bare feet, keeping shoulders in a relaxed position, arms hanging freely, and head aligned in horizontal plane.

2- HbA1c: all the subjects will perform pretest $HA1_C$ test to include the diabetic criteria.

Normal values vary from 3 to 6 mmol/mol, where the prediabetic starts from seven and the the diabetic starts from 8 mmol/mol according to the diabetic. **(Monnier et al., 2016). APPENDIX IV**

3- **Bilateral lower limb sensory& motor nerve conduction study**.

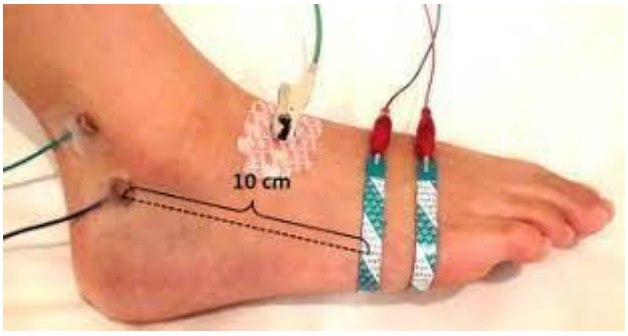
All patients will follow the same evaluative procedures.

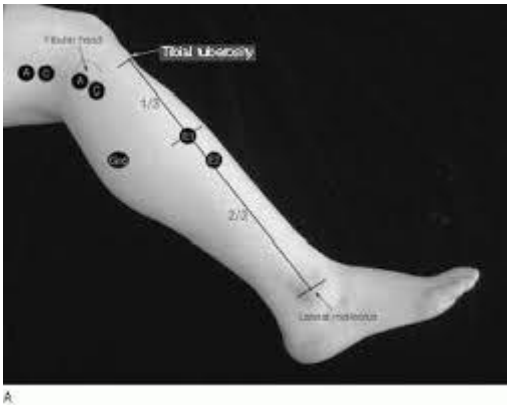
a) Sensory nerve conduction velocity .:normally it ranges from 49 to 52 m/ms. At diabetic polyneuropathy it decreases to 20 m/ms.

b) motor nerve conduction velocity of the lower limb ranges between 40 to 41 m/s and it decreases to 20 m/s in neuropathy

c) Sensory& motor nerve conduction evaluation for right and left sural, posterior tibial, deep peroneal and superficial peroneal nerves:

Using a 14-cm antidromic technique, data were collected for onset latency, peak latency, onset-to-peak amplitude, peak-to-peak amplitude, area, duration, side-to-side variability, and between-nerve variability. **(Misra et al., 2016)**





4- **Using the Norfolk Quality of Life Questionnaire-Diabetic Neuropathy (Norfolk QOL-DN):**

Which consist of 48 questions. For items 1–7, respondents were asked to score the presence of seven symptoms (numbness, tingling/pins and needles, electric shocks, superficial pain, deep pain, weakness, other symptoms) in their feet, legs, hands, and/or arms during the past 4 weeks. These symptoms relate specifically to nerve fiber function: For example, numbness, tingling, and pins and needles relate to **small fibers**, while electric shocks and weakness relate to **large fiber** neuropathy.

Scores for each symptom equal the number of body sites for which a symptom is reported (i.e., 0–4). **Items 8–11** pertain to duration of symptoms, nature of symptoms (e.g.,worse at night), and medications. These are for clinical purposes and are not included in the scoring of any of the scales.

For items 12–15, respondents are asked to indicate "yes" (1) or "no" (0) to a diagnosis of neuropathy or the existence of complications of small fiber neuropathy (e.g., gangrene). **For items 16–37**, respondents are asked to refer to the past 4 weeks and indicate on a 5-point Likert-type scale the extent to which physical problems related to neuropathy have presented a problem when performing ADL (e.g. bathing)

(0 □ "not a problem" to 4 □ "severe problem"). **Items 38–46** represent generic health status items (e.g., pain interfere with normal work) and are not nerve fiber specific. Respondents indicate health status on a 5-point Likert-type scale with higher scores indicating poorer health status. **Item 47** asks respondents to indicate number of pain medications used (past and present) from 1–2, 3–4, or 5 or more**. (Coelho, Teresa, et al., 2017)**.

A) Treatment procedure:

Group A (Experimental group): twenty female patients will receive combined program of **planter& ankle and cuff vibration** for both lower limbs with conventional program for diabetic polyneuropathy 12 weeks (3 sessions/ week).

Local plantar vibration for the treatment of diabetic neuropathy: (Sabziparvar et al., 2021)

Before starting the treatment, we explained the procedure to the patient, and informed consent was obtained. The patient was positioned in a crook lying on the bed with a pillow under the knees. The patient wore no shoes and socks. The room temperature was set to 25 °C. A local vibration with a frequency of 62.5 Hz for 7 min was applied to the plantar side of both feet& cuff muscle and dorsal aspect of the foot The device was placed on a footstool, out of bed. The patient was treated for three sessions every other week.

2- Group B (Experimental group): twenty female patients will receive combined program of **Intermitted pneumatic compression** for both lower limbs with conventional program for diabetic polyneuropathy 12 weeks (3 sessions/ week).

Intermittent pneumatic compression (1-Salek et al., 2015). The intervention was conducted by using IPC for all sessions with 1-day interval. Every session lasted 15 min with pressure of 170 mmHg.

Frequency: 3 time / week for 12 weeks. At the beginning of each session, patients filled out a consent form and tested for blood sugar level, to control hypo- or hyperglycemia. Before starting the treatment, all processes were explained to the participants and necessary comments were given to them. Patients were asked to lie in supine position and cuffs of IPC placed around their feet to the upper part of thigh. The applying pressure of IPC was 170 mmHg with slow speed of inflation in all sessions. This process was repeated for all patients in the intervention group.

2- Group C (Control group):

Twenty female patients will receive **conventional program** for both lower limbs with program for diabetic polyneuropathy 12 weeks (3 sessions/ week).

A) Conventional exercise consist of:

- **Infra Red Thermal Stimulation on** the lower limb for 10 mins repeated 3time/week for 12 weeks.

- **Stretching exercises for calves and hamstrings**: Subject sit on a chair or bench and take chin down towards one shoulder then use hand ontop of head to encourage chin down, while using other hand to grab the chair behind subject and resist.

-**Balance exercises** each subject will use balance board for 5 mins three times a week for three months (12 sessions) to improve balance ability and to prevent falls.

STATISTICAL ANALYSIS

The data will be collected from patients before and after the application of the treatment protocol and it will be classified into pre and post-treatment values.

Descriptive statistics

The data will be represented as: mean, standard deviation and percentage of improvement level of significance < 0.05.

-Inferential analysis:-

ANOVA will be used to compare the effect of three different approaches among the three groups

Differences in the values for each subject before and after treatment were evaluated using the **paired t- test.**

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APPENDIX I

Informed consent form

I am freely voluntarily consenting to participate in this research study under the supervision of research: mohamed shawky el iraqi

A descriptive of the study procedure has been explained tome and understands that I may withdraw may consent and discontinue participation in this research study at any time without prejudice to me.

Participant

Date

إقرار

أوافق أنا ..... على المشاركة في الدراسة البحثية الخاصة بالباحث/محمد شوقي العراقي ، وقد تم شرح خطوات البحث لي .بالتفاصيل وإنه من حقي أن انسحب من الدراسة في أي وقت ودون أي أضرار لي وهذا إقرار مني بذلك

التوقيع

التاريخ

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Appendix II

Norfolk quality of life questionnaire-diabetic neuropathy

Table 2.
Communalities [a]

List of abbreviated questions	Extraction
1. Numbness	0.621
2. Tingling	0.676
3. Electric	0.376
4. Unusual sensations	0.341
5. Superficial pain	0.515
6. Deep pain	0.577
7. Weakness	0.476
16. Pain kept awake?	0.474
17. Touch of bed sheets bothered?	0.524
18. Burned or injured and not felt?	0.571
19. Symptom kept you from usual activities?	0.644
20. Difficulty fine movements?	0.550
21. Unsteady on feet?	0.685
22. Problem getting out of chair?	0.612
23. Problem walking downstairs?	0.678
24. Unable to feel feet?	0.587
25. Unable to tell hot/cold with hands?	0.545
26. Unable to tell hot/cold with feet?	0.416
27. Vomiting after meals?	0.685
28. Diarrhea or loss of bowel control?	0.456
29. Involuntary urination?	0.414
32. Orthostasis?	0.372
33. Difficulty bathing/showering?	0.755
34. Difficulty dressing?	0.748
35. Difficulty walking?	0.789
36. Difficulty getting on/off toilet?	0.753
37. Difficulty using eating utensils?	0.530
38. Health—cut work or other time?	0.720
39. Health—accomplished less?	0.774
40. Health—limited in kind of activity?	0.779
41. Health—difficulty performing activity/work?	0.816
42. Your general health now?	0.595
43. Compared to 3 months ago, health now is?	0.564
44. Physical health interfered with normal social activity?	0.561
45. Pain interfered with normal work?	0.662
46. Weakness or shakiness interferes with normal work?	0.642

[a] Communalities ranged from 0.341 to 0.81. Questions 1–7 relate to symptoms, 16–37 relate to activities of daily living, and 38–46 relate to generic health over the past 4 weeks.

APPENDIX III

Brief Pain Inventory

Date: ____/____/____ Time: _____

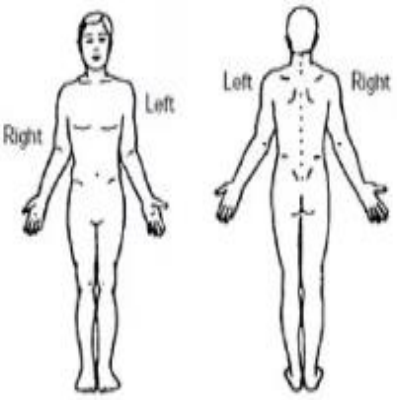
Name: _____ _____ _____

Last First Middle intial

1) Throughout our lives, most of us have had pain from time to time (such as minor headaches, sprains, and toothaches). Have you had pain other than these everyday kinds of pain today?

1. Yes 2. No

2) On the diagram, shade in the areas where you feel pain. Put an X on the area that hurts the most.



3) Please rate your pain by circling the one number that best describes your pain at its **worst** in the past 24 hours.

0 1 2 3 4 5 6 7 8 9 10
No pain — Pain as bad as you can imagine

4) Please rate your pain by circling the one number that best describes your pain at its **least** in the past 24 hours.

0 1 2 3 4 5 6 7 8 9 10
No pain — Pain as bad as you can imagine

5) Please rate your pain by circling the one number that best describes your pain on **average**.

0 1 2 3 4 5 6 7 8 9 10
No pain — Pain as bad as you can imagine

6) Please rate your pain by circling the one number that tells how much pain you have **right now**.

0 1 2 3 4 5 6 7 8 9 10
No pain — Pain as bad as you can imagine

7) What treatments or medications are you receiving for your pain?

_____

_____

8) In the past 24 hours, how much **relief** have pain treatments or medications provided? Please circle the one percentage that most shows how much relief you have received.

0% 10 20 30 40 50 60 70 80 90 100%
No relief — Complete relief

9) Circle the one number that describes how, during the past 24 hours, pain has **interfered** with your:

A. General activity

0 1 2 3 4 5 6 7 8 9 10
Does not interfere — Completely interferes

B. Mood

0 1 2 3 4 5 6 7 8 9 10
Does not interfere — Completely interferes

C. Walking ability

0 1 2 3 4 5 6 7 8 9 10
Does not interfere — Completely interferes

D. Normal work (includes both work outside the home and housework)

0 1 2 3 4 5 6 7 8 9 10
Does not interfere — Completely interferes

E. Relations with other people

0 1 2 3 4 5 6 7 8 9 10
Does not interfere — Completely interferes

F. Sleep

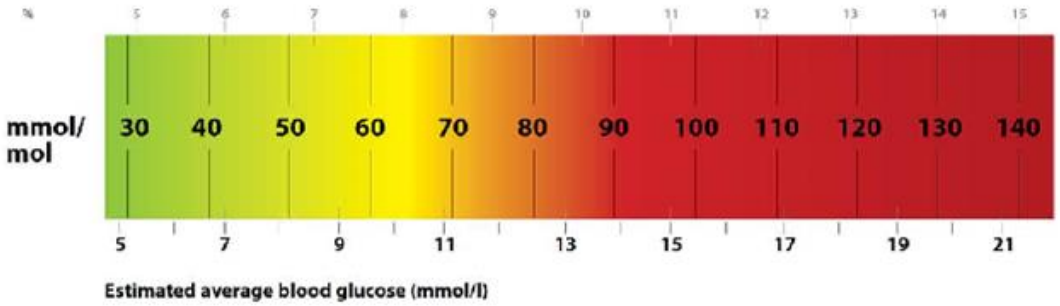
0 1 2 3 4 5 6 7 8 9 10
Does not interfere — Completely interferes

G. Enjoyment of life

0 1 2 3 4 5 6 7 8 9 10
Does not interfere — Completely interferes

APPENDIX IV

HbA_1C as indicator of Glycaemic Control



APPENDIX V

Table 3. Grading of muscle strength

Grade	Ability to move
5	The muscle can move the joint it crosses through a full range of motion, against gravity, and against full resistance applied by the examiner.
4	The muscle can move the joint it crosses through a full range of motion against moderate resistance.
3	The muscle can move the joint it crosses through a full range of motion against gravity but without any resistance.
2	The muscle can move the joint it crosses through a full range of motion only if the part is properly positioned so that the force of gravity is eliminated.
1	Muscle contraction is seen or identified with palpation, but it is insufficient to produce joint motion even with elimination of gravity.
0	No muscle contraction is seen or identified with palpation; paralysis.

APPENDIX VI

Berg scale for balance assesment

	Old	Revised
1. SITTING TO STANDING		
able to stand without using hand and stabilize indep.	4	4
able to stand independently using hands	3	3
able to stand using hands after several tries	2	2
needs minimal aid to stand or to stabilize	1	0
needs moderate or maximal assist to stand	0	0
2. STANDING UNSUPPORTED		
able to stand safely 2 minutes	4	3
able to stand 2 minutes with supervision	3	3
able to stand 30 seconds unsupported	2	1
needs several tries to stand 30 seconds unsupported	1	1
unable to stand 30 seconds unassisted	0	0
3. SITTING UNSUPPORTED		
able to sit safely and securely 2 minutes	4	3
able to sit 2 minutes under supervision	3	3
able to sit 30 seconds	2	1
able to sit 10 seconds	1	1
unable to sit without support 10 seconds	0	0
4. STANDING TO SITTING		
sits safely with minimal use of hands	4	4
controls descent by using hands	3	3
uses back of legs against chair to control descent	2	1
sits independently but has uncontrolled descent	1	1
needs assistance to sit	0	0
5. TRANSFERS		
able to transfer safely with minor use of hands	4	4
able to transfer safely definite use of hands	3	3
able to transfer with verbal cueing and/or supervision	2	2
needs one person to assist	1	0
needs two people to assist or supervise to be safe	0	0
6. STANDING UNSUPPORED WITH EYES CLOSED		
able to stand 10 seconds safely	4	4
able to stand 10 seconds with supervision	3	3
able to stand 3 seconds	2	1
unable to keep eyes closed 3 seconds but stays steady	1	1
needs help to keep from falling	0	0
7. STANDING UNSUPPORTED WITH FEET TOGETHER		
able to place feet together independently and stand 1 minute safely	4	4
able to place feet together independently and stand 1 minute with supervision	3	3
able to place feet together independently but unable to hold for 30 seconds	2	2
needs help to attain position but unable to stand 15 seconds feet together	1	0
needs help to attain position and unable to hold for 15 seconds	0	0

	Old	Revised
8. REACHING FORWARD WITH OUTSTRETCHED ARM		
can reach forward confidently >25cm	4	4
can reach forward >12cm safely	3	3
can reach forward >5cm safely	2	1
reaches forward but needs supervision	1	1
loses balance while trying;requires external support	0	0
9. PICK UP OBJECT FROM FLOOR		
able to pick up slipper safely and easily	4	4
able to pick up slipper but needs supervision	3	3
unable to pick up but reaches 2–5cm from slipper and keeps balance indep	2	0
unable to pick up and needs supervision while trying	1	0
unable to try/needs assist to keep from losing balance or falling	0	0
10. TURN TO LOOK BEHIND		
looks behind from both sides and weight shifts well	4	4
looks behind one side only other side shows less weight shift	3	2
turns sideways only but maintains balance	2	2
needs supervision when turning	1	1
needs assist to keep from losing balance or falling	0	0
11. TURN 360 DEGREES		
able to turn 360 degrees safely in 4 seconds or less	4	3
able to turn 360 degrees safely one side only in 4 seconds or less	3	3
able to turn 360 degrees safely but slowly	2	2
needs close supervision or verbal cuing	1	1
needs assistance while turning	0	0
12. PLACE ALTERNATE FOOT ON STEP OF STOOL		
able to stand independently and safely and complete 8 steps in 20 seconds	4	3
able to stand independently and complete 8 steps > 20 seconds	3	3
able to complete 4 steps without aid with supervision	2	1
able to complete > 2 steps needs minimal assist	1	1
needs assistance to keep from falling/unable to try	0	0
13. TANDEM STANCE		
able to place foot tandem independently and hold 30 secs	4	4
able to place foot ahead of other independently and hold 30 seconds	3	3
able to take small step independently and hold 30 secs	2	0
needs help to step but can hold 15 seconds	1	0
loses balance while stepping or standing	0	0
14. STANDING ON ONE LEG		
able to lift leg independently and hold > 10 seconds	4	4
able to lift leg independently and hold 5-10 seconds	3	2
able to lift leg independently and hold = or >3 seconds	2	2
tries to lift leg unable to hold 3 seconds but remains standing independently	1	1
unable to try or needs assist to prevent fall	0	0

Key: ⇨ = pivot point for each item

Appendix VII

Toronto Clinical Scoring System (TCSS)

TCSS items		Description
Symptoms score	Pain	0 = absent, 1 = present
	Numbness	0 = absent, 1 = present
	Tingling	0 = absent, 1 = present
	Weakness	0 = absent, 1 = present
	Ataxia	0 = absent, 1 = present
	Upper-limb symptoms	0 = absent, 1 = present
Reflex score	Knee reflexes	Score for each side: 0 = normal, 1 = reduced, 2 = absent
	Ankle reflexes	Score for each side: 0 = normal, 1 = reduced, 2 = absent
Sensory test score	Pinprick	0 = normal, 1 = abnormal
	Temperature	0 = normal, 1 = abnormal
	Light touch	0 = normal, 1 = abnormal
	Vibration sense	0 = normal, 1 = abnormal
	Position sense	0 = normal, 1 = abnormal

القياسات المستخرجة للضغط المتقطع في مقابل الإهتزاز عالي التردد علي جودة الحياة في حالات إلتهاب الأعصاب الطرفية لمريض السكري