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Research Article

EVALUTION OF HAND BASED ON SENSATION, VIBRATION AND GRIP STRENGTH IN ELECTRICIANS

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A R T I C L E I N F O

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A B S T R A C T

Aim: To compare hand based on sensation, vibration and grip strength in normal individuals and electricians using drill machine.
Background: Hand arm vibration syndrome is an occupational disease seen among workers using vibratory tools. These patients experience symptoms of upper limb particularly of hand. Very few studies are been done in workers using low frequency vibratory tools.
Methodlogy: Primary data collection was done using convenient sampling. 60 individuals between 25-35 age group were selected and divided in two groups normal individuals and electricians containing 30 each.Assessment was done using Semmes Weinstein monofilament, jamar dynamometer and 128 Hz tuning fork.
Results: Hand muscle strength, sensation and Vibration sense has shown reduction in electricians compared to normal individuals.
Conclusion: The study concludes that there is decrease in sensation, vibration and grip strength in electricians.

INTRODUCTION

Vibration is periodic back and forth motion of the particles of the elastic body or medium, commonly resulting when any physical system is displaced from its equilibrium. The nature of these tools involves vibration which is transmitted from tool to the hands and arm of the person holding the tool. Vibration exposure may cause hand arm vibration syndrome (HAVS), which is characterised by 'vibration white finger' (VWF), sensorineural symptoms and musculoskeletal disturbances [(1)]. Hand held vibratory tools are commonly used in different occupations. The tools vary in size, weight, acceleration, amplitude and frequency. Other factors of importance include vibration impulsiveness, the direction of vibration, the intermittence of exposure, the work methods, the contact force and posture.

Vibration exposure may affect large myelinated nerves (A beta) that respond to touch, pressure and vibration exposure. Small sensory nerves (myelinated a-delta fibres and unmyelinated C-fibres) can also be affected which will decrease the patients thermal and pain perception [(1)].

The development of these symptoms depends on several factors, e.g. the intensity and duration of exposure, the type of process involved and the tools used, as well as genetic and ergonomic factors[(1)] .

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Hand arm vibration syndrome is an occupational disease in workers who are exposed to vibration due to the usage of vibratory tools such as jack hammers, pneumatic hammers, drills and chain saws[(2)].

Vibration injuries are subdivided into three subgroups: neurological, vascular and musculoskeletal disorders. Neurological injuries persist early symptoms such as tingling and/or numbness in the hands and the fingers. Damage caused by fully developed neurological vibration is irreversible which leads to high level of disability and work impairment [(3)].

Vascular injuries affects the capillaries in the hand and fingers, causing these to constrict. This causes blanching. During the episodes of blanching, caused by vasoconstriction, to the parts of the fingers or the hand, the person experiences numbness [(3)]. Musculoskeletal injuries may take the form of arthritis, tendinitis and changes in muscle fibres, can result in impaired grip force, reduce mobility and pain in hand and arm. [(3)]

The Jamar dynamometer is the gold-standard in grip strength testing equipment. It is an instrument for measuring the maximum isometric strength of hand and forearm muscles. It was introduced in 1954 (bechtol; 1954) and consists of a sealed hydraulic system with adjustable hand spacing that measures handgrip force. The dynamometer is used for testing hand grip strength and tracking progress with strength training and during rehabilitation. It is found to be highly reliable (0.98) and valid (0.99) for measuring hand grip strength. [(4)] Semmes Weinstein monofilament is used to assess touch sensation. It is available in 5 sizes of which 2.80 (0.07g) is

used to assess normal sensation. It can detect change over time i.e. progression and deterioration.[5] Tuning fork a two-pronged steel device which vibrates when struck. It provides an easy and inexpensive test of vibratory sensation. [5]

MATERIALS AND METHODS

Study Design

Type of study – comparative study
Duration of study – 1 year
Location – metropolitan city

Sample Design

Sample size – 60
Sample population – Group A-Normal individuals (25-35years)
Group B- Electricians (25-35years)
Sampling – convenient sampling

Materials Used

0.07g Semmes Weinstein monofilament
Jamar dynamometer
128 Hz tuning fork
Pen
Writing pad

Inclusion Criteria

1. Electricians (minimum 1year of exposure)
2. Dominant hand
3. 25-35yearsindividual
4. Patients willing to participate

Exclusion Criteria

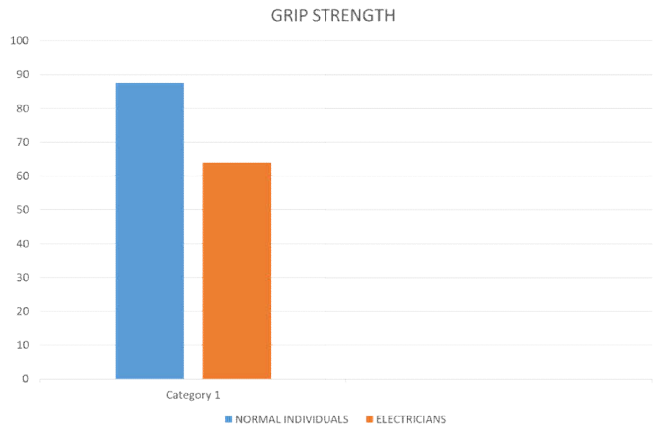
1. Diabetic neuropathy
2. Recent hand injuries
3. Cervical radiculopathy
4. Unwilling to participate
5. Congenital deformities of hand

Procedure

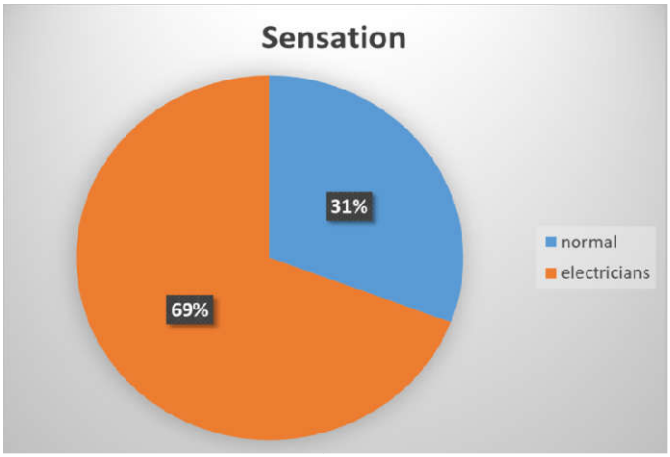
A written consent form will be taken from the subject in the language best understood by them. Screening of the subject will be done as per the inclusion criteria. 60 subjects are divided into two groups, group A (30 normal individual) and group B (30 electricians using drill machine). Participants will be screened for the sensation using 0.07g Semmes-Weinstein monofilament apparatus. During this process, the individual has to close their eyes and indicate by responding yes, when monofilament will be touched on their hand. Hold the monofilament perpendicular to hand and with a smooth, steady motion, touch the skin until the monofilament bends approximately 1cm. Hold it against the skin for approximately 2seconds. Using the monofilament, test 10 sites according to the zones of hand. Repeat the test up to 3 times on the area when the subject does not indicate they feel the monofilament. Vibration perception will be assessed using 128Hz tuning fork. During this process, tuning fork has to be hit on rubber pad and placed on the ulnar styloid process, then following that the participant is asked whether the vibration is felt. Strength of hand muscles of the subject will be assessed using dynamometer, holding the handle of the dynamometer is adjusted if required - the base should rest on first metacarpal (heel of palm), while the handle should rest on middle of four fingers. Participant then squeezes the dynamometer with maximum isometric effort, which is maintained for about 5 seconds. No other body movement is allowed. The subject should be strongly encouraged to give a maximum effort with the arms at the right angles and elbow by the side of the body.

RESULT

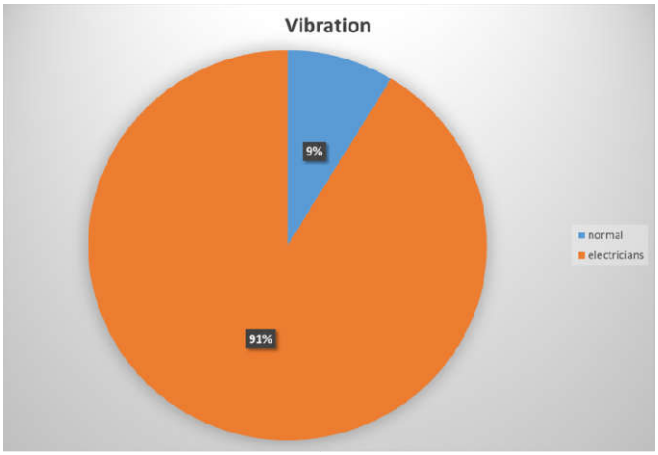
The study concluded that there wasreduction in grip strength in electricians using drill machine compared to normal individuals. Also sensation was affected in 69% of electricians and vibration in 91% of electricians.



The above graph shows grip strength is reduced in electricians.



The above graph shows sensation is affected in 69%of electricians.



The above graph shows vibration is affected in 91% of electricians.

DISCUSSION

The present study aimed to evaluate and compare the hand based on sensation, vibration and grip strength in electricians and normal individuals.The present study documents that grip strength was reduced in electricians compared to normal individuals which may be due to thenar muscles which may undergo necrosis, fibrosis and fibre-type regrouping, indicating that vibratory tools may cause damage to the muscles as well as to the nerve supply[6]. Also L. Gerhardsson *et al*. [2] conducted a study which contradicts the present study by saying that there is no significant difference in normal and vibration exposed individuals hand muscle strength.

The present study documents sensation was affected in 69% of the electricians which were assessed over the palmar aspect of the hand at five different points according to the zones of hand using Semmes-Weinstein monofilament as palmar aspect is more in contact with the vibratory tool than the dorsal aspect of the hand and absorption of vibration may be associated with tissue shear and bending stresses that may increase the risk of tissue damage through increase in oxidative stress and inflammation[14] which concluded that vibration is affected. Supporting the present study, a study reported by Roh JH [9] showed that there is prevalence of the vibration syndrome in rock drillers using vibratory tools.

The present study states that vibration perception is reduced in 91% electricians which may be due to affection of large myelinated nerves (A beta) that respond to touch, pressure and vibration exposure. Supporting the present study, a study done by Gerhardsson L *et al*. [1] showed significant increase of the vibrotactile perception in exposed workers.

In the present study the electricians were between 25-35 years old and thus an age dependent effect seen in geriatric population is excluded. Supporting the present study, studies conducted by Tsunetaka Matoba[6] and Malchaire *et al*. [7] states that short term exposure to vibratory tools reduced the vibrotactile perception. Also a study done by Perry [12] subjects in the age group of 72-73years old showed a doubling of their detection threshold as compared to the age group 65-71years old which can also include age related changes together with the effect of use of vibratory tools.

In present study objective instruments like jamar dynamometer which was found to be highly reliable (0.98) and valid (0.99) for measuring hand grip strength[4], tuning fork and Semmes Weinstein monofilament which is the most sensitive predictors of early vibration induced neurophysiologic effects in hands [1] were used to assess the hand function. The probable cause of reduction in sensory and vibratory perception of hand may be due to chronic micro traumatism and perivascular and peripheral vegetative formations, leading to disturbances in tissue trophism and blood supply. It also affects the nerve trunks as well as on the skin receptor apparatus. A study conducted by Buhaug *et al*.[10] which used DASH questionnaire to describe the disability in the upper limb of hand arm vibration syndrome patients which is a self-report questionnaire that patient rates contradicts the present study as DASH score interprets the affection of the whole upper limb and not particularly the hand. DASH cannot be computed if greater than three items are missing. Hence the objective instruments were used in the present study.

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