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SCREENING OF SUBCLINICAL SENSORY IMPAIRMENT IN HAND AMONG DIABETIC BLINDS

Janakiraman Balamurugan[1], Ravichandran Hariharasudhan[2]

[1]Madha College of Physiotherapy, Chennai
[2]Sree Balaji Medical College and Hospital, Chromepet, Chennai

E-mail of Corresponding Author: bala77physio@gmail.com

ABSTRACT

Background: Prior to hand rehabilitation of blinds with diabetic retinopathy, assessment of tactual deficits is the key towards the functional outcomes of rehabilitation. Force sensitivity threshold and spatial resolution testing are easy tools in detecting subclinical impairment of peripheral nerves. Both are reliable, less expensive, very accurate and less time consuming in detecting sensory deficits. This study attempts to use force sensitivity threshold and spatial resolution testing to identify subclinical sensory impairment in hand among diabetic blinds. **Objectives:** To identify subclinical diabetic peripheral neuropathy in late blind adult subjects with diabetic retinopathy. **Study Design:** Observational study.
Study Setting: Opthalmology and Endocrine departments of Madha Medical College and Hospital, Chennai and Sree Balaji Medical College Hospital, Chennai. **Interventions:** Not applicable.
Outcome measures: Quantitative parameters include cutaneous force threshold and spatial resolution threshold. **Methods:** Sixty participants of three different categories, twenty in each category, participated in the study. The 20 subjects of each group (Diabetic blind group, Non Diabetic late blinds, and Blind folded sighted group) were subjected to force sensitivity threshold test and tactile spatial resolution test after obtaining consent. **Statistical Analysis:** The data was analyzed using one way ANOVA and Kruskal Wallis test, 5% level of probability was used to indicate statistical significance **Result:** The mean of force sensitivity among Experimental group consisting of diabetic blinds was 1.127gm, (S.D: 0.99, range: 0.04-2.00), mean of spatial resolution capacity of static 2 point test was 3.25mm, (S.D: 0.76, range: 2 - 4), moving 2 point test was 2.85mm (S.D: 0.489, range: 2 - 4). Control group 1, mean force sensitivity was 0.3415gm, (S.D: 0.715, range: 0.02-2.00), mean of spatial resolution capacity of static 2 point test was 1.80mm, (S.D: 0.41, range: 1 - 2), moving 2 point test was 1.10mm (S.D: 0.308, range: 1 - 2). Control group 2, mean force sensitivity was 0.64gm, (S.D: 0.91355, range: 0.04-2.00), mean of spatial resolution capacity of static 2 point test was 2.20mm, (S.D: 0.41, range: 2 - 3), moving 2 point test was 1.50mm (S.D: 0.513, range: 1 - 2). **Conclusion:** The study result shows that there is a significant difference between the groups. Diabetic blinds performed significantly poorer than the controls in terms of Force sensitivity threshold and spatial resolution.

Keywords; Diabetic retinopathy, Diabetic neuropathy, Monofilament testing, Two Point discrimination tests, hand rehabilitation.

INTRODUCTION

Sense of touch is a critical component of normal tactile hand function and provides us the ability to effectively perceive and manipulate the environment with our hand[28]. Diabetic retinopathy is an ocular neurovascular complication which has emerged as one of the fore most cause of blindness 20 years ago[7, 21]. The age of onset for Diabetes mellitus has also gone down considerably so, people who get Diabetes early in their life is at greater risk of developing Diabetic neuropathy[4]. Paramedic those who dealt with diabetic blinds has reported that tactual disturbances caused by Diabetic peripheral neuropathy is a major impedance and residual tactile sensitivity is an important predictor of outcomes of hand rehabilitation[5, 27]. It's very important to understand that in subjects with total or partial visual compromise, the sensorimotor ability of hand will determine the quality of life and degree of independence[6]. So the re-education and rehabilitation of the diabetic blinds is banked on their intact sensory cues and sensory integrity[18]. There are only few studies that have really emphasized focus on addressing the sensory deficits of upper extremities in Indian diabetic subject. In contrast more studies were love on more sensorimotor function of the lower extremities in diabetic subjects[8]. In order of decreasing sensitivity for two point discrimination, the tongue was found to be most sensitive, followed by the lips, fingers, palm, toes, forehead[16](Weber's & Weinstein 1968)[17]. Motor control alone doesn't ensure skilful use of hand; rather, the synthesis of movement and sensitivity endows the hand with its exquisite abilities[9]. So, greater the loss of sensibility the more significantly the hand function is impaired[1]. The static and moving two point discrimination tests are tests of innervations density to find out the ability to discriminate between two identical stimuli placed close together on the skin[2]. The monofilament discrimination test assesses the threshold of stimulus necessary for the perception of light touch to deep pressure and its value in detecting early nerve changes[3]. Sensory deficits precedes the clinical onset of Peripheral neuropathy in Diabetes Mellitus subjects (Ozaki I 2001)[26]. To build a pre evaluation test battery is essential towards the special challenges faced by blindness rehabilitation professionals[10]. This study quantifies sensibility deficits in diabetic blinds.

MATERIALS AND METHODS

All the subjects were approached through private advertisement and through demographic data collected from various eye and diabetic rehabilitation centres. A total of 60 subjects of three different categories were approached for their consent to participate in the study after their willingness, the subjects were explained about the procedures of screening after inclusion and exclusion criteria's were done. All 60 subjects were right handed, both sex and with age limit of 55 – 65 years. The data collection was done in Madha college of physiotherapy. Inclusion criteria for, Experimental Group (diabetic blinds) are total duration of diabetes > 15 years, duration of blindness ≥ 5 years[11], for Control Group 1 (Non Diabetic late blind) was subjects without Diabetes mellitus as a cause for blindness. Inclusion for Control Group 2 (Blind folded sighted subjects) was Non-Diabetic sighted subjects. Exclusion criteria for all groups were previously diagnosed Peripheral neuropathy[25], any systemic or regional diseases affecting sensory functions, Cervical disc disease or spondylosis, radiculopathies, any central nervous system disorders, Cognitive disorders[15,24]. Among the three groups the Diabetic blind group contains 20 diabetic late blind subjects with the cause of blindness was diagnosed by Physician as Diabetic retinopathy, the period of blindness being 5 years. The other two group i.e., Late blind

group contains 20 non diabetic blind adult subjects and normal blinded sighted group contains 20 subjects. In keeping with Bell-Korotsky testing procedures 5 set monofilaments of different colour like Blue, Purple, Orange, Light red, and Dark red of increasing diameters was used to assess / evaluate the force threshold sensitivity of subjects in their finger pads in their right hand[12]. Cutaneous force sensitivity threshold were measured in grams. The patient's hand is fully supported and vision occluded (control group 2). The subject is instructed to give a verbal response when the filament is felt. The stimuli were applied with sufficient force to just produce skin deformation[13]. Static and moving two point discrimination test was then performed in sitting position, with the right hand supported on a table and vision occluded using a discrimination device the millimeter calibrations of the device is checked for its validity[22]. The device has adjustable ends so the width between the ends was varied in millimeter increments. One or Two points were randomly applied parallel to the longitudinal axis of finger pulps[13, 25]. To eliminate the subject ability to guess the answers almost/at most care was taken to ensure that 2 point was applied at same time and with equal force[14]. The subjects were instructed to respond by verbal answers, if the subject were not able to accurately detect two points, the width between the points is increased until the two points were perceived[30]. To acquire accuracy and reliability the sensory testing requires concentration by the patient and should be performed in a great distraction free environment[19].

STATISTICAL ANALYSIS AND RESULTS

For statistical calculations, the mean of force sensitivity threshold and spatial resolution of three groups was used. The results were evaluated with one way Analysis of variance/ Non – parametric Kruskal wallis test were done with the help of SPSS package 1.4 for windows. The mean of Experimental Group consisting of Diabetic blinds was 1.127gm, (S.D – 0.99, range- 0.04-2.00), mean of spatial resolution capacity of static 2 point discrimination test was 3.25mm, (S.D – 0.76, range- 2 - 4), moving 2 point discrimination test was 2.85mm (S.D – 0.489, range- 2 - 4). Control Group 1, mean force sensitivity was 0.3415gm, (S.D – 0.715, range- 0.02-2.00), mean of spatial resolution capacity of static 2 point discrimination test was 1.80mm, (S.D – 0.41, range- 1 - 2), moving 2 point discrimination test was 1.10mm (S.D – 0.308, range- 1 - 2). Control Group 2, mean force sensitivity was 0.64gm, (S.D-0.91355, range-0.04-2.00), mean of spatial resolution capacity of static 2 point discrimination test was 2.20mm, (S.D – 0.41, range- 2 - 3), moving 2 point discrimination test was 1.50mm (S.D – 0.513, range- 1 – 2) (Table 1). There is a significant difference when comparing Diabetic blind group with the Non diabetic late blind group and Blind folded sighted groups. The significance was set as $P < 0.01$. This significance existed in both Force threshold and spatial resolution testing methods, implies that Diabetic blinds are bilaterally prone to loss of tactile sensation along with the blindness caused by retinopathy, while the data's of blindfolded sighted subjects and non diabetic late blinds were kept as the reference values.

DISCUSSION

Diabetic retinopathy is responsible for 4.8% of the 37 million cases of blindness due to eye diseases throughout the world i.e. 1.8 million persons (WHO 2010 released to IAPB). The evaluation of hand sensation is of paramount importance in guiding the hand rehabilitation outcomes among Diabetic retinopathy blinds. It assesses the patient's current ability of tactile functions and forms a basis for constructing an effective screening tool and hand rehabilitation approach for Diabetic blind subjects, who mostly relies on their dominant hand in future for their object localisation and identification. The current study clearly shows that there is significant evidence suggestive of detectable sensory impairment in diabetic blind adults prior to the appearance of clinical symptoms of peripheral neuropathy. Interestingly Table 1 shows that non diabetic blinds are more sensitive to cutaneous force sensitivity and more spatially accurate than the control group 2. The same has been supported by Daniel Goldreich et al (2003). This noteworthy tendency is attributed to the increased manual experience in the non diabetic blind controls, which resulted in sensory enhancement effect and shows statistical significance Bernbaum et al (1989). Though the tools used in current study possess high reliability and validity, the slightest limitation of this study would be the usage of 5 set nylon monofilaments; future studies can be performed with multiple fraction sets like a 14 set monofilament to easily identify subclinical sensory impairment in diabetic patients so as to prevent complications.

CONCLUSION

This study with the statistical results (figure 1) concludes that diabetic blinds are also impeded by peripheral neuropathic changes in the upper limb nerves, along with Diabetic retinopathy. This may pose a mammoth challenge for hand rehabilitation professionals, treating these subjects. Both cutaneous force sensitivity threshold and spatial resolution testing have proved to be very reliable in identifying the subclinical changes in the peripheral nerves of Diabetic blind subjects.

CLINICAL IMPLICATIONS

Early diagnosis helps prevention and improves prognosis. So to develop a sensory evaluation tools to identify sensory impairment sustained by diabetic blind subjects due to upper limb peripheral neuropathy, which is important to hand rehabilitation professionals to develop a appropriate prevention program and rehabilitation protocol.

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Table 1: Descriptive

Dependent variables	N	Mean	Std. Dev	Std Error	Minimum Range	Maximum Range
Force sensitivity Threshold						
Experimental Group	20	1.127	0.99	0.221	0.04	2.00
Control Group 1	20	0.3415	0.715	0.159	0.02	2.00
Control Group 2	20	0.64	0.913	0.204	0.04	2.00
Static 2 pt discrimination						
Experimental Group	20	3.25	0.71	0.16	2	4
Control Group 1	20	1.8	0.41	0.09	1	2
Control Group 2	20	2.2	0.41	0.09	2	3
Moving 2 pt discrimination						
Experimental Group	20	2.85	0.489	0.109	2	4
Control Group 1	20	1.1	0.308	0.069	1	2
Control Group 2	20	1.5	0.513	0.115	1	2

Table 2: ANOVA

Dependent variables	Sum of Squares	df	Mean Square	F	Sig
Force sensitivity Threshold					
Between Groups	6.289	2	3.144	4.055	0.23
Within groups	44.203	57	0.775		
Static2 pt discrimination					
Between Groups	22.433	2	11.217	39.588	0.000
Within groups	16.150	57	0.283		
Moving 2 pt discrimination					
Between Groups	33.633	2	16.817	84.454	0.000
Within groups	11.35	57	0.199		

Table 3: Kruskal Wallis Test

Dependent variables	Chi Square	DF	Asymp. Sig
Force sensitivity Threshold	9.431	2	0.009
Static 2 point discrimination	35.465	2	0.000
Moving 2 point discrimination	43.175	2	0.000

Fig 1

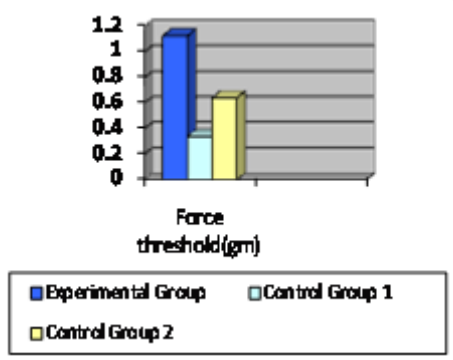

Fig 2

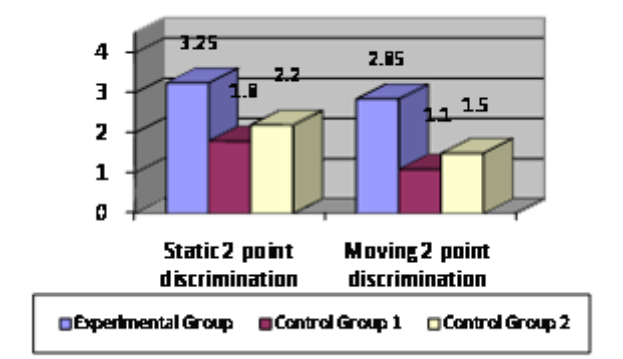

Fig 1: Mean value representation of cutaneous force sensitivity threshold testing &
Fig 2: Mean value representation of spatial resolution testing of all the groups

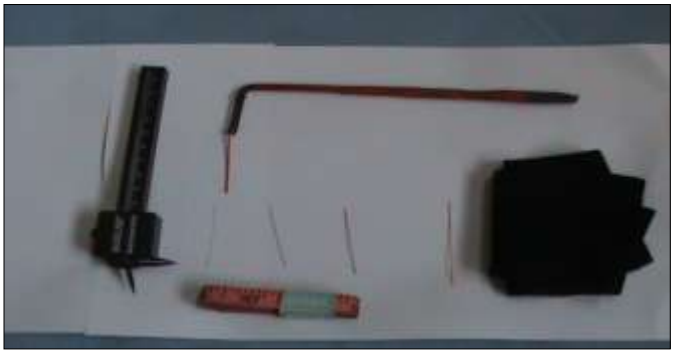

Fig 3: Materials used: Two point discriminator, Monofilaments, Blindfolding cloth, Inch tape

Fig 4: Moving 2 point discrimination testing in middle finger

Fig 5: Monofilament threshold testing