"THE NORMAL REFERENCE VALUES OF STATIC AND DYNAMIC TWO POINT DISCRIMINATION FOR TIP OF FINGER IN MEDIAN AND ULNAR DISTRIBUTION IN HEALTHY YOUNG INDIAN INDIVIDUALS-OBSERVATIONAL STUDY."

Dr. Karishma Jagad[1], Dr. Nidhi Dhanesha[2]

Author's affiliation- [1]Senior lecturer, Government Physiotherapy College, Jamnagar, Gujarat, India.
[2]Second year resident, Department of Physiotherapy, Government Physiotherapy College, Jamnagar, Gujarat, India.
Correspondence: Karishma Jagad,

ABSTRACT

Background- The normal ability to distinguish the two points from one is the two-point discriminative sense. This forms an extremely important assessment in patient with injuries to nerves distributed to upper extremity and in parietal lobe disorders. But till date there is no normal value for the static and dynamic discrimination of two-point sense using disk discriminator for the upper extremity in Indian adults.

Purpose- The purpose of this study is to examine the normal reference value of static and dynamic two point discrimination using disc-discriminator in healthy Indian individual between age group of 18-25 years.

Methods- 450 apparently healthy Indian individual between age group of 18 to 25 years were recruited for the study. Static and dynamic two point discrimination values were measured from sensory areas of median and ulnar nerve using disk-discriminator.

Result – Mean and standard deviation for static and dynamic two point discrimination values were calculated and graph of frequency distribution with respect to two point discrimination values were calculated.

Conclusion- The normal reference value of both static and dynamic two-point discrimination along median and ulnar distribution is established in Indian population.

Keywords- Two point discrimination, Median and ulnar nerve, Disk discriminator

INTRODUCTION

Two-point discrimination (2PD) is the ability to discriminate that two nearby objects touching the skin are truly two distinct points, not one. It is often tested with two sharp points during a neurological examination and is assumed to reflect how finely area of skin is innervated. In clinical settings, two-point discrimination is a widely used technique for assessing tactile perception. (D. Shooter 2011)

The therapist may use callipers, simply a reshaped paperclip or disk discriminator to do the testing. The therapist may alternate randomly between touching the patient with one point or with two points on the area being tested (e.g. finger, arm, leg, toe). (Blumfeld 2010)The patient is asked to report whether one or two points was felt. The smallest distance between two points that still results in the perception of two distinct stimuli is recorded as the patient's two-point threshold. (O'Sullivan 2007)the two point discrimination can be classified into static and dynamic.

The distance used in the 2PD varies according to which part of the body is measured: 1 mm on the tongue, 2–6 mm on the tips of fingers, 8–12 mm on the palm, and 400–600 mm on the back. [Bates 1995] [GK 1990] [EB 1992] [Moberg 1990] [MH 1994]

The 2PD test is used widespread in clinical practice to assess tactile acuity and central somato -sensory function in different diseases. The test was used to evaluate the sensory disorders in carpal tunnel syndrome [Wolny 2016] systemic sclerosis [silva 2014], diabetic peripheral neuropathy (Erlymeiz 2013) and children with spastic hemi-plegia [Krumlinde-Sundholm 2002] the 2PD test is very common to evaluate somato-sensory impairments in stroke patients [S 2016]

Therefore, the 2PD test is often used in clinical studies and laboratory tests in order to examine sensory disturbances and to assess the effectiveness of therapy. This is because the 2PD test is a cost-effective, easy-to-use and sensitive tool in the everyday clinical practice of physicians, physiotherapists or occupational therapists to assess both clinical condition and the effects of therapy. [Shibin 2013]
The normative values of both static and dynamic 2 point discrimination is established in western countries. There is scarcity of literature available about the normative values of two point discrimination in Indian population. Kannathu Shibin et al. studied normal reference value of static two-point discrimination among Indian adults between age group of 18 to 28 years using aesthesiometer with sample size of 50 individual drawn from same population. [DS 1984]Sample was drawn from single population hence it cannot be used to generalize for whole Indian population.

There are also studies stating that dynamic two point discrimination values are more sensitive than stationary two point discrimination. [Crosby 1989]The disk discriminator was found to be more preferable device for two point discrimination. [E 1962] So this study aims at finding normal reference values of static and dynamic two point discrimination in healthy young adults with sample from different population using Disk discriminator. This Normative values can be used for evaluation of patients.

MATERIALS AND METHODS

The observational study was conducted for 3 months between December 2017 to January 2018. Advertisement for sensory examination were put up on notice of board Government Physiotherapy college, Jamnagar for inviting interested candidate between age group of 18-25 years for sensory examination in college physiotherapy department in a given time period. The advertisement for the sensory examination were also placed on the Navy physiotherapy department in Valsura and the interested candidate between age group of 18-25 years were invited for the sensory examination camp held for 3 days in the department itself.

 Eligibility criteria included : normal healthy individual between age group of 18- 25 years and subjects with any upper extremity fracture and soft tissue injuries within the previous six months, cutaneous disorders, scars, burns, dermal hypersensitivity and any neurological deficits in the upper extremity were excluded. Before testing subjects were screened for eligibility criteria and written informed consent was taken from subjects who were eligible. Total of 450 subject belonging to different parts of Gujarat and subjects from navy centre belonging to different states of India were examined and data was collected.

FIGURE

FIGURE- 1

FIGURE- 2

PROCEDURE

Following the basic principles of 2 PD, the subjects received an explanation of the test, which was given in a quiet office in which they could sit comfortably without being disturbed The subjects were asked to wash their hands properly before examination the tool used for the 2 PD was disk discriminator. The measuring points were tip of the little figure for ulnar nerve and tip of index finger for median nerve. The subjects sat on a comfortable chair in a relaxed posture with arm on table and their palm touching the table surface and eyes were closed. As shown in figure 1 and 2.

For static 2 PD two points of the discriminator made vertical contact with the skin for one second with a minimal amount of pressure such that that the skin just began to blanch. The subjects were asked to say either "one point" or "two points."The two-point discrimination value for each subject was the shortest distance for which he or she perceived two distinct stimuli and said "two points." For dynamic 2 PD the procedure is same as static but the discriminator is stroked along the volar surface of little figure. Randomly "one point" or "two points'' were applied to avoid false result. The minimal two-point distance which subjects could differentiate immediately was estimated by the above mentioned method.

If the subject identifies correctly 8 out of 10 successive touches, then it was accepted as correct and reliable. Touching the same point on the skin was avoided to minimize accommodation to the two-point touch stimulus, by the examiner. Both static and dynamic discrimination was examined by the same examiner. Mean and standard deviation values were calculated for both static and dynamic 2 point discrimination of all 450 subjects.

RESULT

Normative values and summary statistics obtained from results of Static and Dynamic Two Point Discrimination test demonstrated these values ranged from 2 to 6mm among the participants in the median (Tip of index finger) and ulnar (Tip of little finger) distribution in both Rt and Lt hand Table 1.

Table – 1

| SR. NO	SITE	MEAN ± SD
1	Static 2 Point discrimination Rt median distribution (tip of index finger) **2PDMEDRTST**	2.9345 ± 0.9644 mm
2	Dynamic 2 Point discrimination Rt median distribution (tip of index finger) **2PDMEDRTDY**	2.5530 ± 0.7543 mm
3	Static 2 Point discrimination Lt median distribution (tip of index finger) **2PDMEDLTST**	2.8961 ±0.9715 mm
4	Dynamic 2 Point discrimination Lt median distribution (tip of index finger) **2PDMEDLTDY**	2.5643 ± 0.7445 mm
5	Static 2 Point discrimination Rt ulnar distribution (tip of little finger) **2PDULNRTST**	3.2212 ± 1.061 mm
6	Dynamic 2 Point discrimination Rt Ulnar distribution (tip of little finger) **2PDULNRTDY**	2.7220 ± 0.8145 mm
7	Static 2 Point discrimination Lt ulnar distribution (tip of little finger) **2PDULNLTST**	3.0632 ± 1.0447 mm
8	Static 2 Point discrimination Lt ulnar distribution (tip of little finger) **2PDULNLTDY**	2.6997 ± 0.7744 mm

The mean values and SD obtained for Static 2 Point discrimination Rt median distribution (tip of index finger) 2PDMEDRTST is 2.9345 ± 0.964, Dynamic 2 Point discrimination Rt median distribution (tip of

index finger) **2PDMEDRTDY** is 2.5530 ± 0.7543, Static 2 Point discrimination Lt median distribution (tip of index finger) **2PDMEDLTST** is 2.8961 ± 0.9715, Dynamic 2 Point discrimination Lt median distribution (tip of index finger) **2PDMEDLTDY** is 2.5643 ± 0.7445.
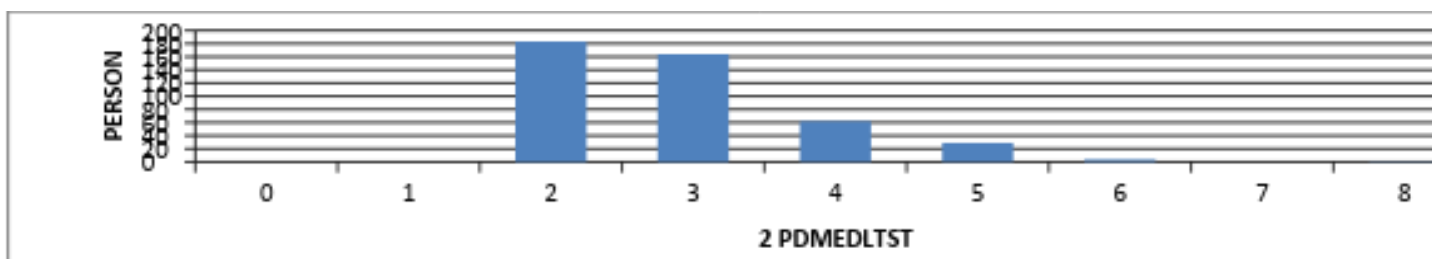
Graph 1: The graph shows frequency distribution of static 2 point discrimination value along median nerve distribution in Right hand.
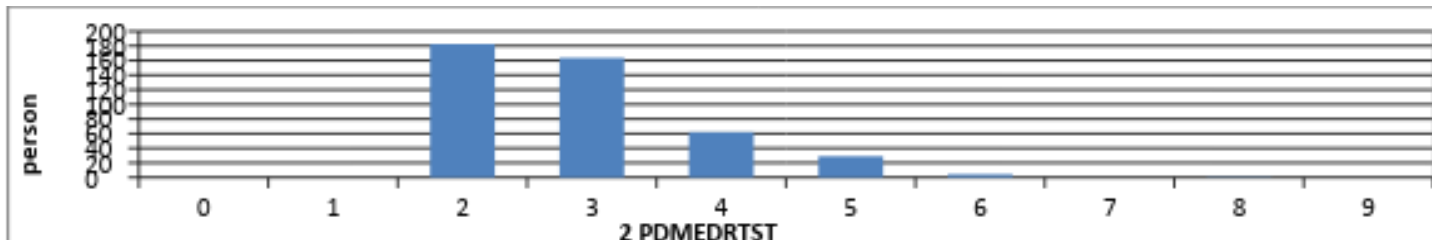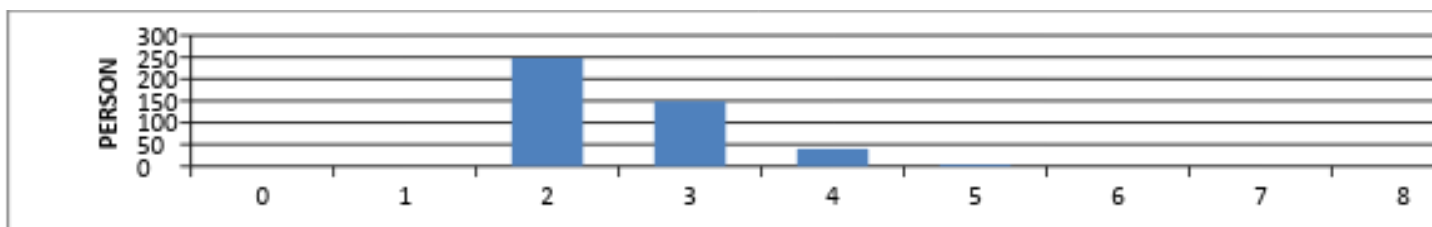

Graph 2: The graph shows frequency distribution of dynamic 2 point discrimination value along median nerve distribution in Right hand.
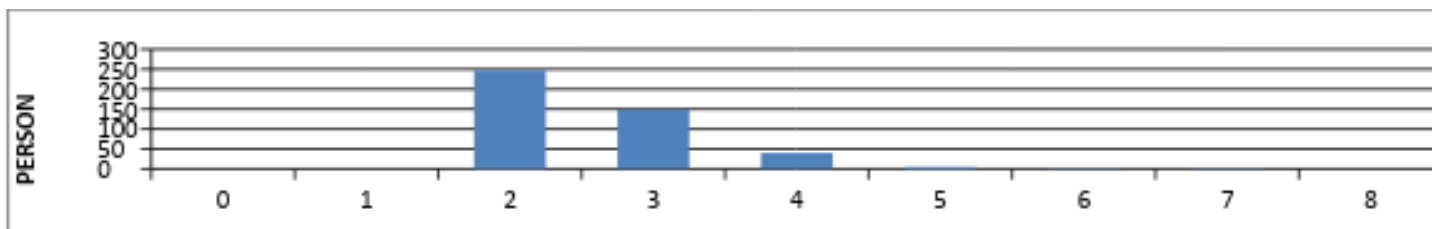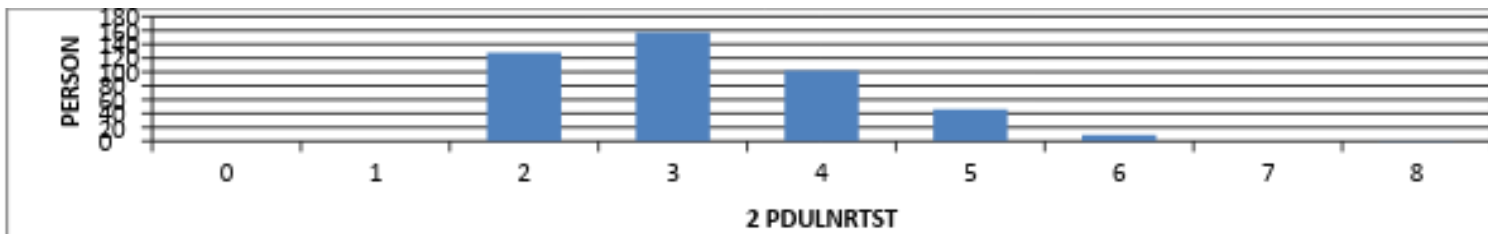

Graph 3: The graph shows frequency distribution of Static 2 point discrimination valu e along median nerve distribution in Left hand.
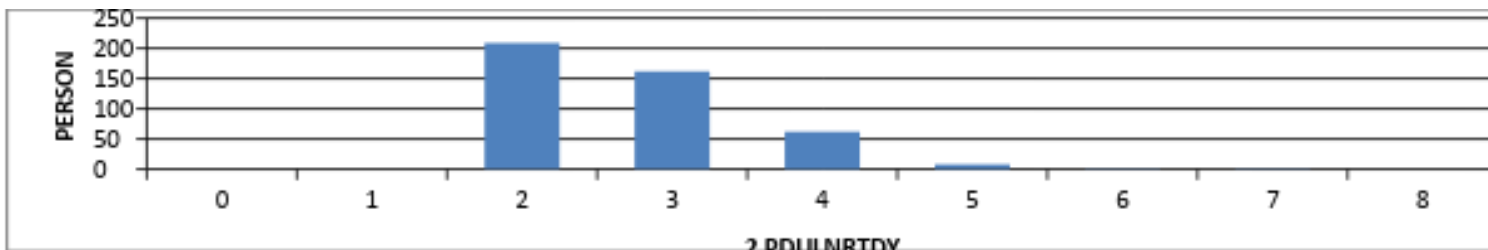

Graph 4: The graph shows frequency distribution of Dynamic 2 point discrimination value along median nerve distribution in Left hand.
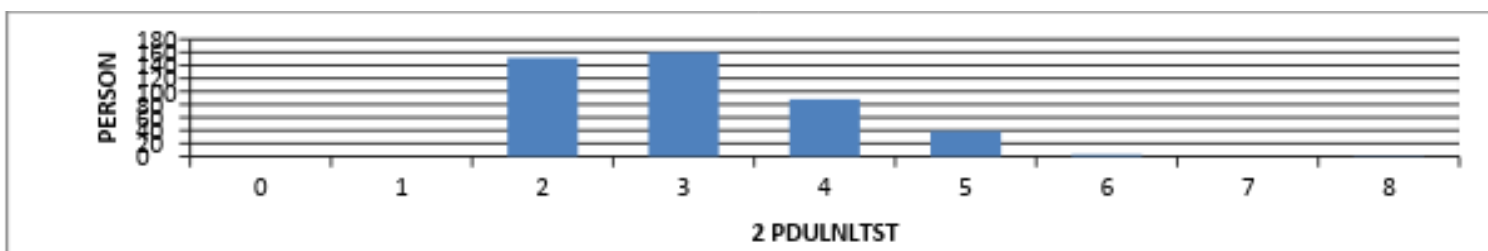

Graph 5: The graph shows frequency distribution of Static 2 point discrimination value along ulnar nerve distribution in Right hand.

Graph 6: The graph shows frequency distribution of Dynamic 2 point discrimination value along ulnar nerve distribution in Right hand.

Graph 7 : The graph shows frequency distribution of Staic 2 point discrimination value along ulnar nerve distribution in Left hand.

Graph 8 : The graph shows frequency distribution of Dynamic 2 point discrimination value along ulnar nerve distribution in Left hand.
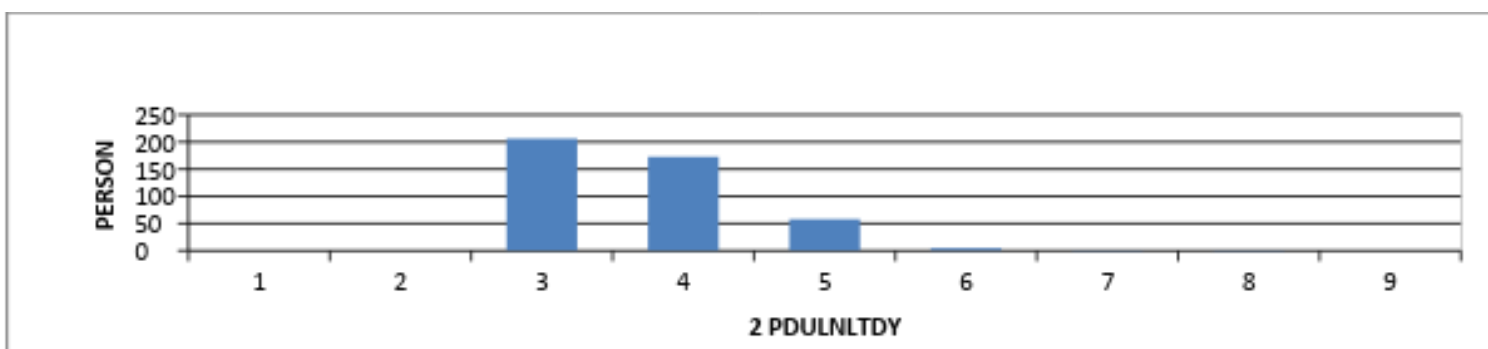
Static 2 Point discrimination Rt ulnar distribution (tip of little finger) **2PDULNRTST** is3.2212 ± 1.061, Dynamic 2 Point discrimination Rt Ulnar distribution (tip of little finger) **2PDULNRTDY** is 2.7220 ± 0.8145, Static 2 Point discrimination Lt ulnar distribution (tip of little finger) **2PDULNLTST** is 3.0632 ± 1.0447 and Static 2 Point discrimination Lt ulnar distribution (tip of little finger) **2PDULNLTDY** is 2.6997 ± 0.7744.
 The mean of TPD values for each subject group is represented in graph.

DISCUSSION

The study was carried out to obtained normal reference values of both static and dynamic 2 point discrimination along distribution of median and ulnar nerves. Our findings are suggestive of following normative values: **2PDMEDRTST** is 2.9345 ± 0.964 mm, **2PDMEDRTDY** is 2.5530 ± 0.7543,**2PDMEDLTST** is 2.8961 ± 0.9715,**2PDMEDLTDY** is 2.5643 ± 0.7445,**2PDULNRTST** is3.2212 ± 1.061, **2PDULNRTDY** is 2.7220 ± 0.8145, **2PDULNLTST** is 3.0632 ± 1.0447 and **2PDULNLTDY** is 2.6997 ± 0.7744.This findings are consistent with study done by Kannathu Shibin et all " The Discrimination of Two-point Touch Sense for the Upper Extremity in Indian Adults" , 50 apparently normal subjects comprising of 25 men and 25 women were recruited randomly for the study. 15 sensory areas in upper extremity was selected which covers all major dermatomes and static two-point was estimated in millimetres by using aesthesiometer. The values obtained for Palmer surface distal phalanx long finger were 2.5±0.1, Palmer surface distal phalanx little finger were 2.4±0.1. [Shibin 2013]

Static 2 point discrimination findings can also be related to study done by Safana Alsaeed et al. Normative Values of Two Point Discrimination Test among students of Princess Noura Bint Abdulrahman University in Riyadh. In this study the test was executed on 270 students of art & design, medical and literary backgrounds of age between 20-23 years which were randomly selected from different colleges of Princess Noura Bint Abdul rahman University in Riyadh.TPD values were determined using disc discriminator for distal palmer of the hand and tip of middle finger of their dominant hand parallel to the median nerve, which innervate the area of the hand and perpendicular on the fingertips. The values obtained was 2.68 ± 0.68 for medical students, 2.2 ± 0.46 for art students and 3.06 ± 0.9 for literary students. [Alsaeed 2014]

Dynamic 2 point discrimination values are consistent with study done by Dean S. Louis et al "Evaluation of normal values for stationary and moving two-point discrimination in the hand." Four hundred sixty-seven subjects, 202 females and 265 males, whose ages ranged from 4 years to 92 years were studied. The test was performed starting with the palmer pad of the thumb, proceeding in a sequential fashion to the palmer pad of the small finger, then to the dorsum of the first web space, and finally to the dorsum of the middle phalanx of the long finger. Values for static and moving 2 point discrimination were obtained using finely machined industrial calliper, the mean value for stationary two-point discrimination in the small finger was 3.34 mm, while the comparable value for moving two-point discrimination was 3.82 mm. [DS 1984] It has been reported that tips of finger are most sensitive part of hand as compare to other parts. This is in agreement with study of Kannathu and Asir (2013) which recently proved that discrimination of the two-point touch sensitivity in finger tips is much more than any other areas in the upper extremity. They found the reason about most sensitivity that increased free nerve endings in the hands. [Shibin 2013]

Limitation of our study is that we have only examined tip of finger. In future such study can be done for other areas of UL and LL, in different population, in different age group and also in person with various neurological disorders. The data of the study may be useful in the clinical assessment and comparing their values with established normal values which may guide in rehabilitation. It can be used for research purpose to compare different two point discrimination values.

CONCLUSION The normal reference value of both static and dynamic two-point discrimination along median and ulnar distribution is established in Indian population.

CONFLICTS OF INTEREST None declared.

ACKNOWLEDGEMENT

REFERENCES

1 Alsaeed, Safana. 2014, "Normative Values of Two-Point Discrimination Test among Students of Princess Noura Bint Abdulrahman University in Riyadh." *International Journal of Advanced Physiology and Allied Sciences*: 42-52.

2 Bates, Barabara. 1995,*Techniques for examination: physical examination and history taking.* Philadelphia: JB Lippincott,.

3 Blumfeld, Hal. , 2010 *"Hal Neuroanatomy through Clinical Cases".* sunderland: Sinauer Associates.

4 Crosby, Page M. , 1989 "comparison Two-Point Discrimination Testing Devices ." *Microsurgery*: 134-137.

5 DS, Louis. , 1984 "Evaluation of normal values for stationary and moving two-point discrimination in the hand." *The journal of hand surgery*: 552-55.

6 E, Moberg. , 1962 "Criticism and study of methods for examining sensibility in the hand." *Neurology*: 8-19.

7 E, Moberg. 1990 "Two-point discrimination test. A valuable part of hand surgical rehabilitation." *Scand J Rehabil Med*,: 127–134.

8 EB, Cope. , 1992 "Normal values for the two-point discrimination test." *Paediatric Neurology*: 251–254.

9 GK, Bigly. 1990*Sensation: clinical methods the history–physical and laboratory examinations.* Stoneham: Butterworths,.

10 Krumlinde-Sundholm. , 2002 "Comparing tests of tactile sensibility: aspects relevant to testing children with spastic hemiplegic." *Dev Med Child Neurol*: 604-12.

11 Erlymeiz et all,2013 "Two-point discrimination in diabetic patients J Diabetes";5(4):442-8**.**

12 MH, Swartz. , 1994 *The nervous system: Textbook of physical diagnosis; history and examination.* Philadelphia: WB Saunders.

13 O'Sullivan, susan. , 2007 *Physical Rehabilitation Fifth Edition.* Philadelphia: F.A. Davis Company.

14 S, Meyer. *r*, 2016 "Somatosensory Impairments in the Upper Limb Post stroke: Distribution and Association with Motor Function and Visuospatial Neglect." *Neurorehabil Neural Repai*: 731-42.

15 Shibin, Kannathu. , 2013 "The Discrimination of Two-point Touch Sense for the Upper Extremity in Indian Adults." *International Journal of Health and Rehabilitation Sciences*: 38-46.

16 Shooter, David. , 2011 ""Use of two-point discrimination as a nerve repair assessment tool: Preliminary report"." *ANZ Journal of Surger,*: 866-868.

17 silva, Paula gabriel. 2014 "Assessment of light touch sensation in the hands of systemic sclerosis patients." *Clinics,*: 585–588.

18 Wolny, T. , 2016 "Two-point discrimination and kinaesthetic sense disorders in productive age individuals with carpal tunnel syndrome." *Journal of Occupational Health*: 289-296.