Assessment of Two-Point Discrimination in the Hand Region among Patients with Type II Diabetes Mellitus Across Five Age Groups

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ABSTRACT

Background: Diabetes mellitus is a chronic metabolic disorder with elevated blood glucose levels. It has a global prevalence of approximately 50% and affects 8.8% of Indian adults aged between 20 and 79 years. The condition is associated with various complications, including peripheral nerve dysfunction, which contributes to increased morbidity, reduced quality of life, and shortened life expectancy. Early detection of diabetic neuropathy is essential for effective management. 2-point discrimination testing is a widely used clinical method to evaluate polyneuropathy-related sensory deficits. This assessment is typically performed using tools such as a compass or aesthesiometer to determine tactile spatial acuity. Objectives were to evaluate 2-point discrimination thresholds across five different age groups in individuals with Type II Diabetes Mellitus, to examine the correlation between the duration of diabetes and 2-point discrimination thresholds, and to investigate the relationship between the severity of neuropathy and 2-point discrimination thresholds.

Methodology: This observational study was conducted on patients diagnosed with Type II Diabetes Mellitus, aged between 30 and 75 years (31-40, 41-50, 51-60, 61-70, and 71-75 years), with a minimum disease duration of five years. Participants were categorized into five distinct age groups for comparative analysis. 2-point discrimination thresholds were measured using an aesthesiometer, with standardized testing protocols followed across all subjects. Individuals with comorbid conditions or other forms of neuropathy were excluded to eliminate confounding variables.

Result: The study found significant variations in 2-point discrimination thresholds across the five age groups of individuals with Type II Diabetes Mellitus. In general, 2PD thresholds were higher in older age groups, with the 41–50 years age group showing the most pronounced sensory decline. Specifically, the thumb and the thenar and hypothenar regions exhibited the highest 2PD thresholds across all groups, indicating a greater loss of tactile sensitivity in these areas. The data also showed that the duration of diabetes correlated with an increase in 2PD values, suggesting a progressive decline in tactile acuity with longer disease duration. Furthermore, regions affected by neuropathy, such as the thenar and hypothenar areas, had significantly higher 2PD thresholds, supporting the link between the severity of neuropathy and impaired sensory function. These results underscore the impact of both age and neuropathy severity on tactile sensitivity in Type II Diabetes Mellitus patients.

Conclusion: 2-point discrimination thresholds increase with age and duration of Type II Diabetes Mellitus, indicating declining tactile sensitivity. Higher thresholds in the thenar and hypothenar regions suggest a strong association with neuropathy severity.

Keywords: 2PD, T2DM, Aesthesiometer

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INTRODUCTION

Diabetes mellitus is a chronic metabolic disease characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Common clinical manifestations include excessive urination (polyuria), excessive thirst (polydipsia), and increased hunger (polyphagia). If inadequately managed, diabetes can result in a wide range of acute and chronic complications affecting multiple organ systems.[1] Diabetic neuropathy is one of the most common complications and may present with varying degrees of

sensory impairment, ranging from subtle deficits to significant loss of sensation, often occurring even in individuals with minimal symptoms. Sensory disturbances generally begin in the feet and gradually extend proximally, later involving the hands and upper extremities.[2] Diabetes mellitus is associated with increased morbidity, premature mortality, and a substantial decline in overall quality of life.[3]

Globally, diabetes represents a major public health challenge, affecting more than 135 million individuals, with estimates predicting an increase to nearly 300 million cases by 2025.[4] Type 2 diabetes mellitus accounts for approximately 90–95% of all diagnosed cases of diabetes[5] and is predominantly observed in older adults, with the highest prevalence reported among individuals aged 60–69 years.[6] The disease often develops insidiously, and many individuals remain undiagnosed for several years, typically between four and seven years, before clinical detection occurs.[7]

Diabetic neuropathy is a common long-term complication, particularly among individuals with prolonged disease duration and poor glycemic control, affecting nearly 50–60% of this population.[8] The presence of neuropathy significantly increases the risk of foot ulceration and subsequent lower-limb complications.[9] Although symptoms may initially be mild or absent, progressive nerve damage can result in noticeable sensory deficits.[10] These sensory abnormalities generally originate in the feet and later involve the hands and arms as the condition advances.[11]

The pathological process of diabetic neuropathy typically follows a length-dependent pattern, with the longest nerve fibers being affected first. As nerve damage progresses proximally to the mid-calf level, sensory deficits may become evident in the hands, producing the characteristic “stocking-and-glove” distribution of sensory loss. Longer axons are particularly susceptible to metabolic and vascular injury, resulting in progressive impairment of peripheral nerve function. Small-fiber involvement may lead to diminished perception of temperature, light touch, pinprick sensations, and pain, whereas damage to large nerve fibers can compromise vibration sense, proprioception, muscle strength, sharp-dull discrimination, and two-point discrimination abilities.[12]

Diabetes is a lifelong disorder associated with substantial healthcare costs and a significant burden on individuals and healthcare systems worldwide. Chronic hyperglycemia contributes to the development of both microvascular and macrovascular complications, affecting vital organs such as the eyes, kidneys, cardiovascular system, peripheral nerves, and lower extremities. Structural and functional alterations resulting from vascular damage can ultimately lead to organ dysfunction and failure. Several mechanisms have been proposed to explain the development of diabetic neuropathy, including prolonged hyperglycemia, impaired microvascular blood supply, oxidative and nitrosative stress, reduced neurotrophic support, and immune-mediated neuronal injury.[13] Despite extensive research, the precise prevalence of diabetic neuropathy remains uncertain, with reported estimates varying widely from 10% to 90%, largely due to differences in diagnostic criteria, study populations, and assessment methodologies used across investigations.[14]

Point Discrimination

Two-point discrimination (TPD) is a sensory assessment technique that evaluates an individual's capacity to perceive two separate points of contact applied simultaneously to the skin.[15] It is commonly defined as the minimum distance at which two identical tactile stimuli, delivered with equal pressure, are recognized as distinct rather than as a single point of contact.[16] The concept of two-point discrimination was originally described by Weber in 1853 and has since become an important component of sensory examination.[17]

Based on the method of stimulus application, TPD assessment can be categorized into static and moving forms, with static blunt-tip testing being the most frequently employed clinical approach, while sharp-tip testing is used less commonly. An aesthesiometer is the standard instrument utilized for measuring static two-point discrimination thresholds in clinical and research settings.[18]

Somatosensory perception plays a critical role in conscious awareness, motor coordination, environmental interaction, and the processing of sensory information.[19] Evaluation of sensory functions provides valuable information regarding the integrity and performance of both the central nervous system (CNS) and peripheral nervous system (PNS).[20]

The two-point discrimination test is widely used to assess tactile spatial acuity by determining an individual's ability to distinguish between two simultaneously applied points on the skin surface. During testing, two stimuli are delivered at the same time with equal pressure, and the minimum separation distance at which the subject can accurately identify them as two distinct points is recorded. An aesthesiometer is commonly employed for this purpose because it allows precise and reproducible measurement of discrimination thresholds.[21]

PHYSIOLOGY OF 2-PD

Dermal stimulation
▼
Cutaneous mechanoreceptor activation (Merkel cells, Meissner corpuscles, etc.)
▼
Transduction: Mechanical stimulus → electrical signal
▼
Aβ Sensory Fibers Propagate Action Potential
▼
Dorsal Root Sends Signal to Spinal Cord
▼
Ascends the Dorsal Column (Fasciculus Gracilis/Cuneatus)
▼
Synapse in Medulla (Nucleus Gracilis/Cuneatus)
▼
Decussation (Crosses Midline) → Ascends via Medial Lemniscus
▼
Synapse in Thalamus (VPL Nucleus)
▼
Final Projection to Primary Somatosensory Cortex (S1)
▼
Conscious perception and discrimination of stimuli [22-27]

Aestheiometer

Figure:1 (Aesthesiometer)

Diabetic neuropathy is a progressive neurological complication of diabetes that is associated with decreased nerve conduction velocity, reduced sensory nerve action potential amplitudes, and delayed somatosensory signal transmission within the spinal pathways. These alterations reflect degeneration and loss of distal myelinated sensory nerve fibers.[28] Therefore, comprehensive assessment of sensory nerve function is essential for early identification and management of neuropathic changes.

Several studies have suggested that impaired sensory input from the hands can negatively influence motor performance and dexterity in individuals with various neurological and musculoskeletal disorders.[29] Despite this evidence, relatively few investigations have specifically explored the effect of diabetes-related sensory deficits on hand function. Diabetes mellitus may progressively affect the structural and functional integrity of the hand, leading to impairments that interfere with activities requiring precision, coordination, and fine motor control, all of which are essential for daily living and occupational tasks.[30]

Among individuals with diabetic neuropathy, sensory disturbances are highly prevalent, with approximately 90% reporting sensory-related symptoms, while motor impairments have been documented in nearly 77% of affected individuals.[31] Diabetic peripheral neuropathy frequently presents with a combination of sensory and motor dysfunctions; however, clinical management and rehabilitation strategies have traditionally focused more on lower-limb complications than on upper-extremity involvement.[32]

Most previous research has concentrated on diabetic foot pathology and its associated functional limitations, whereas the effects of diabetes on hand function have received comparatively limited attention.[33] Hand-related complications of diabetes, often referred to as diabetic hand syndrome, may manifest as numbness, tingling sensations, persistent pain, stiffness, muscular weakness, altered sensory perception, and increased fatigue. These impairments can adversely affect sensorimotor integration, manual dexterity, grip performance, and overall functional use of the hand.[34]

Research evaluating two-point discrimination (TPD) in healthy individuals between 21 and 60 years of age has provided important normative data for sensory assessment. Such reference values are particularly valuable because age- and gender-specific TPD standards are often unavailable in many local populations. The availability of normative data facilitates comparison between normal and pathological sensory findings and contributes to a better understanding of age-related changes in sensory perception among both males and females. This information is of significant relevance in the field of neurophysiotherapy and neurological rehabilitation.[35]

A thorough understanding of the extent and severity of sensory deficits in individuals with type 2 diabetes mellitus is necessary for developing targeted and effective rehabilitation programs. Therefore, the present study was designed to evaluate sensory impairment and investigate its influence on upper-extremity function, particularly the sensory and functional components of hand performance, in individuals with type 2 diabetes mellitus.

METHODOLOGY

This cross-sectional study was carried out at NIMS University, Jaipur, Rajasthan, over a five-month period from December 2024 to April 2025. A total of 96 participants with a confirmed diagnosis of Type II Diabetes Mellitus of more than five years' duration were enrolled through a convenience sampling method. Individuals who voluntarily agreed to participate and provided written informed consent were included in the study. Participants presenting with neurological disorders other than diabetic neuropathy, upper-limb trauma, dermatological conditions affecting the hand, musculoskeletal disorders involving the upper extremity, or a history of burns were excluded from participation.

Study participants were recruited from the General Medicine and Endocrinology outpatient departments (OPDs) of NIMS Hospital, Jaipur. Based on the study protocol, subjects were categorized into five different age groups for comparative analysis. Prior to the commencement of the study, ethical clearance was obtained from the Institutional Ethics Committee of NIMS University. Informed written consent was obtained from every participant after explaining the purpose and procedures of the study.

Hand function was evaluated using the Duruöz Hand Index (DHI), a standardized tool designed to assess hand-related functional limitations in daily activities. Sensory assessment was performed using the Two-Point Discrimination (2PD) test with the help of an aesthesiometer. Measurements were taken at multiple anatomical locations of the hand, including the thumb, index finger, middle finger, ring finger, little finger, thenar eminence, and hypothenar eminence. During the assessment, participants were instructed to close their eyes and report whether they perceived one point or two distinct points of contact. Three measurements were obtained at each testing site, and the most accurate (best) value was selected for statistical analysis.

Procedure:

Two-Point Discrimination (2PD) was assessed over the thumb, index, middle, ring, and little fingers, as well as the thenar and hypothenar regions using an aesthesiometer. Participants were instructed to keep their eyes closed and identify whether they felt one point or two points. The hand was supported throughout the assessment to prevent finger movement. The aesthesiometer was applied perpendicular to the skin with equal pressure, and the minimum distance at which two points were correctly identified was recorded. The best of three readings was considered for analysis.

Outcome Measure:

• Duruöz Hand Index (DHI): Used to assess hand function and disability.

Data Collection

Written informed consent was obtained from all participants. The procedure was explained before testing, and the best of three readings for each assessment site was recorded.

Statistical Analysis

Data were analyzed using SPSS version 25.0. Mean and standard deviation were calculated, and one-way ANOVA was used to compare 2PD values among the five age groups. Statistical significance was set at $p < 0.05$.

Figure: 2 (Assessment Of Tpd)

Figure:3 (Assessment Of Tpd)

Figure :4(Assessment Of Tpd)

Figure :5(Assessment Of Tpd)

RESULT

Table 1: Group -A: Age 31 – 40 with Type – II Diabetes Mellitus

Mean and Standard Deviation							
	Thumb	Index finger	Middle finger	Ring finger	Little finger	Thenar	Hypothenar
N	20	20	20	20	20	20	20
Mean	4.06	2.5900	2.8000	2.5500	2.5000	4.4650	4.4300
Std. Deviation	6.85	.83281	1.05631	.82558	.76089	.75273	.66022

The mean 2PD values ranged from 2.50 mm (little finger) to 4.47 mm (thenar region). Among the digits, the thumb showed the highest mean 2PD value at 4.06 mm, indicating a reduced tactile acuity compared to the other fingers. The index and middle fingers had slightly higher values (2.59 mm and 2.80 mm, respectively) than the ring and little fingers. The thenar and hypothenar regions exhibited relatively higher 2PD thresholds (4.47 mm and 4.43 mm, respectively), suggesting that tactile sensitivity in these areas may be more affected.

The standard deviation was highest in the thumb (6.85), indicating greater variability in 2PD among participants for this digit. In contrast, the hypothenar region showed the least variability (0.66), followed closely by the thenar area (0.75), suggesting more consistent measurements across individuals in those regions.

Table 2: Group - B: Age 41 – 50 with Type – II Diabetes Mellitus

Mean and Standard Deviation							
	Thumb	Index finger	Middle finger	Ring finger	Little finger	Thenar	Hypothenar
Mean	8.6368	8.1632	7.9579	8.1632	7.7474	11.1316	11.4421
N	19	19	19	19	19	19	19
Std. Deviation	3.23972	3.62188	3.90033	3.62188	3.84525	2.51574	2.49005

Table 2 displays the mean and standard deviation values of two-point discrimination (2PD) measurements in various regions of the hand for Group B (Age 41–50 years) with Type 2 Diabetes Mellitus. The data represent assessments from 19 individuals across the thumb, index finger, middle finger, ring finger, little finger, thenar, and hypothenar regions. The mean 2PD values were higher in this group compared to Group A, indicating a general decline in tactile sensitivity with increasing age. Among the digits, the thumb showed the highest mean value (8.64 mm), while the little finger had the lowest (7.75 mm). The index, middle, and ring fingers showed fairly consistent values, ranging between 7.96 mm and 8.16 mm.The thenar and hypothenar regions again demonstrated the highest 2PD thresholds, with mean values of 11.13 mm and 11.44 mm respectively, suggesting a more pronounced sensory impairment in these areas. In terms of standard deviation, the middle finger had the highest variability (3.90), followed closely by the little finger (3.85), indicating a broader range of sensitivity among participants in those regions. The thenar and hypothenar regions showed relatively lower standard deviations (2.52 and 2.49, respectively), suggesting more consistent sensory deficits across the group in those areas

Table 3: Group - C: Age 51 – 60 with Type – II Diabetes Mellitus

Mean and Standard Deviation							
	Thumb	Index finger	Middle finger	Ring finger	Little finger	Thenar	Hypothenar
Mean	3.6579	3.1000	3.3895	3.8053	3.5000	5.9895	6.2579
N	19	19	19	19	19	19	19
Std. Deviation	1.75636	1.25122	1.36500	1.08703	1.50923	2.06879	2.41875

Table 3 presents the mean and standard deviation values of two-point discrimination (2PD) measurements for Group C (Age 51–60 years) with Type 2 Diabetes Mellitus. The data include assessments from 19 participants across the thumb, fingers, thenar, and hypothenar regions. In this group, the mean 2PD values were moderately elevated compared to Group A but lower than those observed in Group B, indicating some variability in sensory perception across age groups. Among the fingers, the ring finger had the highest mean 2PD value at 3.81 mm, while the index finger showed the lowest at 3.10 mm. The thumb, middle, and little fingers showed fairly similar values, ranging between 3.39 mm and 3.66 mm. The thenar and hypothenar regions again showed the highest 2PD thresholds, with mean values of 5.99 mm and 6.26 mm, respectively. These findings are consistent with the trend of reduced tactile acuity in these palm regions across all groups. Regarding standard deviations, the thumb (1.76), thenar (2.07), and hypothenar (2.42) regions showed slightly higher variability compared to the fingers, indicating a broader range of sensory responses among participants in these areas. In contrast, the ring finger exhibited the least variability (1.09), suggesting more consistent results across individuals.

Table 4: Group - D: Age 61 – 70 with Type – II Diabetes Mellitus

Mean and Standard Deviation							
	Thumb	Index finger	Middle finger	Ring finger	Little finger	Thenar	Hypothenar
Mean	2.6368	2.5842	2.7421	3.3316	3.9053	4.5737	4.7316
N	19	19	19	19	19	19	19
Std. Deviation	.76827	.67681	1.15148	.96035	4.83212	1.72911	2.26692

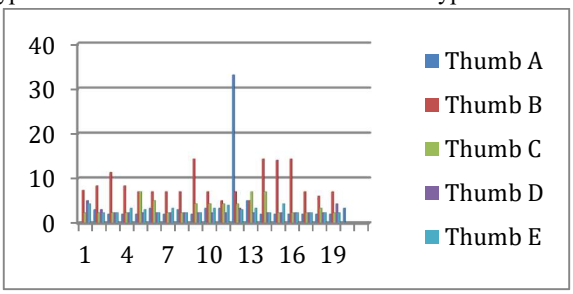
Table 5 summarizes the mean and standard deviation values of two-point discrimination (2PD) measurements for Group E (Age 71–75 years) with Type 2 Diabetes Mellitus. This group consists of 19 participants, with data recorded from the thumb, fingers, and the thenar and hypothenarregions.Themean 2PD values among the fingers range from 2.88 mm (middle finger) to 4.78 mm (little finger), showing a mild increase in 2PD thresholds compared to younger age groups. The ring and little fingers again exhibited higher mean values (3.43 mm and 4.78 mm), suggesting reduced tactile acuity in the distal ulnar side of the hand in older diabetic patients.Thethenar and hypothenar regions displayed mean 2PD values of 4.57 mm and 4.48 mm, which are slightly higher than finger regions (excluding the little finger), continuing the trend of reduced sensitivity in these areas.In terms of standard deviation, the values were generally low for the thumb, index, middle, and ring fingers (ranging from 0.69 to 0.73), indicating consistent results among participants. However, the little finger showed a substantially higher standard deviation of 6.44, reflecting significant variability in tactile perception in that region. Moderate variability was also observed in the thenar (1.45) and hypothenar (1.16) regions.

ANOVA

Table 6: ANOVA of Thumb for Group – A, B, C, D, E

ANOVA					
Source	***SS***	***df***	***MS***	F	P
Between-treatments	456.4861	4	114.1215	8.9654	0.001
Within-treatments	1158.348	91	12.7291		
Total	1614.8341	95			

A One-way ANOVA (Post Hoc Tukey HSD) was conducted for assessment of 2 –point discrimination in Thumb region in patient with type 2 diabetes mellitus. The f-ratio value is 8.9654. The p-value is < .00001. The result is significant at $p < .05$. (F-value is lower shows alternate hypothesis is accepted).

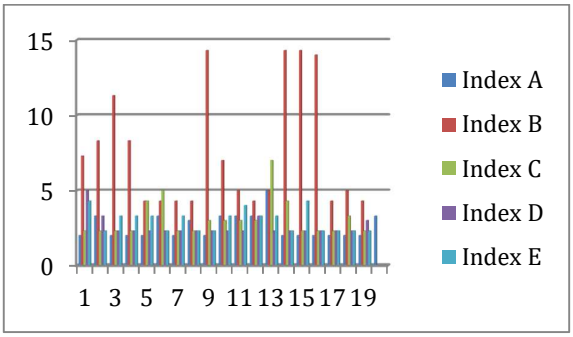


Graph (1) Comparison of 2 point discrimination values in thumb area in diabetes patients across five age group (X- Number of patients and Y- 2 Point discrimination value)

Table 7: ANOVA of Index Finger for Group – A, B, C, D, E

ANOVA				
Source	***SS***	***df***	***MS***	
Between-treatments	352.4561	4	88.114	$F = 23.15695$
Within-treatments	346.2622	91	3.8051	
Total	698.7183	95		

A One-way ANOVA (Post Hoc Tukey HSD) was conducted for assessment of 2 –point discrimination in Index Finger region in patient with type 2 diabetes mellitus. The f-ratio value is 23.15695. The p-value is < .00001. The result is significant at $p < .05$. (F-value is greater shows null hypothesis is accepted).

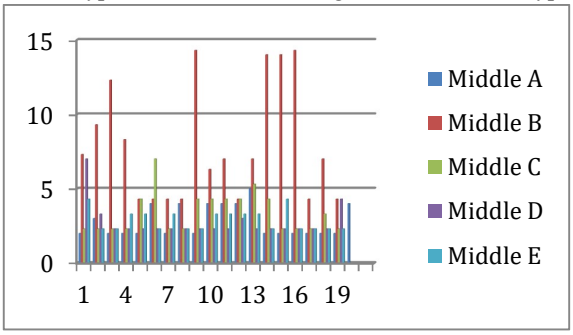


Graph (2) Comparison of 2 point discrimination values in index finger area in diabetes patients across five age group (X- Number of patients and Y- 2 Point discrimination value)

Table 8: ANOVA of Middle Finger for Group – A, B, C, D, E

ANOVA				
Source	***SS***	***df***	***MS***	
Between-treatments	387.1312	4	96.7828	*F* = 24.39258
Within-treatments	361.0621	91	3.9677	
Total	748.1933	95		

A One-way ANOVA (Post Hoc Tukey HSD) was conducted for assessment of 2 –point discrimination in Middle finger region in patient with type 2 diabetes mellitus. The f-ratio value is 24.39258. The p-value is < .00001. The result is significant at p < .05. (F-value is greater shows null hypothesis is accepted).

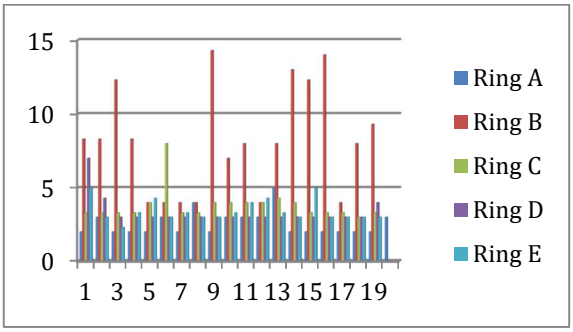


Graph (3) Comparison of 2 point discrimination values in middle finfer area in diabetes patients across five age group (X- Number of patients and Y- 2 Point discrimination value)

Table 9: ANOVA of Ring Finger for Group – A, B, C, D, E

ANOVA				
Source	***SS***	***df***	***MS***	
Between-treatments	381.4034	4	95.3509	*F* = 29.24266
Within-treatments	296.7216	91	3.2607	
Total	678.125	95		

A One-way ANOVA (Post Hoc Tukey HSD) was conducted for assessment of 2 –point discrimination in ring finger region in patient with type 2 diabetes mellitus.The f-ratio value is 29.24266. The p-value is < .00001. The result is significant at p < .05.(F-value is greater shows null hypothesis is accepted).

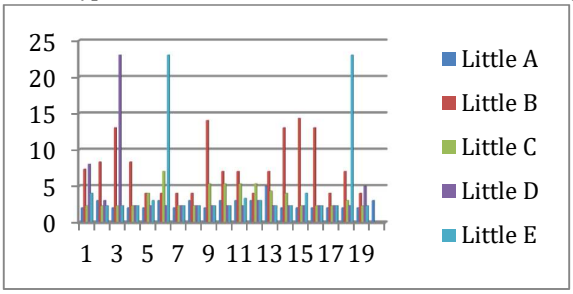


Graph (4) Comparison of 2 point discrimination values in ring finger area in diabetes patients across five age group (X-Number of patients and Y- 2 Point discrimination value)

Table 10: ANOVA of Little Finger for Group – A, B, C, D, E

ANOVA				
Source	***SS***	***df***	***MS***	
Between-treatments	307.5112	4	76.8778	$F = 4.70811$
Within-treatments	1485.9221	91	16.3288	
Total	1793.4333	95		

A One-way ANOVA (Post Hoc Tukey HSD) was conducted for assessment of 2 –point discrimination in little finger region in patient with type 2 diabetes mellitus.The f-ratio value is 4.70811. The p-value is < .00169. The result is significant at $p < .05$.(F-value is lower shows alternate hypothesis is accepted).

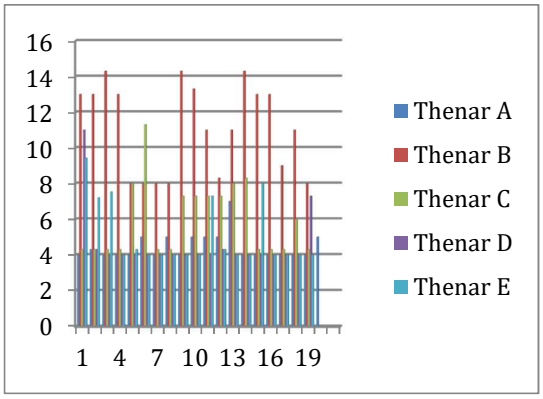


Graph (5) Comparison of 2 point discrimination values in little finger area in diabetes patients across five age group (X-Number of patients and Y- 2 Point discrimination value

Table 11: ANOVA of Thenar Eminence for Group – A, B, C, D, E

ANOVA				
Source	***SS***	***df***	***MS***	
Between-treatments	623.1602	4	155.7901	$F = 48.32624$
Within-treatments	293.3581	91	3.2237	
Total	916.5183	95		

A One-way ANOVA (Post Hoc Tukey HSD) was conducted for assessment of 2 –point discrimination in Thenar region in patient with type 2 diabetes mellitus.**The f-ratio value is 48.32624. The p-value is < .00001. The result is significant at $p < .05$.**(F-value is greater shows null hypothesis is accepted).

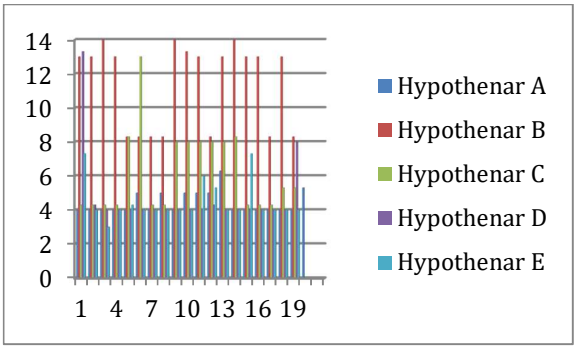


Graph (6) Comparison of 2 point discrimination values in thenar area in diabetes patients across five age group (X-Number of patients and Y- 2 Point discrimination value)

Table 12: ANOVA of Hypo Thenar Eminence for Group – A, B, C, D, E

ANOVA				
Source	***SS***	***df***	***MS***	
Between-treatments	681.4991	4	170.3748	$F = 45.36004$
Within-treatments	341.8009	91	3.7561	
Total	1023.3	95		

A One-way ANOVA (Post Hoc Tukey HSD) was conducted for assessment of 2 –point discrimination in Hypothenar region in patient with type 2 diabetes mellitus.**The f-ratio value is 45.36004. The p-value is < .00001. The result is significant at p < .05.**(F-value is greater shows null hypothesis is accepted).



Graph (7) Comparison of 2 point discrimination values in hypothenar area in diabetes patients across five age group (X-Number of patients and Y- 2 Point discrimination value)

DISCUSSION

The present study demonstrated significant age-related differences in two-point discrimination (2PD) among individuals with Type 2 Diabetes Mellitus. The highest 2PD values were observed in the 41–50 years age group, particularly in the thenar and hypothenar regions, indicating greater sensory impairment. These findings suggest that prolonged exposure to hyperglycemia may contribute to progressive sensory decline, which is consistent with previous reports on diabetic neuropathy progression.

Participants aged 31–40 years showed the lowest 2PD values across most hand regions, reflecting relatively preserved sensory function. This observation supports earlier studies indicating that sensory deficits are less pronounced during the initial stages of diabetic neuropathy and may require sensitive assessment tools such as 2PD testing for detection.

Analysis of individual hand regions revealed significant differences across age groups. The thumb, index, middle, and ring fingers demonstrated substantial increases in 2PD thresholds, suggesting greater susceptibility to diabetic sensory impairment. Among these, the index, middle, and ring fingers showed the most pronounced changes, highlighting the vulnerability of median nerve-innervated areas to neuropathic damage. In contrast, the little finger showed comparatively smaller variations, which may be related to relative preservation of ulnar nerve function during the earlier stages of neuropathy.

The thenar and hypothenar eminences exhibited the highest 2PD values among all assessed regions, indicating greater sensory deterioration. These findings are in agreement with previous studies reporting that palmar regions generally demonstrate reduced tactile sensitivity compared to the fingertips. The greater impairment observed in these regions may be associated with diabetes-related vascular and neural changes.

Comparison with normative studies revealed substantially higher 2PD thresholds in the diabetic population, confirming impaired tactile perception associated with diabetes. Previous research has also reported superior sensory discrimination in healthy individuals, particularly among younger adults and females, further emphasizing the impact of diabetic neuropathy on hand sensation.

Overall, the findings support the clinical usefulness of 2PD testing as a simple, cost-effective, and reliable method for assessing sensory impairment in individuals with diabetes. Early identification of sensory deficits may facilitate timely rehabilitation interventions, improve hand function, and help prevent further functional decline. The results also suggest that middle-aged diabetic individuals, particularly those between 41 and 50 years, may benefit most from targeted sensory rehabilitation and glycemic management strategies.

CONCLUSION

The findings of this study support the use of two-point discrimination (2PD) testing as a simple and effective tool for assessing sensory impairment in individuals with Type 2 Diabetes Mellitus. Incorporating region-specific 2PD assessment into routine clinical practice may help identify neuropathic changes early, guide timely interventions, and improve patient outcomes.

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