

# SENSORY AND BALANCE DEFICITS IN PEOPLE WITH DIABETES

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## Background

People with diabetes (DM) particularly those suffering from diabetic peripheral neuropathy (DPN) demonstrated sensorimotor deficits and balance dysfunction rendering them more vulnerable to fall. Our study aimed to compare the light touch sensation, proprioception and standing balance between DM patients, DPN patients and healthy control subjects.

## Methods

23 subjects (mean age:  $64 \pm 10$  yrs) with diabetes but no peripheral neuropathy (DM-non-DPN), 9 subjects (mean age:  $65 \pm 8$  yrs) with diabetic peripheral neuropathy (DPN), and 32 age-matched healthy controls (mean age:  $59 \pm 8$  yrs) were recruited. All participants underwent monofilament test over 10 sites at the foot, passive ankle joint repositioning test for ankle proprioception measurement by using the HUMAC® / NORM™ Testing & Rehabilitation System, Sensory Organization Test (SOT) for balance posturography using a Computerized posturography machine (SMART Balance Master®, NeuroCom® International, Inc).



Fig 1. The HUMAC® / NORM™ Testing and Rehabilitation System for examination of ankle proprioception

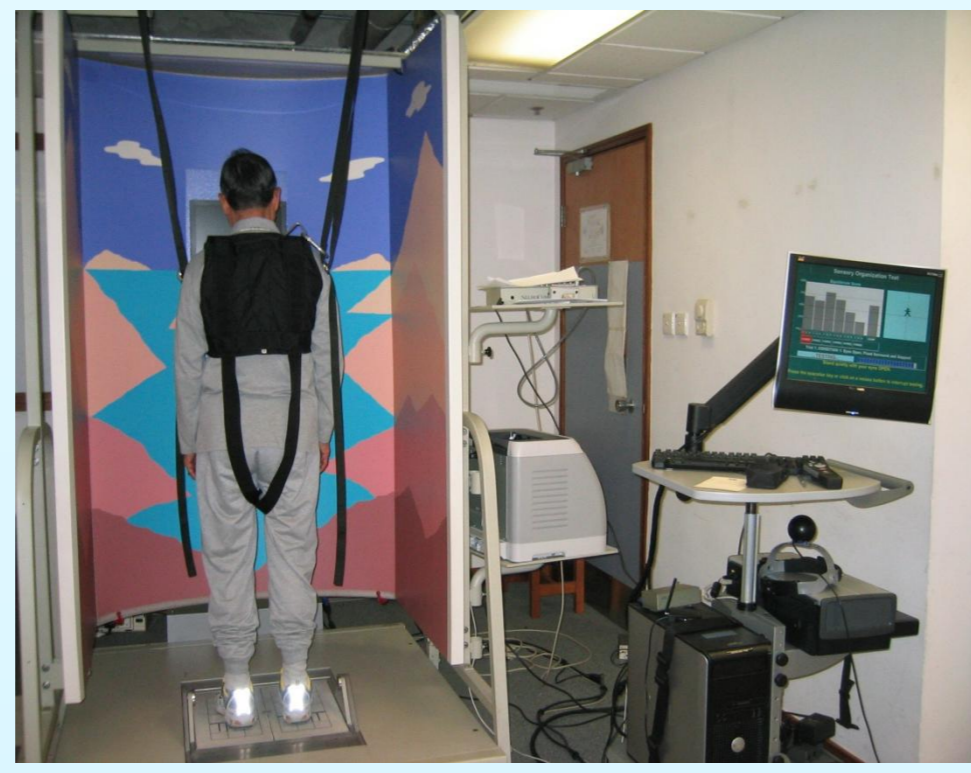


Fig 2. The SMART Balance Master computerized posturography was used to measure the static balance performance.

All data analyses were performed by using SPSS 15.0. Group differences in outcome variables including light touch sensation score, absolute angle errors in passive ankle joint repositioning test, equilibrium score and strategy scores of the six conditions of SOT were assessed using One-way Analysis of Variance (ANOVA).

## Results

- Both DPN (ranged from  $4.59 \pm 1.0$  to  $5.37 \pm 0.7$ ) and DM-non-DPN groups (ranged from  $3.65 \pm 0.6$  to  $4.53 \pm 0.3$ ) demonstrated a decrease in light touch sensation as compared with healthy control (ranged from  $3.33 \pm 0.5$  to  $4.40 \pm 0.2$ ; all  $p < 0.01$ ). However, no significant group difference was found in ankle proprioception (DPN  $6.58 \pm 5$ ; DM-non-DPN  $5.81 \pm 3$ ; control  $6.11 \pm 1.7$ ;  $p > 0.05$ ).
- The decreased light touch sensation in the foot was correlated with a shift from using more of hip than ankle strategy in balance tasks especially in visual deprived conditions ( $r = -0.354$  to  $-0.701$ ;  $p < 0.05$ ).
- Given normal somatosensory input but deprived visual inputs (condition 2), the equilibrium score of the DPN group ( $86.8 \pm 5.6$ ) was drastically decreased, which was significantly lower than did the DM-non-DPN group ( $92.1 \pm 2.9$ ) whose balance was comparable to the healthy control ( $92.1 \pm 2.0$ ;  $p < 0.01$ ).

- Upon disruption of somatosensory inputs, the static balance of the DM-non-DPN group (ranged from  $54.6 \pm 23.8$  to  $73.9 \pm 11.4$ ) was impaired but the DPN group (ranged from  $72.7 \pm 8.8$  to  $83.0 \pm 8.3$ ) was comparable to the healthy control (ranged from  $58.4 \pm 13$  to  $79.4 \pm 7.9$ ;  $p < 0.05$ ).

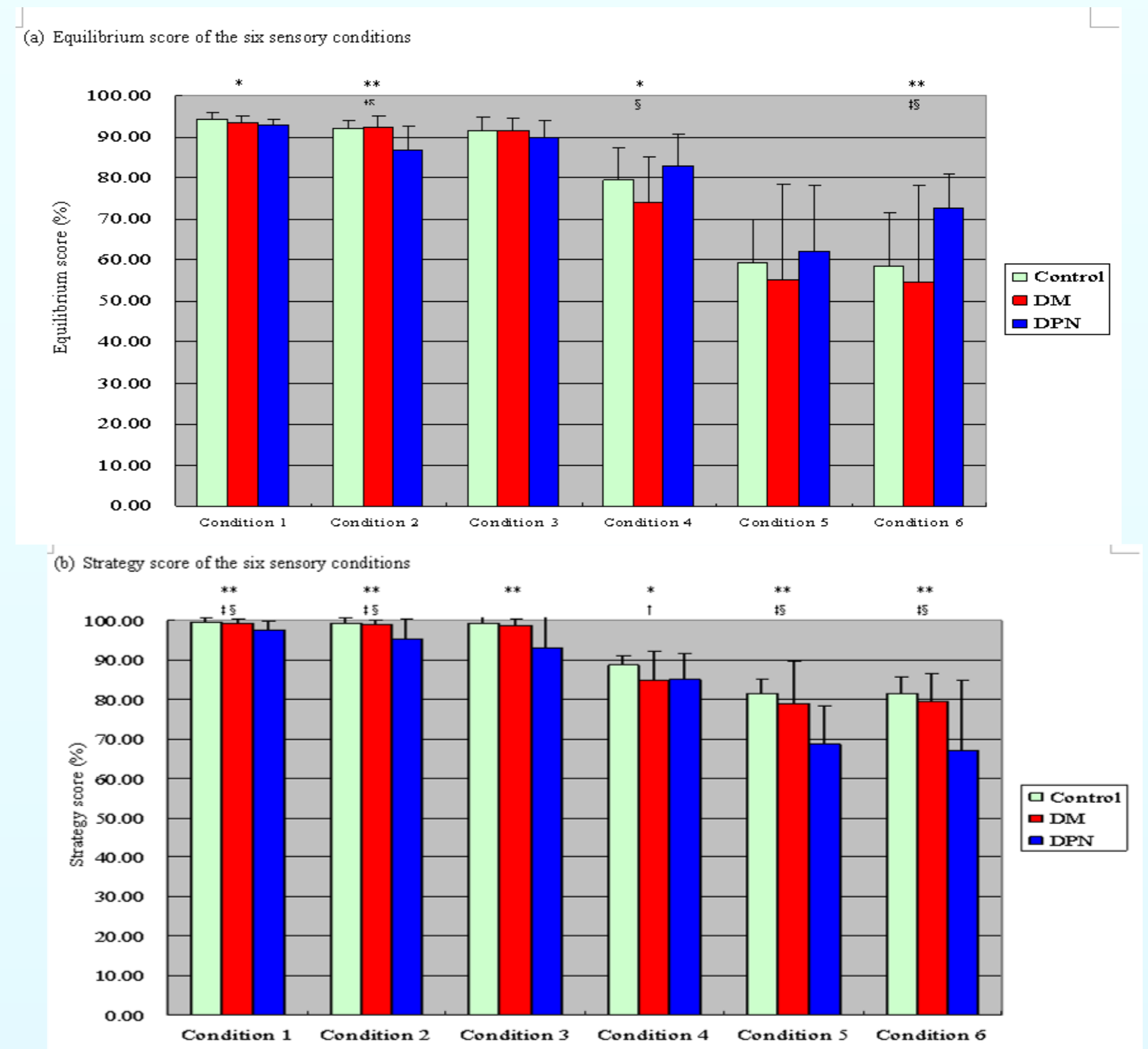


Fig 3. Comparison of the balance performance of the sensory organization test between groups (a) equilibrium score of the six sensory conditions; (b) strategy score of the six sensory conditions; Between-group \* $p < 0.05$ ; \*\*  $p < 0.01$ . † Significant difference between the Control and DM-non-DPN groups ( $p < 0.05$ ); ‡ Significant difference between the Control and DPN groups ( $p < 0.05$ ); § Significant difference between the DM-non-DPN and DPN groups ( $p < 0.05$ )

## Discussions

- Destabilizing effect by vision deprivation is more profound in DPN patients who had already demonstrated impairment in somatosensory systems. Balance test with vision compromised can be sensitive test for DPN patients. In real life, they have an increase risk of fall under vision deprivation situation such as at night time.
- In condition 4 to 6, compromised somatosensory input from the supporting surface may force the individual to ignore information from the perceived unstable supporting surface. DM patients without DPN demonstrated the greatest stability loss among the 3 groups. Therefore, balance test with somatosensory signal compromised can be sensitive test in DM patients without DPN. In real life, these patients have increased risk of fall when they get on and off a bus or escalator.
- Decreased light touch sensation might impair the activation of reflexive connections between cutaneous afferents and peripheral ankle musculature activation required for the execution of ankle strategy which might account for the shift of adopting more of hip than ankle strategy in all DM subjects with impaired light touch sensation.

## Conclusions

People with DPN manifested a loss of protective sensation but retained relatively normal ankle proprioception. Different balance strategies were adopted in the DM group and DPN groups, which warrant specific fall risk screening and management.

## Acknowledgement

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