

Original article

Maxillary sensory nerve responses induced by different types of dentures

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Abstract

Purpose: The purpose of this study was to investigate whether different types of dentures induced different responses to stimulations in sensory nerve underlying the denture-supporting mucosa using current perception threshold (CPT).

Materials and methods: The study population comprised 45 complete denture wearers with a mean age of 69.7 years (CD), 30 partial denture wearers (PD) with a mean age of 67.1 years, and 40 edentulous participants with a mean age of 69.0 years (Dent). Current perception threshold (CPT) on the greater palatine nerve at 2000 Hz, 250 Hz, and 5 Hz, corresponding to A-beta, A-delta, and C fibers respectively, were measured by the Neurometer[®] NS3000 device. The differences CPTs among CD, PD, and Dent groups were analyzed by Kruskal–Wallis test and Mann–Whitney *U* test with adjusting the multiple comparisons' inflation of type 1 error rate by a Bonferroni correction.

Results: CPTs of CD, PD, and Dent group at 2000 Hz were 61.5 ± 45.8 , 53.5 ± 25.3 , 33.0 ± 11.4 (10^{-2} mA) respectively. CPTs of CD, PD, and Dent group at 250 Hz were 29.2 ± 28.2 , 20.1 ± 13.2 , 14.3 ± 5.9 (10^{-2} mA) respectively. CPTs of CD, PD, and Dent group at 5 Hz were 28.9 ± 23.4 , 17.8 ± 12.2 , 12.2 ± 5.6 (10^{-2} mA) respectively. The CPTs at all frequencies increased in the following order: Dent < PD < CD wearer. The statistical analyses showed that the different types of dentures significantly affected CPTs at 2000 Hz ($p < 0.0001$), 250 Hz ($p < 0.0001$), and 5 Hz ($p < 0.0001$).

Conclusion: The different types of dentures induce different responses to stimulations in the sensory nerve underlying the denture-supporting mucosa.

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Key words: Current perception threshold; Denture; Sensory nerve

1. Introduction

In individuals who have been either edentulous for many years, or in whom marked resorption is present, the regions of the incisive and palatine foramina have been considered to require relief in order to prevent impingement of the nerves and blood vessels underlying the mucosa of the edentulous alveolar ridge [1,2]. However, until now there has been no concrete evidence of changes in nerve functions induced by wearing dentures.

To further understand this phenomenon, we have been investigating the influence of compression induced by wearing dentures on nerve function, using current perception threshold

(CPT) [3]. Then, it was report showed that wearing dentures affected nerves underlying the mucosa of the edentulous alveolar ridge [4].

Although keeping complete dentition healthy in essence, human oral condition generally progress beyond the partially edentulous stage to the complete edentulous stage with increasing age [5,6]. Thus, one clinical question rose whether responses to stimulations in the sensory nerve underlying the mucosa of the maxillar alveolar ridge would be different among patients retaining their natural teeth or having fixed prostheses (Dent), patients wearing partial dentures (PD), or patients wearing complete dentures (CD). Thus, the purpose of this study was to investigate whether different types of dentures induce differential responses to stimulations in the sensory nerve underlying the denture-supporting mucosa, as assessed by CPT-measurement. Our null hypothesis was that the CPTs obtained from participants with different oral status (Dent, PD, and CD) would not be different.

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2. Materials and methods

2.1. Study population

Patients at Nihon University School of Dentistry at Matsudo Affiliated Hospital, Chiba, Japan, who were willing to undergo prosthodontics treatment, were recruited to participate in the study. Targeted individuals to be included were following categories: CD, PD, and Dent. We enrolled 45, 30, and 40 participants in the CD, PD, and Dent categories, respectively. Dent participants with a mean age of 69.0 years were individuals who had never worn dentures and could eat daily meals with their natural teeth and/or tooth-supported fixed prostheses. PD participants with a mean age of 67.1 years were of Kennedy class II, mostly having the first and second molar as missing teeth. PD participants we sought to recruit in this study were individuals who have the denture base including the major connector covered the great palatine foramen. Except this condition, we did not consider the inclusion criteria about the denture design in the study protocol. Participants who wore dentures with telescopic crowns and/or attachments to ensure a rigid support or connection for potentially less sinking into the mucosa on the free-end distal saddle were excluded. CD participants with a mean age of 69.7 years were could eat daily meals with their dentures. Those were completely edentulous and their maxillary dentures were designed to completely cover maxillary alveolar ridge including the line between hamular notch and palatine foveola.

Exclusion criteria checked by interview were as follows: (a) patients with dental implant restorations, (b) patients with general health problems which influence on response to stimulation of sensory nerves (e.g., diabetic mellitus, trigeminal neuralgia, post-herpetic neuralgia), (c) patients with an anxiety about participation in the study due to their heart diseases (e.g., cardiac infarction, ischemic arrhythmia), and (d) patients with a lack of understanding of written or spoken Japanese.

This study was approved by the Human Ethics Committee of Nihon University School of Dentistry at Matsudo, and the volunteers were enrolled after obtaining their written informed consent.

2.2. CPT measurements

The subjects were seated comfortably on dental chairs in a quiet room. Only one operator measured mucosal CPTs in the greater palatine nerve areas around the great palatine foramen of all participants with a Neurometer[®] NS3000 device (Neurotron Inc., Baltimore, MD, USA), by applying electrical stimulation at 5, 250, and 2000 Hz (Fig. 1). The greater palatine nerve was selected as the target for the measurement, as the great palatine foramen was present in all denture wearers participating in this study.

To ensure contact between the mucosa and the stimulation electrodes, a measuring apparatus was developed for each subject with \varnothing 1 mm thermoforming disks (Erkodur[®], Erkodent, Baden-Württemberg, Germany). Plates (18 mm \times 6 mm \times 3 mm) containing the stimulation electrodes

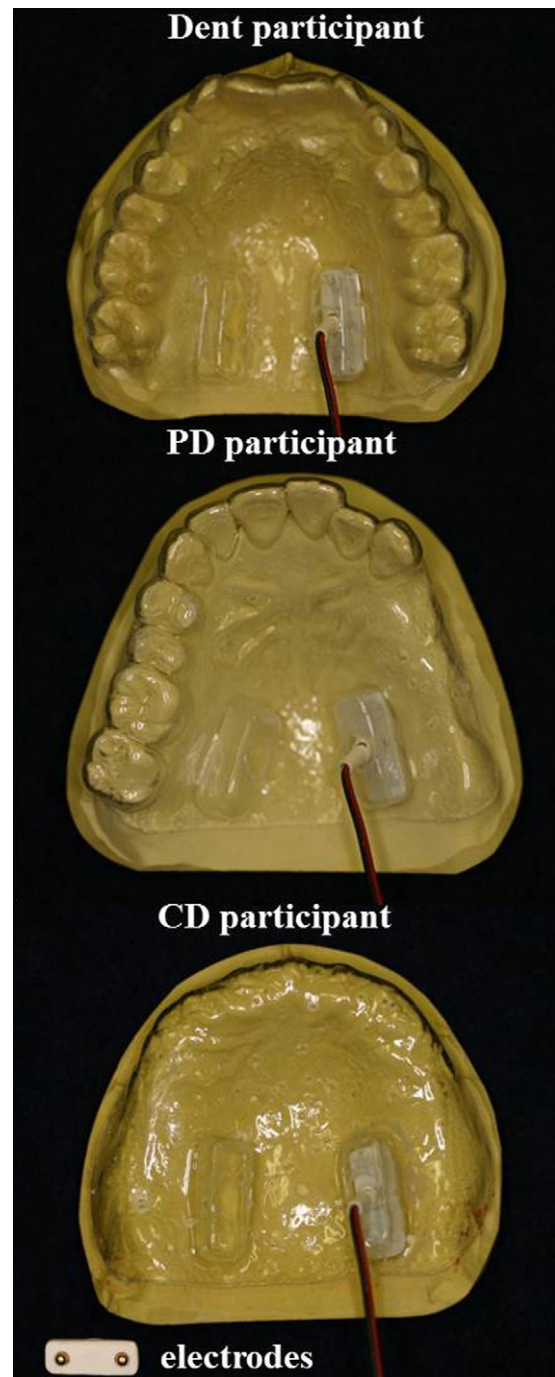


Fig. 1. Measurement of current perception thresholds. Dent represents patients retaining their natural teeth or having fixed prostheses. PD represents patients wearing partial dentures. CD represents patients wearing complete dentures.

(\varnothing 2 mm) were mounted on an intraoral removable appliance. Initially, according to the instruction manual, at each particular frequency of electrical stimulation, the electric current was slowly increased from 0.01 mA until the subjects reported a sensation. An approximate CPT level was then determined. Raw CPT results can range from 000 to 999; these values are directly related to milliamperes (mA) of current corresponding to the stimulus intensity (0.01–9.99 mA), which means that one CPT is 1×10^{-2} mA. Subsequently, a microprocessor-controlled forced-choice technique, which used 6–20 cycles of randomly

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