

Tactile Sensation and Occlusal Loading Condition of Mandibular Premolars and Molars

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The aim of the study was to investigate any correlation between tactile sensation and occlusal loading conditions of mandibular premolars and molars, by means of tactile detection threshold (TDT). TDTs of mandibular premolars and molars of twenty adults were determined by calibrated monofilaments. Occlusal force (OF) applied on each tooth at maximal-clenching was measured by a pressure-sensitive film. There was neither a correlation between the mean TDTs and the total OFs of individual participant nor in each tooth type. TDTs of the teeth on the preferred chewing side were significantly higher than those of the contralateral side. The results suggest that periodontal sensation is more related to frequency than to magnitude of loading. Periodontal mechanoreceptors of loaded teeth receive temporal, spatial and intensive characteristics of forces. These characteristics contribute to the efficient control of jaw movement during mastication [1–4]. Oki et al. [5] reported that the mechano-sensitive threshold of the periodontal sensation after transient mechanical loading was higher than those before loading. They also revealed that the mechano-sensitive threshold in the habitual bruxism group was higher than that in the non-bruxism group [6]. Recently, a significantly lower interocclusal tactile threshold in the molar region was detected in bruxers, when compared to non-bruxers [7]. These results underscore a relationship between the periodontal sensation and the occlusal loading.

Clinically, occlusal sensory disturbances might be related to various oral dysfunctions. One of them, coined “occlusal dysesthesia”, i.e., characterized by symptoms of uncomfortable feelings of occlusion, despite the absence of any observable occlusal anomaly or discrepancy, has been of concern in the clinic [8, 9]. Until now, the mechanism still is not unraveled. The purpose of this study was to investigate the relationship between the periodontal sensation in mandibular premolars and molars, through tactile detection threshold (TDT) and occlusal force (OF) considering tooth type and preferred chewing side (PCS). The hypothesis to be tested is that TDT is influenced by occlusal loading condition.

Twenty male volunteers with a natural complete dentition (age 26.7 ± 1.5 years) and with normal jaw function gave their informed consent to participate in the study. Patients with a habitual parafunction, such as bruxism, any history of orthodontic treatment and any obvious malocclusion, were excluded. Mandibular premolars and molars on both sides were studied (e.g., a

total of $20 \times 8 = 160$ teeth were included). The research protocol was reviewed and approved by the Research Ethics Committee of the Tohoku University Graduate School of Dentistry. The TDT of each tooth was measured by calibrated monofilaments (Touch-Test®, North Coast Medical, CA, USA) with 20 different diameters corresponding to 20 target forces (0.008–300 g) [10]. Tactile stimulation was applied perpendicularly to the tooth axis at the buccal surface. The sequence of tested teeth was randomized. TDT was determined by the psychophysical method (method of limits) [1]. After several alternate ascending and descending series of tests, the mean value of the detected thresholds was considered as the TDT of the tested tooth. Occlusal force of maximal voluntary clenching on the intercuspal position was measured by pressure-sensitive film (Dental Prescale 50H, Fuji Film, Tokyo, Japan) and calculated through an analysis device (Occluser 705FRD, GC, Tokyo, Japan). Measurement of OF was carried out after TDT test. The identity of each tooth corresponding to the OF value was crosschecked by a silicon check bite (Flexicon, GC, Tokyo, Japan). The PCS was determined by placing half a piece of cotton roll on the center of the tongue and by observing the direction to which the cotton roll was moved during the first chewing cycle.

Data were reported as mean (SD). The difference between the groups was analyzed by Kruskal-Wallis and Dunn-test. Paired data, such as TDT of PCS and non-PCS, were analyzed using Wilcoxon signed-rank test. The correlation between two groups was analyzed by Spearman's rank correlation coefficient. Statistical analyses were performed by statistical software (SPSS 13.0, Chicago, IL, USA) with the significance set at $P < 0.05$. Mean TDTs of the individual participant were not correlated with their total OFs (Fig. 2). Moreover, no significant correlation between TDTs and OFs was found within any tooth type (Fig. 3). TDTs of the teeth on the PCS were significantly higher than those of the contralateral side ($P < 0.01$; Fig. 4), without significant differences between right and left side. These results suggest that periodontal tactile sensation is related to the PCS, but not to OF, which might partially reject our research hypothesis. Although the results were somehow limited, our data still suggest that, when compared with the static occlusal loading condition such as OF at maximal voluntary clenching, periodontal tactile sensation might be more influenced by the functional loading conditions, which are determined by the frequency and magnitude of the load during function (i.e., mastication). These results may support a

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previous study which showed a higher periodontal mechano-sensitive threshold after transient mechanical loading [5] as well as a different periodontal sensation between the habitual bruxism and the non-bruxism group [6, 7]. The underlying mechanisms might be related to the change of periodontal ligament properties and their periodontal mechanoreceptors function or to the adaptation of signal processing in the central nervous system

In terms of clinical relevance, the sensory system with its periodontal mechanoreceptor plays an important role in modulating the oral function (such as chewing). Therefore, the proper feedback control of chewing might be jeopardized by the decreased periodontal sensation, which may be related to excessive habitual chewing, hence even leading to traumatic occlusion or tooth fracture. Also the results of this study could contribute to further understanding the mechanism of the occlusal perceptive and/or discriminative disorder, such as “occlusal dysesthesia”. Though it is not diagnosed to depression by the result of SDS clinical, SDS is used to judge the tendency and the state of depression. As for SDS, there is a role to know the state of depression in a short time for assistance.