Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.intl.elsevierhealth.com/journals/jden

Tactile sensitivity of vital and endodontically treated teeth

Birte-Juliane Schneider [a,1], *Sandra Freitag-Wolf* [b,2], *Matthias Kern* [a,*]

[a] *Department of Prosthodontics, Propaedeutics and Dental Materials, School of Dentistry, Christian-Albrechts University at Kiel, Arnold-Heller-Str.16, 24105 Kiel, Germany*

[b] *Institute of Medical Informatics and Statistics, Christian-Albrechts University at Kiel, Brunswiker Str.10, 24105 Kiel, Germany*

ARTICLE INFO

Article history:
Received 20 June 2014
Received in revised form
7 August 2014
Accepted 26 August 2014

Keywords:
Tactile sensitivity
Endodontically treated teeth
Tooth vitality
Removable partial dental prostheses
Humans
Gender

ABSTRACT

Objectives: Endodontically treated teeth (ETT) used as abutments for removable partial dental prostheses (RPDPs) have an increased fracture risk as compared to vital abutments. One suggested explanation is that ETT exhibit a lower threshold level for tactile sensitivity than vital teeth. Therefore, this study compared the threshold for tactile sensitivity of vital teeth and ETT in the same individuals.

Methods: Forty participants with double crown-retained RPDPs fixed to vital teeth and ETT were included in the study. Each subject had at least one vital and one corresponding contralateral endodontically treated abutment tooth in the same jaw. After removal of the RPDP, an increasing centric force (0 cN to max. 2000 cN) was separately applied axially to both free-standing abutment teeth using a force gauge while the patient was asked to give three acoustic signals: (1) when noticing the first contact, (2) when noticing pressure and (3) when the pressure became displeasing. Afterwards, the same trial was performed with an eccentric force applied parallel to the tooth axis.

Results: Statistical analysis revealed no significant differences in the threshold of tactile sensitivity of vital teeth and ETT to either centric or eccentric loading ($p > 0.05$). Eccentric loading showed lower mean threshold values compared to centric loading. A large variability of tactile sensitivity between individuals was noted. However, there were no gender-related significant differences in tactile sensitivity ($p > 0.05$).

Conclusions: The tactile sensitivity of vital and non-vital teeth seems comparable.

Clinical significance: The assumption that a lower threshold level for tactile sensitivity in ETT than in vital teeth is responsible for their increased fracture risk could not be confirmed. Therefore, other reasons, e.g. loss of hard tissue due to root canal treatment, have to be considered responsible for the increased fracture risk of ETT.

* Corresponding author. Tel.: +49 431 597 2874.
E-mail addresses: bi-u@gmx.de (B.-J. Schneider), freitag@medinfo.uni-kiel.de (S. Freitag-Wolf), mkern@proth.uni-kiel.de (M. Kern).
[1] Tel.: +49 17621982383.
[2] Tel.: +49 4315973180.

http://dx.doi.org/10.1016/j.jdent.2014.08.016

1. Introduction

A healthy periodontium has various neural receptors with distinct functions.[1] One function of the receptors in the periodontal ligament is the discriminatory ability of tactile and nociceptive sensitivity and the regulation of muscular activity.[2] The existence of intradental pressoreceptors has been documented and a higher threshold for pressoreceptive sensibility of ETT has been reported.[3]

Subjects with a removable partial or complete dental prosthesis have shown a reduced discriminatory ability compared to natural teeth.[4] In addition, there are receptors outside of the periodontium, for example, in the mucosa, the periosteum of the jaw bone, in the joints and muscle spindles, which seem to be important for mechanoreception and discriminatory ability.[1,5]

Active and passive assessments of thresholds of oral tactile sensitivity have been described. The passive threshold is determined by applying an increasing mechanical force to the tooth. The first sensation that is provoked with the minimal force is called the absolute threshold of perception.[6] The required loading for the first sensation on teeth is 1–10 cN.[7]

Endodontically treated teeth (ETT) used as abutment teeth for removable partial dental prostheses (RPDPs) have an increased fracture risk as compared to vital abutments.[8] One suggested explanation is that ETT exhibit a lower threshold level for tactile sensitivity than vital teeth.[9] Randow et al.[9] reported in 1986 that non-vital teeth have a reduced discriminatory tactile function with lower nociceptive responsiveness than vital teeth. However, they investigated only three subjects with one vital tooth and one ETT using cantilever loading. Results showed that the mean pain threshold level of non-vital teeth was twice as high compared to the level of vital teeth. However, this small clinical study seems to present a rather weak clinical evidence as only three subjects have been evaluated, resulting in an inadequate power of the study to draw reliable conclusions. Nevertheless, this unique experiment has been widely cited in the dental literature although these results have never been confirmed.

Various other reasons for the increased fracture risk of ETT have been discussed in the literature.[10–17] One obvious factor is the higher loss of tooth substance due to carious destruction and endodontic access cavity preparation in ETT. Additionally, the stress caused by endodontic procedures such as instrumentation, irrigation and obturation as well as the insertion of posts might introduce micro-cracks in non-vital teeth.[10–17] ETT with or without post-placement had a lower fracture resistance than vital teeth serving as RPDP abutments.[8,10,16,18,19] On average, 71% of fractured teeth were endodontically treated.[20,21] Often approximately 10 years after endodontic treatment vertical root fractures occured.[11,22]

In order to reveal whether a difference in tactile sensitivity of vital teeth and ETT might play a role in the increased fracture risk of ETT when serving as RPDP abutments, this study evaluated the passive threshold level for tactile sensitivity of vital teeth and ETT using centric and eccentric loading. The null hypothesis was that the tactile sensitivity of ETT does not differ from that of vital teeth.

2. Materials and methods

The study protocol has been approved by the Ethics Committee of the Christian-Albrechts University at Kiel, Germany. Forty participants (24 males, 16 females) were recruited from the Department of Prosthodontics, Propaedeutics and Dental Materials, Christian-Albrechts University at Kiel. All recruited participants gave their informed consent to participate in the study and defined insurance policy was contracted for all participants to cover possible risks for the loaded abutment teeth, such as tooth fracture.

Each subject had at least one vital and one endodontically treated abutment tooth supporting a double crown-retained RPDP. Matched abutment teeth in the same jaw were compared, i.e. incisor to incisor, canine to canine, premolar to premolar and molar to molar.

Inclusion criteria for selected test teeth were a healthy periodontium with a probing depth of maximum 3 mm, no bleeding on probing, a mobility of 0–1,[23] normal response of vital teeth when tested with CO_2 snow, stable bone level with a maximum of one-third bone loss and a root canal filling of sufficient quality. The quality of a root canal treatment was deemed sufficient if there were no clinical symptoms such as pain on bite or percussion and there was no evidence of pathologic changes in the periodontal ligament. Also the root canal filling had to be of appropriate density and extension within 1 mm of the radiographic root length.

After removal of the double-crown retained RPDP for reproductive eccentric loading an extension bar (CoCrMo, $10 \times 9 \times 2$ mm) was individually adapted to each abutment tooth in a right angle to its labial surface by underlining its annular opening with autopolymerizing composite (Luxatemp, DMG Chemisch-Pharmazeutische Fabrik GmbH, Hamburg, Germany) while it was positioned over the abutment (Fig. 1). A rounded notch for the application of the centric loading was created manually in composite resin in the vertical axis of the tooth, for eccentric loading a standardized groove was present in the metal extension. So the threshold of tactile sensitivity could be examined on the freestanding abutment teeth without proximal contacts to adjacent teeth.

The threshold of tactile sensitivity was passively assessed using two force gauges (Correx Force Gauge 25–250 and 200–2000 cN, Correx, Hahn + Kolb Werkzeuge GmbH, Stuttgart, Germany). Pressing slowly down the feeler arm of the gauge with its rounded tip, a continuously increasing axial force up to 2000 cN was applied first centrically and then eccentrically parallel to the tooth axis. The reproducibility of manual force application was evaluated using a modified typodont in a universal testing machine (Zwick Z010; Zwick GmbH, Ulm, Germany). The measured force application varied between 2.4 and 4.3% for the 250 cN force gauge and between 2.2 and 2.7% for the 2000 cN force gauge when measurements were repeated 10 times.

The order of loading the teeth was randomized. Throughout the study, loading was applied blinded by the same individual, who thus did not know whether the loaded tooth was vital or endodontically treated. Every testing was videotaped for a precise subsequent analysis. While the loading force was increased continuously, the patient had