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Assessment of masticatory muscle activity and occlusion time in patients with advanced tooth wear

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ABSTRACT

Objective: Tooth wear is a basic physiological adjustment mechanism in the masticatory system. Unfortunately, it is not clear what the relationship is between the activity of the masticatory muscles and the tooth hard tissue loss (mainly enamel) in patients with advanced tooth wear. The aims of this study were (1) to compare the occlusion times and (2) to compare the EMG activity in maximal voluntary clench of the masseter and anterior temporalis muscles of patients with advanced tooth wear to the same activity of healthy volunteers.

Design: 50 (16F, 34M) patients and 30 (12F, 18M) age matched controls were clinically examined to assess the degree of wear (TWI). Each subject underwent electromyographic analysis (bilateral anterior temporalis, superficial masseter, anterior digastric and sternocleidomastoid muscles) and digital occlusal analysis.

Results: Mean values of the electrical potentials of the mandible elevating muscles during clench were higher in the study group compared to the controls. A negative correlation was found between the temporalis and masseter muscle activities during clench and the mean value of TWI ($r = -0.383$, $p = 0.009$; $r = -0.447$, $p = 0.002$). Occlusion time was longer in the study group compared to controls ($p < 0.05$).

Conclusions: Mandibular adductors demonstrated lower muscular activities during clenching in the tooth wear patients; however, the cause of this finding is not certain. Prolongation of occlusion time may exacerbate occlusal surfaces wear or excessive wear may prolong occlusion time.

1. Introduction

Tooth wear is often a basic physiological adjustment mechanism in masticatory system and it is a recognized physiological, irreversible process. However, there are individuals in whom the phenomenon of wear occurs dramatically faster and, if not treated, may lead to the complete destruction of the system.[1–3] A clinical view of occlusal wear customarily reveals flattening of the occlusal surfaces, the presence of enamel discoloration, cracks and fractures, dentine exposure, sharp and uneven incisal edges, short clinical tooth crowns and in the worst cases, pulp exposure.[1,3] The cause of pathological tooth wear is multifactorial and it is often difficult to determine the primary aetiology. However, tooth wear is thought to occur from a combination of attrition, abrasion, erosion and abfraction. Some specific etiological factors responsible for tooth wear include excessive occlusal forces,

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bruxism, premature contacts in function, eccentric loading of the teeth and hyperactivity of the masticatory muscles. However, it is also recognized that additional factors like the consumption of acidic beverages, citrus fruits and juices, eructation, gastroesophageal reflux disease and bulimia may influence the picture of pathological wear, moreover, may play a key role mainly in the erosive process.[1,4] Individual mechanisms may act independently, but more frequently are combined with other mechanisms that occur during interocclusal activity. Excessive occlusal load resulting from excessive muscular activity may prolong muscular activity of the adductors in centric occlusion. Occlusal conditions may excessively stimulate contractile activity of the masticatory muscles into prolonged occlusal surface friction during function.[5,6] It is worth pointing out that occlusal force varies within the dental arch. The application of occlusal force is greatest in the molar and premolar regions; it decreases on the canines and on the incisors. To measure the relative occlusal force within the dental arch electromyographic (EMG) recording of the elevator muscles may be applied as an adequate method.[7–9] Numerous studies have shown an almost linear correlation between EMG potentials and the occlusal force.[10–12] It has also been claimed that there is a close correlation between muscle response to force and the location of a contact force in occlusion.[13–16] Although, knowledge of occlusal contacts of both dental arches in the centric occlusion is necessary for any discussion of occlusal relations for the natural dentition and restorations, there is no consensus how to measure occlusion. One of the parameters that may describe occlusion is occlusion time, i.e. the time from the first tooth contact to maximum intercuspation at maximal voluntary clench.[7] However, it has not been clear what the relation is between the activity of the masticatory muscles, occlusal status and tooth hard tissue loss (enamel and dentine) in patients with advanced tooth wear.

2. Objectives

The aims of this study were (1) to compare the occlusion times and (2) to compare the EMG activity in maximal voluntary clench (MVC) of the masseter and anterior temporalis muscles of patients with advanced tooth wear to the same activity of healthy volunteers. Null Hypotheses:

H_{n1} = No difference between the occlusion times of the patients and the controls.

H_{n2} = No difference in the masseter and temporalis activity of patients with worn dentition when compared to the same elevator muscle activity of control subjects clenching in MVC.

3. Materials and methods

The data were collected in the Department of Prosthetic Dentistry at the Medical University of Bialystok (Bialystok, Poland), while conforming to the criteria of The Helsinki Declaration, ICH Guideline for Good Clinical Practice.[17]

3.1. *Ethical approval*

The protocol was approved by the Local Ethical Committee of the Medical University of Bialystok, Poland, with an approval number of R-I-003/6/2006. Informed consent was obtained from each participant at the beginning of the study prior to confirmation of their eligibility for the study. The participants were able to withdraw from the study at any time and for any reason without prejudice.

3.2. *Inclusion and exclusion criteria of the experimental group*

Fifty patients with advanced tooth wear and visibly exposed occlusal dentine, 16 women and 34 men with a mean age of 49.5 ± 9 years, comprised the subject pool.

Inclusion in the study required participants to satisfy the following criteria:

1. The presence of widespread advanced occlusal surface tooth wear with multiple sites of exposed occlusal dentine (Tooth Wear Index – TWI on occlusal/incisal surface ≥ 2), but normal buccal, lingual and cervical surfaces (sample in Fig. 1).
2. At least 14 teeth/arch with no present decay and no periodontal bone loss > 2 mm.

Subjects were excluded from the study when they demonstrated:

Fig. 1 – A clinical intraoral photo illustrating a study subject who presented with severe occlusal wear and a control who exhibited no wear.