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Original article

Effect of electromyogram biofeedback on daytime clenching behavior in subjects with masticatory muscle pain

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Abstract

Purpose: Although daytime clenching is believed to be one of the oral parafunctions leading to dental problems, a treatment strategy has not yet been devised. Electromyogram (EMG) biofeedback training was performed to ascertain its effect on the regulation of daytime clenching behavior.
Materials and methods: Twenty subjects (mean age, 30.9 ± 5.6 years) who had mild to moderate masticatory muscle pain with daytime clenching behavior were randomly divided into either a biofeedback group (BF) or control group (CO). Subjects were fitted with a hearing-aid-shaped EMG recording and biofeedback apparatus which was used to record EMG data under natural conditions from the temporal muscle, continuously for five hours on four consecutive days. EMG data on Days 1 and 4 were recorded without biofeedback as pre-test and post-test, respectively, and on Days 2 and 3, subjects in the BF group noticed their clenching behaviors via an alert sound from the EMG biofeedback apparatus. No alert sound was given for the CO group throughout the recording sessions.
Results: There was no significant difference in the number of clenching events for five hours between the BF group (4.6 ± 2.5) and CO group (4.6 ± 0.9) on Day 1, however a significant decrease was found in the BF group between Day 1 (4.6 ± 2.5) and Day 4 (2.4 ± 1.7; $P < 0.05$).
Conclusion: Daytime clenching was reduced in the short-term with the help of an EMG biofeedback system under natural circumstances. Further research is needed to confirm a long-lasting effect.

Keywords: Bruxism; Oral parafunctions; Temporomandibular disorders

1. Introduction

Bruxism is believed to be one of the contributing factors for temporomandibular disorders (TMD) [1–3]. In addition, excess loading on teeth may also lead to tooth attrition, abfractures, broken and cracked teeth, loose teeth, gingival recession, sensitive teeth, occlusal trauma, and limitations for dental implants [4]. In other words, bruxism events increase the likelihood of dental problems. Nocturnal bruxism detection has been reported in studies using polysomnography [5–7] and portable electromyogram (EMG) recording systems [8,9]. Since TMD patients with masticatory muscle pain habitually keep their teeth in contact to some degree [10–12], cognitive biobehavioral therapy could be expected to be a suitable strategy for pain management. Daytime clenching has been identified using a portable EMG recorder under daily circumstances to differentiate clenching events from functional ones [13,14]. In this study, EMG biofeedback training was performed to ascertain its effect on parafunctional mandibular movement regulation and to expand the clinical usage of the EMG recording system.

2. Materials and methods

2.1. Subjects

Twenty-two subjects with mild to moderate masticatory muscle pain and daytime clenching behavior were recruited

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Fig. 1. The newly developed portable EMG recording and biofeedback system. Left panel: at completion of the apparatus set-up. Right panel: the apparatus is covered by the subject's hair.

from volunteers, including students and staff members at the School of Dentistry, Iwate Medical University, and patients under care at the Dental Hospital of Iwate Medical University (11 males, 11 females; mean age, 30.9 ± 6.8 years). Inclusion criteria were: age between 20 and 35 years, awareness of pain or stiffness in the masticatory muscles, and subjective awareness of daytime teeth clenching. Furthermore, two or more items described below were required: tooth indentation inside the cheek and/or on the tongue, masticatory muscle hypertrophy, bone torus, jaw opening range less than 40 mm between upper and lower incisal edges, or tenderness of the masticatory muscles on palpation. Exclusion criteria were: wearing a removable partial denture, lack of any occlusal supporting zone due to tooth loss in the molar region, current use of muscle relaxants or anti-inflammatory medicine, or advanced periodontal disease. Subjects were then randomly divided into two groups—a biofeedback group (BF) and a control group (CO).

This research was approved by the Human Research Ethics Committee of Iwate Medical University Dental School and an informed consent form was obtained from each subject after they had received a detailed explanation of the research protocol.

2.2. Pain intensity description

The most intense pain level in the masticatory muscles, in the past month, was indicated by each subject using an 11-point numerical rating scale (NS) numbered from 0 (no pain) to 10 (the worst pain imaginable). Subjects with mild to moderate pain were included in the study.

2.3. EMG recording

EMG recording was carried out using a one-channel portable EMG recording and biofeedback system, shown in Fig. 1. This portable device was composed of three components—an electromyography unit, a data-logger and an auditory feedback unit. In this study, recording was conducted on four consecutive days (Fig. 2), as follows:

Day 1: Pre-testing session for EMG recording of base line data to determine the EMG biofeedback threshold for each individual subject for the subsequent sessions.

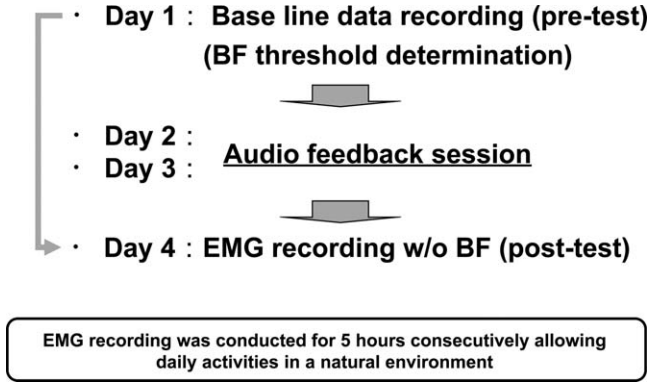

Fig. 2. The study design timeline over four consecutive days. The five-hour recording sessions were carried out during the daytime which included lunch time. Abbreviation: BF, biofeedback.

Days 2 and 3: Biofeedback training sessions to remind subjects of their parafunctional behaviors such as teeth clenching. Subjects in the BF group were instructed to separate their upper and lower teeth when they recognized the alert sound. Subjects in the CO group received no feedback alert signal but were just recorded for their EMG activities.

Day 4: Post-testing session of EMG recording to determine the effect of biofeedback training on the regulation of clenching habits.

Electromyograms were recorded under natural conditions from the anterior part of the temporal muscle on the habitual side of mastication, continuously for five hours, including lunch time. The biofeedback training consisted of a small alert sound which reminded the subject of undesirable clenching when excessive EMG activity was generated with certain burst duration. The alert sound level was adjusted individually beforehand. A suitable threshold, which combined EMG activity and burst duration, was defined for each subject using the base line Day 1 EMG data, in order to differentiate functional from parafunctional EMGs. Subjects were instructed to behave normally, with the exception of washing their faces, touching the electrode intensively, and any actions that might create undesirable noise interference of the EMG signals. To