Development of a portable bruxism monitoring and analysis device equipped with a microcomputer and its practical application

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Abstract—The purposes of this study were to develop and verify the a portable nocturnal bruxism monitoring and analysis device equipped with a microcomputer, and to clinically apply the device to know the actual conditions of bruxism patients. EEPROM was installed in the device for the data recording, and after the data collection, the recorded data was entered into a personal computer via serial port. After confirming the accuracy of the device, a total of 30 subjects were enrolled in this study to monitor their bruxism activities for 3 nights. Bruxism self-aware group consisted of 14 subjects, 7 males and 7 females, and unaware group consisted of 16 patients, 8 males and 8 females. Most of the subjects reported that the new device was easy to handle. The average bruxism time per hour and the average bruxism lasting time were 223.8 ± 112.0 and 3.9 ± 2.9 s in the self-aware group, and 49.3 ± 38.3 and 0.8 ± 0.7 s in the unaware group, respectively. The bruxism self-aware group showed statistically longer average bruxism time per hour and the average bruxism lasting time. It was confirmed that the new bruxism monitoring and analysis device is practical for clinical application to monitor and analyze the electromyographic activities.

Key words: Bruxism; monitoring device; analysis; diagnosis.

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1. INTRODUCTION

During the main process of periodontal tissue destruction, plaque is known to cause inflammatory tissue destruction. However, in the case of advanced periodontitis, occlusal trauma induced by bruxism is thought to play a significant role [1]. It has been reported that bruxism is not only a risk factor that causes the advancement of periodontal diseases, but also is noted to induce TMJ (temporomandibular joint) disorders [2, 3]. Furthermore, in the advent of the aging society, bruxism is viewed as the cause of the increasing instances of root fracture and the failures of fixed prosthesis [4]. Under such a backdrop, examination/diagnosis and treatment of bruxism become quite important.

That being said, scientific research on bruxism is quite limited [5, 6] and as compared to the studies of other fields, countermeasures against bruxism are not quite developed yet [7]. The current situation is led by the lack of proven objective diagnostic methods.

In response to such a status quo, we decided to develop an innovative automatic analytical device that is equipped with the function to freely change the detection threshold of muscular activities’ potential. The apparatus is based on the previous generation of the bruxism recorder (patient attaches this device to record his/her masseter muscular activities on a tape that is brought to the university for analysis) [8, 9]. Although the previous system had an advantage of accurately recording data at patients’ home, patients could not walk around when the device was attached, and patients with little electrophysiologic knowledge had some difficulties in setting up the recording device by themselves. A smaller and easy-to-use device was desired to be developed for using in a daily clinical basis [10, 11].

This study has been conducted with the following three objectives:

1. To develop a new portable bruxism monitoring and analysis device.
2. To verify the validity and the ease of use of the new device.
3. To monitor the electromyographic activities generated during nighttime of the bruxism self-aware group and unaware group to know if there is any characteristic difference between the groups.

2. MATERIALS AND METHODS

2.1. Newly developed bruxism diagnostic system

The newly developed bruxism diagnostic system is composed of two parts, i.e. the portable bruxism monitoring and analysis device, and the software that is installed to a computer. The monitoring and analysis device (Morita MFG) is equipped with a microcomputer to auto-analyze the data and is easy to handle (Fig. 1). Because of the small size of this device (50 mm × 26 mm × 90 mm) and the light weight (90 g, including the battery), it can be used either during daytime or night. It can be either placed on the forehead, or inserted in a pocket of a jacket.