Archives of Oral Biology 60 (2015) 1595–1600

Contents lists available at ScienceDirect

Archives of Oral Biology

journal homepage: www.elsevier.com/locate/aob

The study of grinding patterns and factors influencing the grinding areas during sleep bruxism

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ARTICLE INFO

Article history:
Received 31 July 2014
Received in revised form 24 February 2015
Accepted 13 July 2015

Keywords:
Sleep bruxism
Grinding patterns
Grinding area
Long centric

ABSTRACT

Objective: The purpose of this study is to investigate the grinding patterns and discuss the factors influencing the position relationship between intercuspal position (ICP) and grinding area during sleep bruxism.
Methods: Lateral condylar inclination, inclination of lateral incisal path and freedom in long centric of thirty subjects were measured. The grinding patterns during sleep bruxism were recorded with a bruxism recording device, BruxChecker. The position relationship between ICP and the grinding area was examined. Spearman's rank correlation coefficient was used for correlation analysis between grinding area and free factors (grinding patterns, freedom in long centric and discrepancy between lateral condylar inclination and inclination of lateral incisal path).
Results: All 12 subjects with 0 mm-freedom in long centric exhibited that ICP of both sides located within the grinding areas. 4 subjects showed that ICP of both sides located outside the grinding areas. There is a significant correlation between 0 mm-freedom in long centric and ICP within the grinding areas ($p < 0.01$).
Conclusions: Freedom in long centric has a significant effect on position relationship between intercuspal position and the grinding area.

1. Introduction

Bruxism is a repetitive jaw-muscle activity characterized by clenching or grinding of the teeth and/or by bracing or thrusting of the mandible. Bruxism has two distinct circadian manifestations: it can occur during sleep (indicated as sleep bruxism) or during wakefulness (indicated as awake bruxism) (Lobbezoo et al., 2013). Bruxism is a common phenomenon in the humans, the occurrence of which is attributed to many factors, such as malocclusion, drugs, alcohol, personality, psychological and stress-related factors (Carra et al., 2011; Gomez et al., 1999; Huynh et al., 2006; Lavigne, Rompre, & Montplaisir, 1996). As sleep bruxism occurs in most persons, it could be said that bruxism is a physiological activity rather than pathological activity (Lavigne et al., 2007; Seraidarian, Seraidarian, das Neves Cavalcanti, & Marchini, 2009; Sjoholm, Lehtinen, & Helenius, 1995). However, tremendous occlusal forces during sleep bruxism are sometimes significantly greater than conscious efforts by an individual during the wakefulness (Paesani et al., 2013; Yachida et al., 2012). Significant loads from bruxism can have harmful effects on oral tissues as well as on the restorations. Thus, every dentist must have sufficient knowledge of the fundamental aspects of occlusion as affected by bruxism and treat these conditions on a routine basis in their practice. It is necessary to evaluate the patients grinding pattern and examine the individual occlusal schemes during sleep bruxism while deciding the proper treatment plan for reconstruction of occlusion and making the restorations (Lobbezoo, van der Zaag, van Selms, Hamburger, & Naeije, 2008).

During sleep, jaw muscles tone decrease with the deepening of sleep (Lavigne, kato, Kolta, & Sessle, 2003). Because of the effect of gravity, mandibular is more open and more retrusive during sleep than during wakefulness in the supine position (Miyamoto et al., 1998). In the sleep bruxism, jaw-closing muscles and jaw-opening muscles contract simultaneously (Lavigne et al., 2001). Due to special pattern of muscle contraction (Lavigne et al., 2001) and position of mandibular (Miyamoto et al., 1998), grinding areas and patterns of mandibular movement during sleep bruxism may are different with those of masticatory movement during wakefulness.

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http://dx.doi.org/10.1016/j.archoralbio.2015.07.009
0003-9969/

The BruxChecker, a thin vacuum pressed and red dye painted-sheet, was fabricated for evaluating grinding patterns and examining the individual occlusal schemes during sleep bruxism in Onodera's study (Onodera, Kawagoe, Sasaguri, Protacio-Quismundo, & Sato, 2006). Two different patterns were observed when the relationship between the grinding area and intercuspal position (ICP) were compared. The first pattern involved the ICP being located within the grinding area, which indicated the latero-retrusive movement of the mandible. The second pattern involved the ICP and was located outside the grinding area, which indicated that the mandible jumped into the grinding area from ICP prior to the bruxism activity (Onodera et al., 2006). The general concept of occlusal adjustment which is based on intraoral or articulator mounted casts during wakefulness could not be applied for the second pattern. However, the reason and mechanism for these different grinding patterns has not been discussed. The purpose of this study is to examine the grinding patterns and discuss the factors influencing the position relationship between intercuspal position and grinding area during sleep bruxism. The null hypothesis was that grinding patterns, freedom in long centric and discrepancy between lateral condylar inclination and inclination of lateral incisal path are not related to the position relationship between intercuspal position and grinding area during sleep bruxism.

2. Materials and methods

2.1. Subjects

This study group consisted of 30 Chinese patients that sought advice for bruxism signs and symptoms at Stomatological Hospital of Tongji University (13 males and 17 females, average age 35.2 years, age range 22–51 years). According to the diagnostic grading system of bruxism (Lobbezoo et al., 2013), all subjects underwent an assessment including a bruxism questionnaire and an interview (i.e., oral history taking with specific focus on bruxism habits) plus a clinical examination to evaluate bruxism signs and symptoms. All patients were diagnosed as 'probable' sleep bruxism based on self-report plus the inspection part of a clinical examination. Ten non-sleep bruxism students of Tongji University were also included in this study as control group (5 males and 5 females, average age 23 years, age range 22–24 years). All subjects had more than six teeth per side and had contacts between the maxillary and mandibular canines either at the intercuspal position (ICP) or during the mandibular lateral excursion. This criterion allowed us to compare canine-grinding bruxism with multiple-teeth-grinding bruxism, which is analogous to the clinically observed canine guidance and group function (Tokiwa et al., 2008). All subjects gave their written consent to participate in the study. The study protocol was approved by the ethics committee of School of Stomatology, Tongji University.

2.2. Measurement of lateral condylar inclination, inclination of lateral incisal path and freedom in long centric

Lateral condylar inclination as the inclination of condylar guidance and inclination of lateral incisal path as the inclination of occlusal guidance during grinding movements were measured for each subject. Freedom in long centric as the mandibular sliding distance between intercuspal position and centric relation was also recorded. Each maxillary and mandibular stone cast was mounted on an articulator (Artex CR 218760, Amann Girrbach GmbH, Germany) using a face-bow transfer (Artex CE, Amann Girrbach GmbH, Germany) and bite registrations (centric check bite, mush bite and check bite recorder). Lateral condylar inclination, inclination of lateral incisal path and freedom in long centric were measured on the articulator. The discrepancy between lateral condylar inclination and inclination of lateral incisal path (DCI) was calculated and scored. The DCI was scored with "1" when the lateral condylar inclination was 10° greater than inclination of lateral incisal path. The DCI was scored with "2" when the difference between lateral condylar inclination and inclination of lateral incisal path was $\pm 10^{\circ}$. While the lateral condylar inclination was 10° smaller than inclination of lateral incisal path, the DCI was scored with "3". The freedom in long centric was also graded with "1, 2 and 3" (1: freedom in long centric = 0 mm; 2: freedom in long centric $\leq$ 1 mm; 3: freedom in long centric > 1 mm).

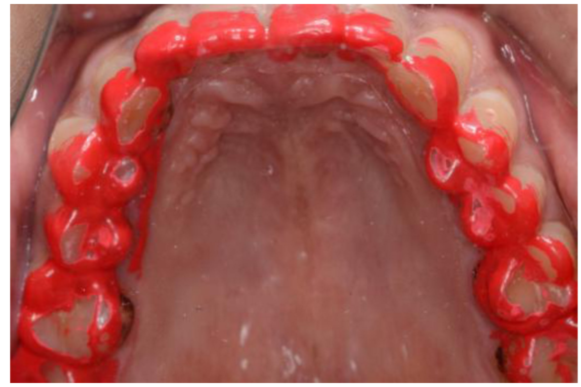

Fig. 1. BruxChecker on the upper dentition of the subject.

2.3. Fabrication of the BruxChecker

The BruxChecker was a 0.1 mm thick clear transparent plate which was composed of polyvinyl chloride (Scheu-Dental, Germany). The BruxChecker was fabricated in a vacuum press (Scheu-Dental, Germany) as described by Onodera (Onodera et al., 2006). The occlusal surface of BruxChecker was painted with a red dye (Acid Red 51, Morimoto Chemical Co., Ltd., Japan) dissolved in shellac–ethanol solution (Shellac Co., Ltd., Japan) in order to visualize the grinding facets. Acid Red 51 is a dye used in artificial food coloring. Fig. 1 shows the BruxChecker on the upper dentition of the patient.

2.4. Examination of grinding pattern and grinding area

After wearing the BruxChecker for two consecutive nights, the subjects' tooth contacts during sleep correspond to the places where the disclosing dye was abraded. The contact area could then be evaluated and observed easily by putting the BruxChecker onto the original cast. In the evaluation of contact area, tooth contact and tooth grinding were differentiated. Tooth contact (Fig. 2) was

Fig. 2. Tooth contacts on left first molar, right canine, first premolar and molars.