Available online at www.sciencedirect.com

ScienceDirect

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

Original article

Influence of chewing time on salivary stress markers

Akinori Tasaka DDS, PhD, Kai Takeuchi DDS, Hiromitsu Sasaki DDS, Takayuki Yoshii DDS, Ryohei Soeda DDS, PhD, Takayuki Ueda DDS, PhD, Kaoru Sakurai DDS, PhD*

Department of Removable Prosthodontics and Gerodontology, Tokyo Dental College, Tokyo, Japan

ARTICLE INFO

Article history:
Received 16 November 2012
Received in revised form
1 October 2013
Accepted 17 October 2013
Available online 20 January 2014

Keywords:
Chewing
Mental stress
Salivary stress marker
Chewing time
Number of chewing strokes

ABSTRACT

Purpose: We investigated the influence of chewing time on salivary stress markers.
Methods: Participants performed arithmetic calculations for 30 min as stress loading, followed by chewing for 0, 5, 10, or 15 min. All experiments finished at 25 min after stress loading. With 0-min chewing, saliva was collected before stress loading (BS), immediately after stress loading (R0), and at 5, 10, 15, and 25 min after stress loading (R5, 10, 15 and 25). With 5, 10, or 15 min chewing, saliva was collected at BS and R0, immediately after chewing (Ch5, 10 and 15, respectively), and 25 min after stress loading (Ch5R25, Ch10R25 and Ch15R25, respectively). Salivary alpha-amylase activity and cortisol levels were measured to evaluate stress. Change in stress markers between R0 and Ch5, 10 and 15 or R25, Ch5R25, Ch10R25 and Ch15R25 were calculated.
Results: No significant differences were observed in rate of change in alpha-amylase activity among the chewing conditions. Rate of decrease in cortisol levels was significantly greater at 15-min chewing than at 5-min chewing. Rate of decrease in cortisol levels was significantly greater at 10 and 15-min chewing than at 0-min chewing.
Conclusion: The present results indicate that chewing time affects the reaction of the endocrine system to mental stress, and that continuous chewing for more than 10 min is effective in reducing stress.

1. Introduction

Many reports have been published on mental stress reduction by chewing. Suzuki et al. [1] found that chewing reduced levels of stress hormones, including adrenalin, noradrenalin, and adrenocorticotropin, in blood. Morita [2] investigated physiological parameters and stress hormone levels in blood as indicators of biological reaction and found that chewing gummies or gum reduced mental stress. The methods used in these earlier reports, however, were invasive as they required collection of blood, which in itself may induce mental stress. In contrast, some recent studies have used measurement of stress hormone levels in saliva as a noninvasive method of evaluating mental stress. Tahara et al. [3] and Scholey et al. [4] found that chewing after mental stress loading reduced levels of salivary cortisol, a mental stress indicator. Nakajo et al. [5] reported that alpha-amylase activity, a sympathetic nervous

* *Corresponding author at*: Department of Removable Prosthodontics and Gerodontology, Tokyo Dental College, 2-9-18 Misakicho Chiyoda-ku Tokyo, 101-0061, Japan. Tel.: +81 3 6380 9201; fax: +81 43 270 3935.
E-mail address: atasaka@tdc.ac.jp (A. Tasaka).
1883-1958/$ – see front matter
http://dx.doi.org/10.1016/j.jpor.2013.10.005

system stress marker, decreased with chewing in a mentally stressful environment. The effects of chewing rate [6] or force [7] on mental stress reduction have also been investigated. These studies revealed that fast or strong chewing elicited a greater reduction in stress level than slow or weak chewing, respectively. The participants in the former study were required to chew over a specified period of time. The results of that study suggested that variation in number of chewing strokes within an allotted time period (chewing rate) affected reduction in stress, with an increase in chewing rate yielding a greater reduction in stress. The effect of number of chewing strokes alone, independent of chewing rate, on stress reduction, however, remains to be determined. To do this, would involve varying the number of chewing strokes without setting a specific chewing rate.

The purpose of the present study, therefore, was to investigate the effect of chewing time on salivary stress markers, with the hypothesis that length of chewing time would affect stress reduction.

2. Materials and methods

2.1. Subjects

Fourteen healthy men of between 26 and 33 years of age (average, 29.3 years) were recruited from students and staff at Tokyo Dental College. All participants had complete natural dentition, excluding the third molars, and were without subjective or objective abnormalities of the stomatognathic system. None had a history of mental illness. All were non-smokers. The present study was approved by the Ethics Committee of Tokyo Dental College (#367). The subjects were fully informed of the experimental procedures and written informed consent was obtained.

2.2. Experimental schedule

In consideration of the effect of circadian rhythm on salivary stress marker levels, all experiments were performed between 2:00 PM and 7:00 PM. Participants were required to refrain from eating, drinking (alcohol or caffeine), taking medication, or exercising within 2 h before the experiments [8,9]. They were allowed 30 min in the experimental room to familiarize themselves with the environment. As stress loading, the subjects were required to perform arithmetic calculations (addition, subtraction, multiplication, or division) [10] for 30 min, followed by chewing for various periods of time as an experimental condition or not chewing as a control. Chewing time was varied as a means of changing the number of chewing strokes. Four chewing conditions were set: 0-min chewing (0-min chewing and 25-min rest); 5-min chewing (5-min chewing and 20-min rest); 10-min chewing (10-min chewing and 15-min rest); and 15-min chewing (15-min chewing and 10-min rest). Thus, each experiment was completed at 25 min after stress loading (Fig. 1). Chewing rate and force were determined by the subjects themselves. A piece of tasteless gum weighing 1.0 g (Lotte, Saitama, Japan) was used as a chewing sample. The hardness of the gum base was 6.4×10^3 Pa s (soft type). The schedule of mental stress loading and rests was determined based on previous reports [3,6]. The participants were instructed to maintain the same posture

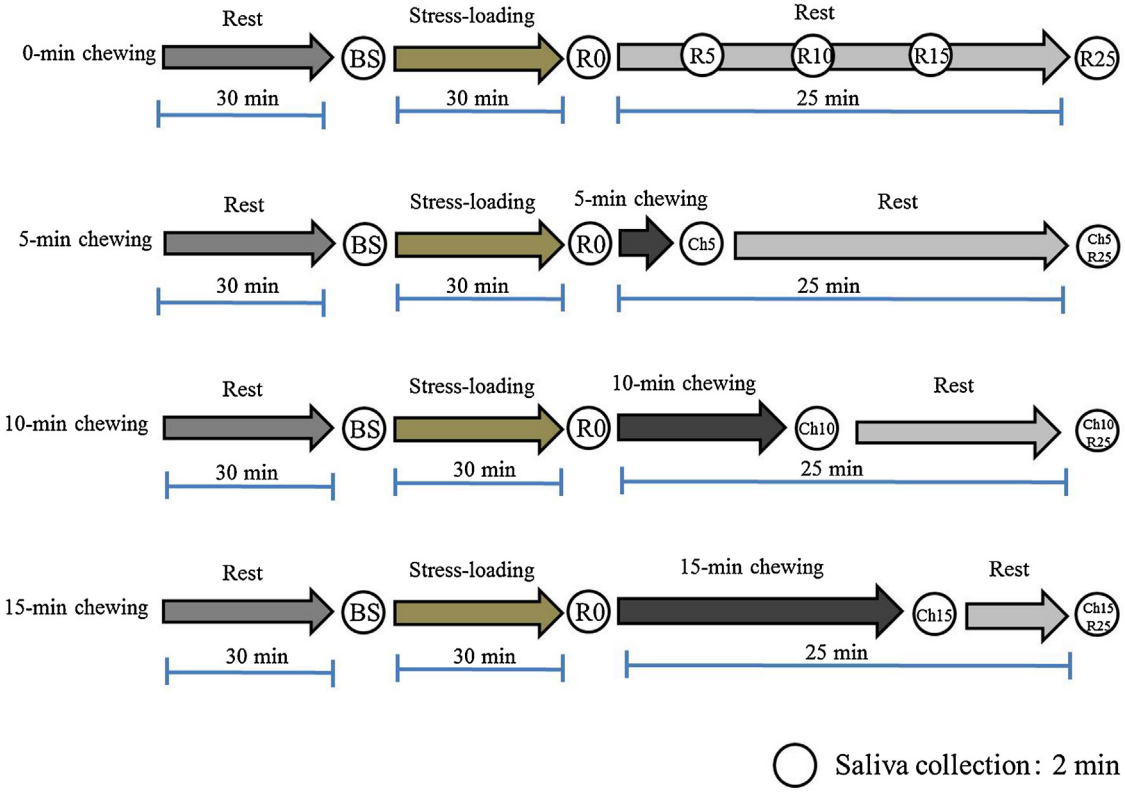

Fig. 1 – Experimental schedule.