

## A study about stress undergoing dental treatment in patients with gagging reflex

Hiroki Omoto<sup>1</sup>, Suguru Dateoka<sup>4</sup>, Yoshiaki Ono<sup>4</sup>, Yoshitomo Honda<sup>2</sup> and Masahiro Nakajima<sup>3</sup>

<sup>1</sup>Graduate School of Dentistry (Department of Dentistry for Disability and Oral Health), <sup>2</sup>Institute of Dental Research, and

<sup>3</sup>Second Department of Oral and Maxillofacial Surgery, Osaka Dental University, 8-1 Kuzuhahanazono-cho, Hirakata-shi, Osaka 573-1121, Japan, and <sup>4</sup>Department of Special Care Dentistry, Osaka Dental University and Hospital, 1-5-17 Otemae, Chuo-ku, Osaka 540-0008, Japan

We investigated changes in the levels of anxiety and stress during dental treatment in patients with a gagging reflex (GR) who were scheduled to receive intravenous sedation. The Y-G personality test (Y-G) was performed at the first examination, and STAI anxiety (STAI) was measured before and after treatment. Salivary amylase (sAMY) was measured using a salivary amylase monitor and salivary cortisol sCOR was measured using a Cortisol Enzyme Immunoassay Kit before, during and after treatment. The Y-G revealed no characteristic personality for the GR patients. Based on the results of the A-state, sAMY, and sCOR measurements, anxiety and stress were reduced during dental treatment under intravenous sedation. Nonetheless, the values measured before each treatment did not change with an increase in the frequency of treatment. This suggests that although dental treatment under intravenous sedation is useful for reducing anxiety and stress during treatment, the anxiety and stress prior to the dental treatment were not reduced. It may be necessary to perform concomitant cognitive behavioral therapy applying an anxiety hierarchy and respondent conditioning to manage the dental care of GR patients and to facilitate their dental home care. (J Osaka Dent Univ 2019 ; 53 : 89-94)

**Key words :** Gagging reflex ; Stress and anxiety ; Dental treatment ; Intravenous sedation ; Serial objective measurements

## INTRODUCTION

The gagging reflex (GR) represents a vomiting-like reflex without vomiting induced by stimulation of the oral cavity. Psychological factors, such as anxiety, stress, past experience, and pain may cause GR during dental treatment,<sup>1</sup> and interfere with the treatment. Moreover, GR is not only an escape behavior from dental treatment, but may also lead to evasion of dental home care, making the oral environment worse.<sup>2</sup> GR is thought to be related to fear of dental treatment and distrust of dentists.<sup>3</sup> Pharmacological behavior management, such as intravenous sedation and general anesthesia, is often indicated for dental treatment of these patients.<sup>2</sup> Although the association of anxiety and stress with GR has been reported,<sup>1,3,4</sup> changes in anxiety and

stress of dental treatment in GR patients over time have not been reported. We investigated these changes during dental treatment in GR patients for whom intravenous sedation was indicated.

## MATERIALS AND METHODS

The subjects were 15 patients (11 males and 4 females with a mean age of  $41 \pm 15$  years) who visited the Osaka Dental University Hospital Clinic for Disabled Persons, and who were diagnosed with a Grade 3 or more severe Classification of Gagging Problem (CGP)<sup>5</sup> requiring intravenous sedation for treatment. They gave consent after receiving sufficient explanation of the objective of this study. The subjects were treated a total of 64 times at a mean frequency of 4.3 times per subject. The shortest, longest, and mean durations of anesthesia were

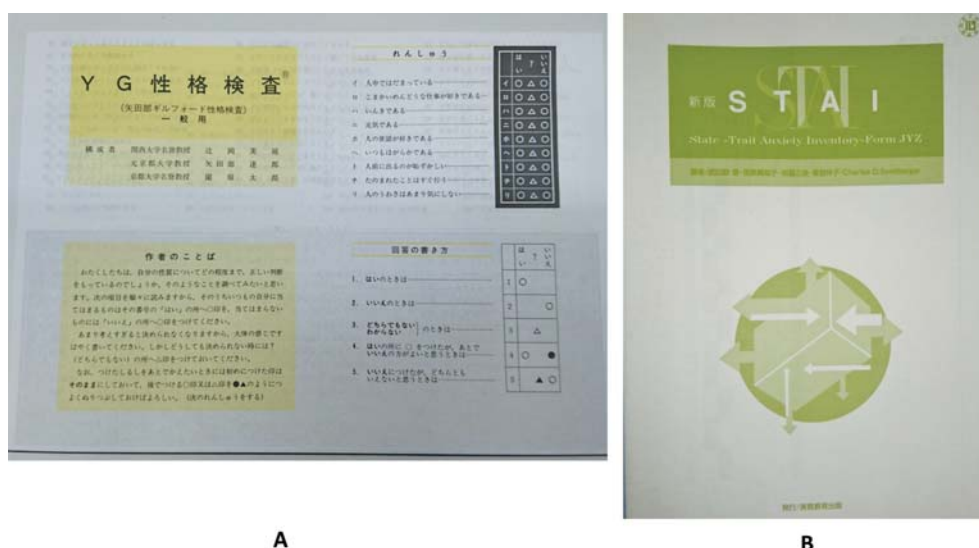


Fig. 1 (A) Yatabe-Guilford personality inventory. (B) New edition of State-Trait Anxiety Inventory.

45, 115 and 70 minutes, respectively.

Subjects who were objectively judged as lacking the ability to give informed consent, those with systemic complications, and pregnant women were excluded from the study. This study was performed after approval by the Osaka Dental University Medical Ethics Committee (Approval no. 110858) and supported by Osaka Dental University Research Funds (No. 18-14). The Yatabe-Guilford personality inventory<sup>®</sup> (Y-G) (Fig. 1 A)<sup>6,7</sup> was performed at the first examination. Anxiety was measured before and after treatment using the new edition of State-Trait Anxiety Inventory<sup>®</sup> (STAI) (A-Trait, A-State) (Fig. 1 B)<sup>8</sup>. The salivary  $\alpha$ -amylase activity (sAMY) level was measured using a Saliva Amylase Monitor<sup>®</sup> (Nipro, Osaka, Japan) (Fig. 2) with saliva collected from the subjects before, during, and after treatment. A sheet for sampling was placed and kept under the tongue for 30 seconds to collect the saliva, and the sAMY level was measured in a counseling room before and after treatment, and at about 30 minutes after the initiation of treatment. Salivary cortisol was measured using the passive drool (sCOR-p) method and the swab (sCOR-s) method. For sCOR-p, a straw (Salimetrics, State College, PA, USA) was placed in a storage tube and about 1 mL of saliva secreted without stimulation was collected before and after treatment in a



Fig. 2 Salivary amylase monitor.

counseling room and frozen at  $-80^{\circ}\text{C}$ . For sCOR-s, the saliva was collected using Saribetto (Salimetrics, State College, PA, USA) before, during, and after treatment. These saliva samples were also frozen at  $-80^{\circ}\text{C}$ . The samples were thawed to the room temperature for analysis and measurement. After centrifugation at 3,000 rpm for 15 minutes, the serum was collected and sCOR was determined by ELISA at an absorbance wavelength of 450 nm using an expanded range, a High Sensitivity, Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics).

The acquired data were subjected to the Wilcoxon rank sum test using statistical analysis software, IBM SPSS statistics 23 (IBM Japan, Tokyo,

Japan). In addition, the level before each treatment was compared with the level before the first treatment. The STAI, sAMY and sCOR measured values were presented as the mean and standard deviation with significance set at 5%.

## RESULTS

Of the 15 subjects, the Y-G type was A (average) in 2 of the patients (13%), B (black-list) in 0, C (calm) in 2 (13%), D (director) in 7 (47%), and E (eccentric) in 4 (27%). Type D was the most common. Nine patients were the emotionally stable CD type while 6 were the introverted CE type personality (Fig. 3).

The mean score for the STAI used to measure the A-Trait was  $44.4 \pm 13.9$  points before treatment and  $42.4 \pm 12.7$  points after treatment. The score exceeded the boundary for judging a high A-Trait in 6 patients, and was low in 9. No significant difference was noted before and after treatment (Fig. 4). The mean A-State score significantly decreased after treatment ( $48.1 \pm 12.5$  points before and  $36.5 \pm 7.9$  points after). Although the score exceeded the boundary for feeling anxiety before treatment in

most patients, it was lower than the boundary after treatment in most of them (Fig. 5 A).

The mean score before the first treatment was  $52.5 \pm 12.7$  points, and it was  $47.6 \pm 10.4$ ,  $49.2 \pm 11.0$ ,  $46.1 \pm 15.9$ , and  $47.1 \pm 14.9$  points before the 2nd, 3rd, 4th and 5th treatments, respectively. A significant decrease from the score before the first treatment was noted only before the 2nd treatment, while no significant difference was noted before subsequent treatments (Fig. 5 B). The mean value for the sAMY was  $28.7 \pm 17.7$  KU/L before treatment,  $19.7 \pm 10.9$  KU/L during treatment, and  $27.9 \pm 19.0$  KU/L after treatment. There were significant differences among these values. The value was significantly higher after treatment than before (Fig. 6 A). The mean level was  $34.5 \pm 23.9$  KU/L before the first treatment, while the values were  $25.0 \pm 8.4$ ,  $27.1 \pm 14.4$ ,  $28.0 \pm 18.9$ , and  $25.8 \pm 7.6$  KU/L before the 2nd, 3rd, 4th and 5th treatments, respectively. No significant difference was noted in the measured value before the first treatment compared with before the subsequent treatments (Fig. 6 B).

The mean sCOR level measured by the sCOR-p

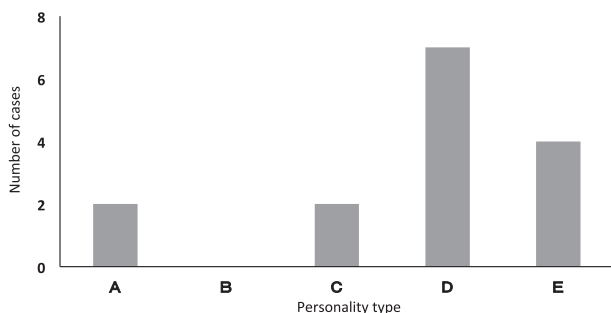


Fig. 3 Y-G.

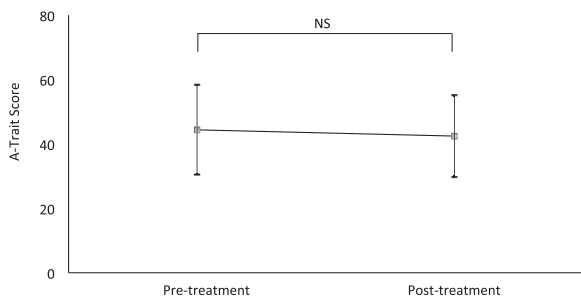


Fig. 4 A-Trait score (NS : Not significant).

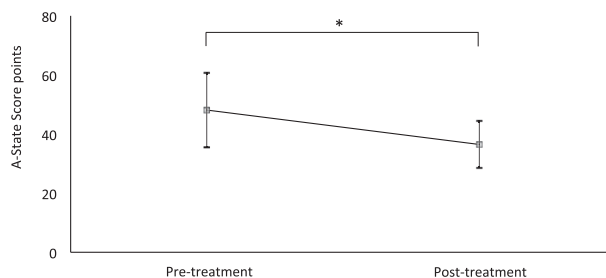


Fig. 5 A A-State score (\* $p < 0.05$ ).

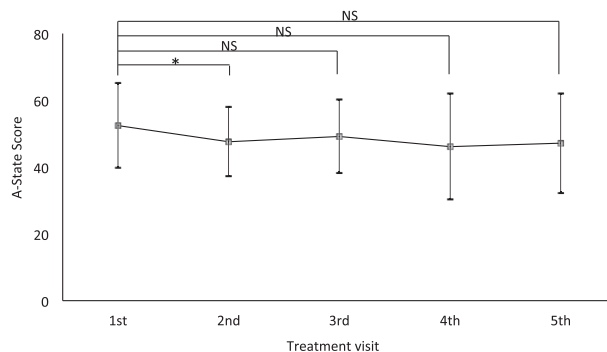


Fig. 5 B Serial measurements of A-State.

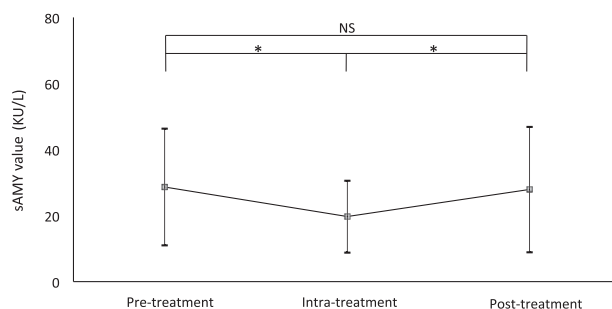


Fig. 6 A sAMY values.

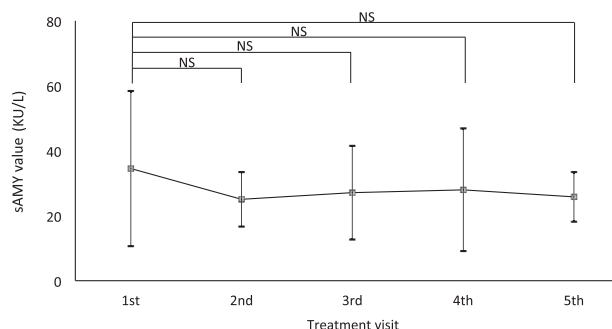


Fig. 6 B Serial measurements of sAMY.

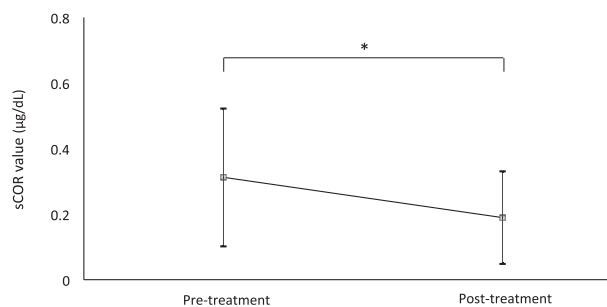


Fig. 7 A sCOR-p values.

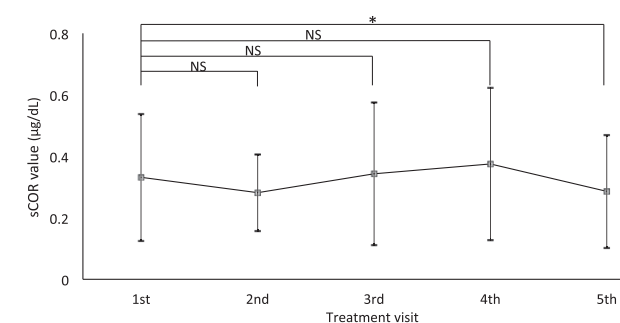


Fig. 7 B Serial measurements of sCOR-p.

method was  $0.31 \pm 0.21$   $\mu\text{g/dL}$  before treatment and  $0.19 \pm 0.14$   $\mu\text{g/dL}$  after, which represented a significant decrease (Fig. 7 A). The mean levels before the 2nd, 3rd, 4th and 5th treatments were  $0.28 \pm 0.12$ ,  $0.34 \pm 0.23$ ,  $0.38 \pm 0.25$ , and  $0.29 \pm 0.18$   $\mu\text{g/dL}$ , respectively. Compared with the level before the first treatment, only that before the 5th treatment was significantly different (Fig. 7 B). The mean sCOR level measured by the sCOR-s method was  $0.27 \pm 0.16$   $\mu\text{g/dL}$  before treatment,  $0.33 \pm 0.28$   $\mu\text{g/dL}$  during treatment, and  $0.19 \pm 0.13$   $\mu\text{g/dL}$  after treatment. Although the changes during treatment were not significant, they were slightly increased. After treatment, the level significantly decreased compared with the values before and during treatment (Fig. 8 A). The mean level before the first treatment was  $0.27 \pm 0.17$   $\mu\text{g/dL}$ , while the values before the 2nd, 3rd, 4th and 5th treatments were  $0.26 \pm 0.11$ ,  $0.27 \pm 0.13$ ,  $0.29 \pm 0.17$ , and  $0.28 \pm 0.17$   $\mu\text{g/dL}$ , respectively. There were no significant differences between the measured value before the first treatment and the values before each subsequent treatment (Fig. 8 B).

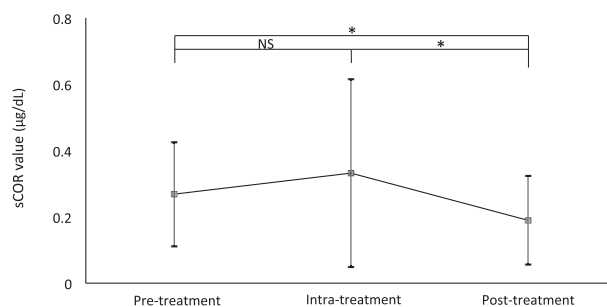


Fig. 8 A sCOR-s values.

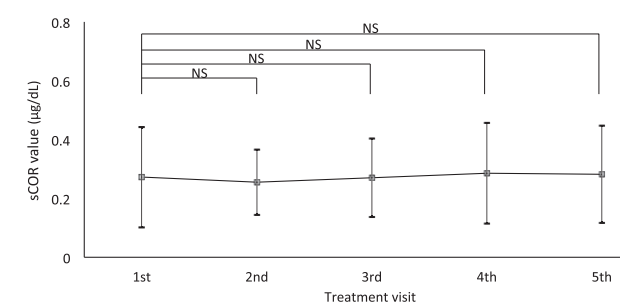


Fig. 8 B Serial measurements of sCOR-s.

## DISCUSSION

The GR during dental treatment is thought to involve anxiety, stress, and psychological factors caused by past experience and pain stimulation.<sup>1</sup> It often interferes with dental treatment. Not only is it an escape behavior from dental treatment, but it also leads to escape from home dental care, aggravating a bad situation in the oral environment.<sup>2</sup> Van Houtem *et al.*<sup>4</sup> reported that GR occurred during dental treatment in 8.2% of patients who visited a dental clinic. To perform dental treatment in GR patients, it may be necessary to reduce of anxiety, evaluate anxiety and stress, and do behavioral therapy. We evaluated the stress of dental treatment, and changes in the anxiety and stress of dental treatment in severe GR patients for whom intravenous sedation was indicated. The Y-G is a frequently used test that is simple and reliable in identifying anxiety that is often not readily apparent. It is frequently used as a quantitative test of character traits.<sup>6</sup> The Y-G has 5 classification types: A (average), B (black-list), C (calm), D (director), and E (eccentric). It clarifies personalities and character traits, and it is used in corporate recruiting, clinical and psychological counseling at hospitals, human resource research, industry, and education. We investigated prior to dental treatment, whether personality is a factor in GR patients. It has been reported that the D type is the most frequent in Japan.<sup>7</sup> It was also most frequent in our study. We found no characteristic personality for GR patients.

The STAI measures both A-Trait and A-State. An A-Trait is one that is characteristic of individual personality, and the value is relatively stable. On the other hand, an A-State is a temporary emotional condition that is situational, such as concern, tension, nervousness, and distress.<sup>8</sup> We measured the degree of anxiety before and after treatment. The A-Trait did not significantly change although it slightly decreased after treatment, suggesting that A-Trait is not directly influenced by dental treatment because it reflects individual character. In contrast, the A-State was higher than normal before treatment. A-State, which varies depending on the situ-

ation, was high prior to treatment and then decreased significantly afterwards, objectively clarifying that GR patients are anxious about dental treatment. However, the A-State level before treatment did not significantly decrease with an increase in the frequency of treatment, suggesting that anxiety about dental treatment did not decrease.

Stress reactions that are expressed as changes in the body's stress hormones are seen in the hyperactivity of two systems: the hypothalamic-pituitary-adrenocortical (HPA) system and the sympathetic-adrenal-medullary (SAM) system.<sup>9-11</sup> The sCOR is the best known marker for evaluating stress in the HPA system. Its relationship with stress has been frequently reported.<sup>12, 13</sup> When the HPA system is activated during stress, COR is secreted from the adrenal cortex. COR indicates an increase in acute and chronic, physical and psychological stress.<sup>14</sup> Since the correlation coefficient between the salivary and blood COR levels is 0.90,<sup>15</sup> and saliva can be collected noninvasively and easily, sCOR is very useful and is used in many studies on stress.<sup>14</sup> Because stress-induced increases in sCOR peak 20-30 minutes after stress loading,<sup>16</sup> we collected saliva 30 minutes after initiation of treatment. sCOR increased during treatment compared with that before treatment. This may have reflected stress before treatment as well as the discomfort of the drip infusion injection. sCOR significantly decreased once the treatment had begun, suggesting that intravenous sedation reduced the stress during dental treatment.

In the SAM system, stress induces sympathetic hyperactivity and catecholamine release from the adrenal medulla, increasing the blood catecholamine level. sAMY strongly correlates with the plasma noradrenaline level,<sup>10</sup> and is thought to serve as an index for evaluating nervous activity in the SAM system.<sup>11</sup> Since sAMY reflects both psychological and physical stress,<sup>17</sup> and serves as a stress index, evaluation of stress during dental treatment has been performed in several studies.<sup>18-21</sup> The sympathetic nervous system is involved in salivary gland activity and controls sAMY secretion.<sup>9</sup> This response is of short duration; only one

to several minutes. sAMY significantly decreased after initiation of treatment. However, the sAMY or sCOR level before treatment did not change with the frequency of treatment, indicating that the frequency did not influence changes in stress. This was similar to the situation with the degree of anxiety.

Anxiety, stress, and past experience or distrust of dentists are involved in the GR during dental treatment.<sup>3</sup> It has been suggested that dental treatment under intravenous sedation is useful in reducing anxiety and stress during treatment. However, it has not been found useful in reducing the anxiety and stress of future dental treatment. Management of dental care for GR patients, including dental home care, may require concomitant cognitive behavioral therapy using anxiety hierarchy and respondent conditioning.

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