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Research Article

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Effects of Design in Novel Management of Patients with Severe Gagging Reflex in Removable Prosthodontics

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ABSTRACT

Background: The environment is often overlooked when considering dental treatment. Yet the dental environment and the interior design of a dentist's surgery may elicit a number of physiological and psychological responses in patients. This study considers the importance of the interior design of a dental surgery and the use of natural auditory stimuli to prevent the gagging reflex.
Methods: This study included twenty male patients who attended the Prosthodontic clinics at King Abdulaziz University, Faculty of Dentistry (KAUFD) for help with removable dentures. During final maxillary impression making visit, the patients were split into two equal groups (group A and group B), each group consisted of ten members. Group B experienced the natural auditory stimuli whilst undergoing treatment. Group A didn't experience the stimuli. The physiological reaction of each patient within both groups was assessed by measuring the pulse rate /minutes (BPM) and arterial oxygen saturation of haemoglobin (SpO2 %). To assess the psychometric variables, patient's satisfaction levels and opinions regarding their treatment was evaluated by testing the Oral Health Impact Profile (OHIP). In addition, the patients in group B were questioned regarding how they felt after listening to the natural sounds.
Results: Hearing natural sounds appeared to decrease and/or inhibit the biological stress response domains. This study revealed that patients who experienced the auditory stimulus displayed decreased heart rate and increased arterial oxygen saturation compared to the control group. The Oral Health Impact Profile (OHIP) demonstrated that aspects of physical pain and psychological discomfort presented the highest within the control group. Patients' responses showed that listening to natural auditory stimuli appeared to provide calm, relaxation and a better quality of treatment.
Conclusions: The use of natural environmental sound stimuli is a novel successful tool that can be implemented to manage the gag reflex.

Key words: *Environment, Interior Design, Natural Auditory Stimuli, Gagging Reflex, Definitive Impression.*

INTRODUCTION

Excessive gagging is recognized as a prevalent obstacle to dental treatment. Undoubtedly, stress plays a significant role in gagging. The gag reflex is a typical problem faced by dentists during dental treatment. This reflex is a normal defence mechanism and gagging prevents foreign bodies from entering the body in particular the trachea, pharynx or larynx. Gagging is a manifestation of anxiety, fear and/or apprehension. It involves excessive lacrimation, salivation, feeling faint and sweating [1]. Some patients may believe that their fear of dental treatment will cause a fatal heart attack. The gag reflex is an involuntary neuromuscular action [2].
The causes of gag reflex could be either somatic (stimulated by direct contact of the sensory nerve) or psychogenic (modulated a trigger area induces the reflex) [2-4]. The most likely cause of gagging is the activation of trigger zones in the posterior region of the oral cavity. Patients who react with a severe gag reflex when a dental instrument touches the lips or the anterior part of the oral cavity are probably expressing a psychogenically initiated response [5].

The initial stimulus of gagging is mediated in the brain by a number of cranial centres, which can be found in the medulla oblongata and are closely linked to the vasomotor, respiratory, salivatory and vestibular centres [6]. The etiological factors that may cause the gag reflex are anatomic factors, psychological factors, iatrogenic factors and local/systemic disorders. Gagging is considered as a multifactorial aetiology [4-7]. Gagging may complicate prosthodontic treatment for edentulous patients either during the making of the dentures or after they have been completed [7].

Many techniques are reported in the literature to manage and control the problem of the gagging reflex and no single technique will solve each patient's problem. The dental treatment is normally performed over a number of visits, therefore a sympathetic manner is important to calm the patient and the patient should experience the dental treatment with a minimum level of stress, panic and anxiety.

Behavioural techniques are often used to reduce anxiety and distraction techniques can be implemented to momentarily divert a patient's attention [8,9]. One of the techniques could involve instructing the patient to breath through the nose and exhale through the mouth or asking the patient to raise his/her foot until this tiring exercise requires more conscious effort. Also dentists may ask the patient to tense and relax certain muscle groups. Relaxation can help improve or override unhelpful thought processes [2,10].

Gagging could be considered as a condition influenced by external, environmental events that possess psychological significance. Therefore, the natural environment and interior design should help to facilitate recovery of directed attention capacity. Most of the previous research used natural sounds or visual imagery to reduce mental fatigue and anxiety [2,6]. Using video films with sounds showed a faster physiological stress recovery during exposure to films [11].

No data was reported previously in the field of prosthodontic dentistry about the correlation between the effects of different natural auditory sounds in the environment and stress recovery to solve the problem of the gagging reflex. Therefore, this relationship was studied to evaluate the physiological and psychological reactions of the gagging patients during impression making whilst hearing different natural auditory sounds.

MATERIALS AND METHODS

This study included twenty male patients who attended the prosthodontic clinics of King Abdulaziz University, Faculty of Dentistry (KAUFD) for help with removable dentures. Their ages ranged from 40-55 years old. The selected subjects displayed exaggerated gagging during the clinical procedure of impression making. Each patient was display exaggerated gagging during impression making which were associated with clinical features such as vomiting, excessive salivation, sweating and mood changes. The gagging was detected by dental instrument touches the lips or anterior part of the oral cavity which are probably expressing a psychogenically initiated response. Our method was subjective and the technique proposed in this study was psychologically based and did not focus on the degree of severity [6]. Patients with a clinical history of respiratory, cardiovascular or neuromuscular disorders were excluded from this study.

The patients were split into two equal groups (group A and group B) where each group consisted of ten members.

Group A: In these patients, the pulse rate/minutes (BPM), arterial oxygen saturation of haemoglobin (SpO_2 %) was measured during maxillary impression making without hearing natural environment auditory stimuli.

Group B: In these patients, the pulse rate /minutes (BPM), arterial oxygen saturation of haemoglobin (SpO_2 %) was measured during maxillary impression making while the patients were hearing natural environment auditory stimuli.

The physiological reaction of each patient within group A and group B were assessed by measuring (BPM) and (SpO_2 %) with a portable pulse oximeter device (beurer pulsoximeter, Gmbh, Germany).

The patients in group (B) were allowed to hear a standardized natural environment sound that had a slow and relaxing effect for 6 minutes whilst the maxillary impression was making. The natural environment auditory stimuli were a combination of sounds which included fountains and tweeting birds. The musical stimuli were presented by asking the patients to put on a pair of earphones. The same level of loudness was standardized for all the patients.

The effect of natural environmental auditory stimuli used in group (B) was assessed by the following dimensions: good mood vs. bad mood, wakefulness vs. sleepiness, and calmness vs. restlessness [12]. The patients were questioned regarding how they felt after listening to the natural environment auditory stimuli. All items were rated on a 5-pointsLikertscale ranging from1-5 (1=poor, 2=fair, 3=good, 4=very good, and 5=excellent).

During these visits patient's satisfaction levels and opinions regarding their treatment was evaluated by oral health related quality of life (OHIP). The OHIP included seven domains: (functional limitation, physical discomfort, psychological discomfort, physical disability, psychological disability, social disability and handicap) (Table 1). The patients from group A and B were asked to fill out these questions structured after impression making in a five-point Likert-format scale which ranged from 0-4(0 = never, 1 = hardly, 2 = occasionally, 3 = fairly often, to 4 = very often). For each of the seven domains of the questionnaire, the mean value for each domain was calculated by summing the mean values assigned to the questions [13,14].

Data was entered into the computer and analysed using IBM SPSS software package version 20.0**.** Quantitative data was described using the mean and standard deviation. The student's t-test for normally quantitative variables was

used, to compare the differences between two studied groups (A and B). The significance of the obtained results was judged at the 5% level of significance. Ethical approval was obtained from the Research Ethics Committee of Faculty of Dentistry of King Abdulaziz University.

Table1: OHIP-14 (seven categories representing the 14 items).

Category	Item	Questionnaire
Functional limitation	1. Problems during impression making	Have you had gagging problem during impression making
	2. The impression material is worsened	Have you felt that the taste of the impression material is worsened
Physical pain	3. Painful aching in the mouth	Have you had Pain in your mouth
	4. Discomfort from the dentist's finger or instruments	Were you uncomfortable from the dentist's finger or instruments when contacting the oral mucosa
Psychological discomfort	5. Self conscious	Did you seek routine dental treatment
	6. Tense	Were you tense because of gag problem from your mouth
Physical disability	7. Unwanted irritating material ejected by contraction of muscles	Did you have unwanted irritating material ejected from the upper respiratory tract by contraction of muscles during gagging reflex
	8. Symptoms associated with gagging reflex	Did you have an excessive salivation ,sweating, fainting or full body response during gagging reflex
Psychological disability	9. Difficulty relaxing	Did you find difficulty to relax because of gag reflex
	10. Being embarrassed	Did you smell the dental impression material in the oral cavity or chocked by swallowing of the impression material
Social disability	11. Irritable when making social contact with others.	Have you an anxiety problem because of gag reflex that avoid social contact.
	12. Difficulty in doing jobs	Have you felt that your life has less quality in the society because of gag reflex
Handicap	13. Life unsatisfying	Have you felt that your life in general was less satisfying because of gag reflex problem
	14. Unable to function	Did you have mood changes or other features associated with gagging, unable to function

RESULTS

Table 2, Figure (1) showed the mean value of arterial oxygen saturation (SpO_2%) in group(B) was higher than group A which was statistically significant (P< 0.001). Whilst heart rate (BPM) was increased in group A compared to group B. Comparison between group A and group B was statistically significant at 5% level (P= 0.002)

Table 2. The mean values of (SpO_2%) and (BPM) among the different study groups

Parameter	Group (A)	Group (B)	t	P
SpO_2% Mean ± SD.	87.10 ± 1.66	94.30 ± 0.67	12.684*	0.001*
BPM Mean ± SD	85.20 ± 3.99	76.0 ± 7.07	3.582*	0.002*

t and p values for Student's t-test for comparing between the two groups

*: Statistically significant at $p \leq 0.05$

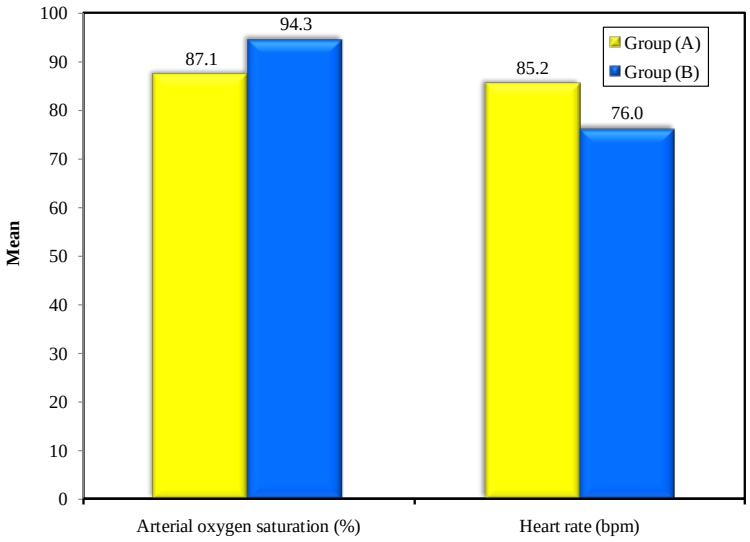

Figure 1. The mean values of (SpO_2%) and (BPM) among the different study groups (A&B)

Table 3, Figure (2) showed the mean score of good mood, calmness and wakefulness in group (B). Statistical significant change was observed in the mood and calmness before and after making maxillary impression (P=0.020and 0.015) respectively.

Table 3. Psychological response to musical stimuli before and after maxillary impression making among group (B)

Parameter	Before impression	After impression	t	p
Mood Mean ± SD.	2.55 ± 1.19	4.4 ± 1.96	2.551*	0.020*
Wakefulness Mean ± SD	1.95 ± 1.50	3.5 ± 2.39	1.737	0.099
Calmness Mean ± SD.	1.60 ± 1.39	4.1 ± 2.6	2.681*	0.015*

t and p values for Student's t-test for comparing the Psychological response before and after making maxillary impression in group B.
*: Statistically significant at $p \leq 0.05$

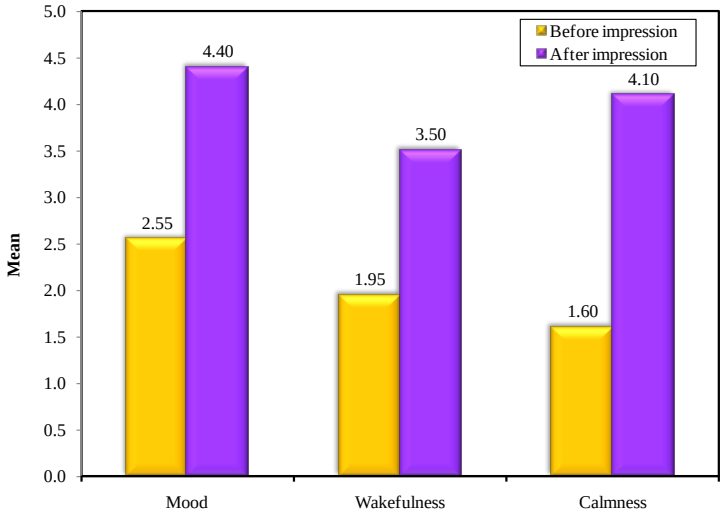

Figure 2. Psychological response to musical stimuli before and after maxillary impression making among group (B)

Table 4, Figure (3) presented the mean score values and standard deviation for the questionnaire results of group A and group B as well as comparison between the groups. All the six domains indicated a statistically significant

difference ($P \leq 0.05$) between group A and B except regarding social disability and handicap. The statistically significant reduction in the mean score was observed in all domains of group B.

Table 4. The questionnaire mean score values among the different study groups (A&B)

Parameter	Group(A) Mean ± SD	Group (B) Mean ± SD	t	P
OHIP 1 and 2 :Functional limitation	2.05 ± 1.10	1.10 ± 0.51	2.347*	0.035*
	2.55 ± 1.19	1.00 ± 0.46	3.842*	0.001*
OHIP 3 and 4 :Physical pain	2.40 ± 1.47	1.50 ±1.17	1.599	0.127
	1.85 ± 1.35	0.70 ± 0.92	2.226*	0.039*
OHIP 5and 6; Psychological discomfort	2.05 ± 1.36	1.60 ± 1.31	0.754	0.460
	1.95 ± 1.46	0.40 ± 0.60	3.105*	0.006*
OHIP7 and 8 : Physical disability	1.40 ± 1.50	0.60 ± 0.68	1.536	0.142
	1.90 ± 1.55	0.40 ±0.60	2.854*	0.011*
OHIP 9 and 10 :Psychological disability	2.5 ± 1.24	1.10 ± 1.16	2.607*	0.017*
	1.65 ± 1.25	0.68 ± 0.93	1.969	0.065
OHIP 11 and 12: Social disability	1.20 ± 1.40	0.50 ± 0.83	1.360	0.190
	0.00 ± 0.00	0.00 ± 0.00	-	-
OHIP 13 and 14: Handicap	0.35 ± 0.67	0.25 ± 0.55	0.365	0.719
	0.00 ± 0.00	0.00 ± 0.00	-	-

t and p values for Student's t-test for comparing between the two groups
*: Statistically significant at $p \leq 0.05$

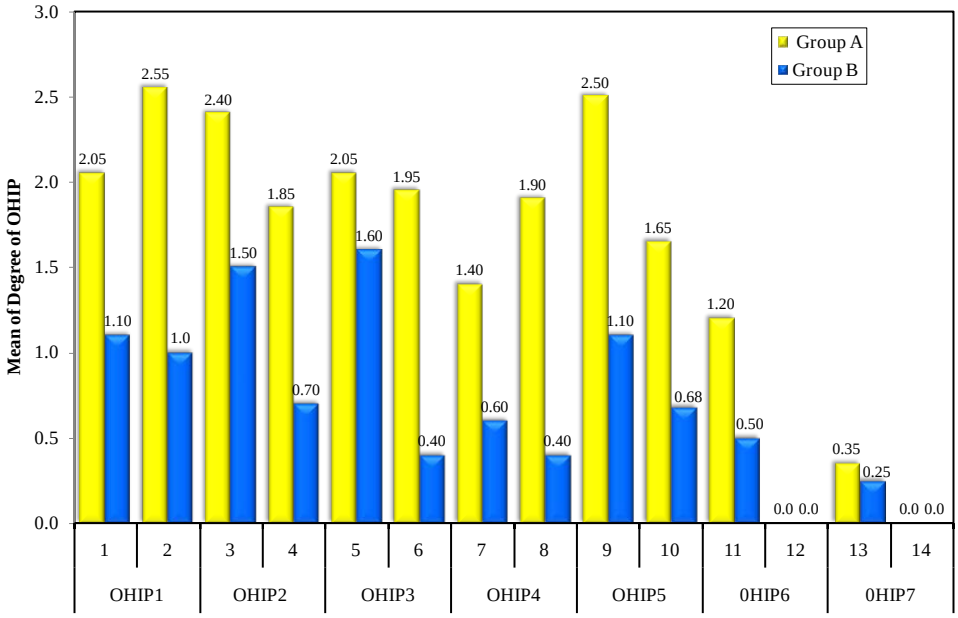

Figure 3: Degree of OHIP for different study groups(A) and group (B)

DISCUSSION

The increased occurrence of the gag reflex can be an expression of emotional distress. Patients suffering from severe gag reflex during impression procedure were selected in this study since impression making is an essential step in the fabrication of complete or partial prostheses. Additionally, success of removable prosthesis (complete dentures) depends on the accuracy of each impression, the materials used, impression tray, and impression techniques [15]. Therefore, appropriate techniques should be in place in order to improve this treatment as good oral health is related to a high quality of life.

The earphone utilized in our study instead of headphone because it is placed in the area of skin of the external auditory meatus, which is innervated by the auricular- branch of the vagus nerve, and is adjacent to an area innervated by the auriculo-temporal branch of the mandibular division of the trigeminal nerve which are responsible for much of the sensory and motor innervations of the larynx, pharynx, palatal and oral mucosa. Earphones convey natural environmental music sound and considered as one of the easiest distraction techniques used in the dental clinic, it

provides a physiological relaxation. Music improves the body's immune system and reduces stress: listening to music was found to be more effective than prescription drugs in reducing anxiety [16,17].
The physiological levels of heart pulse rate and SpO2% in the blood was assessed by the pulse oximeter device. These parameters were measured since gagging can be induced by anxiety, fear and apprehension. The pulse oximeter demonstrated the feasibility of recording data. It can measure the modification in the volume of arterial blood with each pulse beat. This change in blood volume can also be identified in peripheral parts of the body such as the fingertip. It used as indicator of cyclic change in physiology and change in the intra-thoracic blood volume relationship. It also can provide useful information regarding the condition and functioning of the heart. Heart rate is a useful signal for quantifying the activity of the autonomic nervous system (ANS) [18]. The physiological (biological) variables were imperative to evaluate the relationship between using natural environmental music sounds and the patient's reaction to this stimulus in arresting the gag reflex [18, 19].
The results revealed that the patient's heart rate was increased in group (A) whilst it was decreased in group (B). This result was in accordance with several research studies that reported that decrease in heart rate occurred during the playing of sedative music compared to upbeat music [20,16].
The lower level of SpO2 in the blood in group (A) may be contributed to the obstruction of the upper airway promoted by the impression material that irritates the oropharyngeal mucosa which stimulates the afferent fibres of pharyngeal branch of glossopharyngeal nerve or superior laryngeal branch of the vagus nerve. These patients are not receiving enough oxygen to function normally (hypoxic), and experienced a shortness of breath. The increase of SpO2 in group (B) caused latency of gag reflex and decrease of abdominal muscle activity[21]. The decrease of BPM and increase of SpO2 may be due to listening to auditory stimuli which can trigger activity in brain regions that modulate anxiety level induced by gagging reflex and are adaptive to reduce the response to the stress. The ANS controls the cardiac pacemaker and provides regulation of the cardio-vascular rhythm[22].
Assessment of good mood vs. bad mood, wakefulness vs. sleepiness, and calmness vs. restlessness among group (B) subjects revealed an improvement in mood, wakefulness and calmness after listening to natural environment auditory stimuli during making maxillary impression. A popular questionnaire for determining oral health related quality of life is the Oral Health Impact Profile (OHIP). Quality of life indicators can aid in the diagnosis; treatment planning, and also the treatment benefits to patients. This indicator was applied by means of interview to assure understanding and enhance differentiation among possible responses [15, 23].
The results of OHIP from the two study groups revealed that, the aspects of functional limitation physical pain and psychological discomfort presented the highest within group (A). This observation can probably be linked with the general finding that patients who exhibit the gagging reflex bear a relatively psychological burden. In assessing the results of OHIP obtained from the two study groups, it showed that the treatment approach in group (B) (with the lowest means) provided general improvement in overall quality of life of patients as compared to group (A). This may be due to the hearing of natural environment musical sounds via the earphones providing audio-sedation, calm and relaxation [12,24].

CONCLUSION

In conclusion, features of interior design can be implemented in dental clinic to reduce patients' anxiety levels. Practical applications of auditory natural sound is a novel treatment for management of gag reflex which lead to increased efficient dental treatment, improve the dental health of patients and enhance their quality of life.

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