ORIGINAL RESEARCH

# Effect of Virtual Reality and Musical Earplug Temporal Tap Technique in Reduction of Gag Reflex in Pediatric Patients

Mehek Gandhi[1], Laxmi Lakade[2], Sanket Kunte[3], Alok Patel[4], Preetam Shah[5], Shweta Chaudhary[6]

## Abstract

**Background:** Gagging is a stimulated, protective reflex to prevent any material from entering the mouth or oropharynx. However, a hyperactive gag reflex is a common occurrence and anxiety-provoking stimulus while performing routine clinical procedures. Impression making is a clinical procedure that causes pronounced gagging and severe discomfort to the patient. As making an impression is a crucial step in routine dental treatment, it is imperative to make the process of impression making as comfortable as possible to provide quality dental care. Very few studies have reported on the effect of virtual reality (VR) and musical earplug temporal tap technique (METTT) in impression making.

**Objectives:** To evaluate the effect of VR and METTTs on the reduction of the gag reflex in pediatric patients.

**Materials and methods:** Sixty healthy patients aged 6–12 years were diagnosed with the presence of a hyperactive gag reflex using the Gag Severity Index (GSI). GSI scores of 2 and above were included in the study, and mandibular alginate impressions were made with standard distraction methodology, which served as the baseline level of gag in each patient. These children were then randomly divided into two groups. In the first group, 30 patients' maxillary alginate impressions were made with VR facilitated techniques, while the remaining 30 patients' impressions were made with the METTT. The amount of gag reduction was evaluated with the Gag Prevention Index (GPI) score during the impressions at intervals of 0, 30, and 60 seconds. Anxiety was assessed using heart rate, oxygen saturation, and the modified version of the faces dental anxiety scale following impression making.

**Results:** Intragroup METT-facilitated impression-making showed a statistically significant reduction in heart rate. However, intergroup comparison showed no statistically significant difference in the amount of reduction of the gag reflex, oxygen saturation, or patient experience.

**Conclusion:** The gag reflex was not reduced by VR or METTT. Nevertheless, a decrease in heart rate during METTT-facilitated mandibular impression making indicated a reduction in anxiety. Hence, METTT can be applied as an adjuvant in patients with severe gag reflexes when making an impression.

**Keywords:** Behavior management, Dental anxiety, Gag reflex, Musical earplug, Pediatric patients, Temporal tap technique, Virtual reality.

*International Journal of Clinical Pediatric Dentistry* (2024): 10.5005/jp-journals-10005-2919

## Introduction

The gag reflex serves as a defense mechanism to keep foreign items from entering the pharynx, larynx, or trachea. Gagging might be pronounced by stimulation of trigger zones that can be somatogenic or psychogenic.[1] The mechanism underlying this reaction may be compromised for various reasons, which would negatively impact the child's dental health and behavior. In addition, depending on the severity of the gag reflex, dentists face challenges performing diagnostic procedures and treating these patients.

Impression making is one of the most uncomfortable and gag-inducing procedures routinely performed in dentistry. Debs et al. stated that gagging occurred in 42.9% of patients during impression making.[2] This is because impression making can stimulate the trigger zones, causing the gag reflex as a somatic response. The integrity of the vagus nerve and glossopharyngeal nerve (CN IX) is necessary for the somatic gag reflex (CN X). The psychological gag reaction can be caused by the sight, smell, or sound of dentists' tools and materials, without any actual physical contact. Further, it can also increase anxiety in pediatric patients, thereby invoking negative dental behavior.

Management of a hyperactive gag reflex is imperative for patient comfort and compliance during impression making. Several methods, such as distraction, desensitization, acupressure, acupuncture, and local anesthetics,[3] have been advocated for the management of a hyperactive gag reflex. Therefore, the aim of this study was to evaluate the effectiveness of the virtual reality (VR) device and musical earplug temporal tap technique (METTT) in the reduction of the gag reflex in pediatric patients during impression making.

[1–6]Department of Pedodontics and Preventive Dentistry, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Pune, Maharashtra, India

**Corresponding Author:** Mehek Gandhi, Department of Pedodontics and Preventive Dentistry, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Pune, Maharashtra, India, Phone: +91 9765000465, e-mail: drmehekgandhi@gmail.com

**How to cite this article:** Gandhi M, Lakade L, Kunte S, *et al.* Effect of Virtual Reality and Musical Earplug Temporal Tap Technique in Reduction of Gag Reflex in Pediatric Patients. Int J Clin Pediatr Dent 2024;17(9):981–986.

**Source of support:** Nil

**Conflict of interest:** None

## Materials and Methods

This clinical randomized trial was carried out in the Department of Pedodontics and Preventive Dentistry after obtaining approval from the Institutional Research and Ethics Committee (EC/NEW/INST/2021/MH/0029) and registered under Clinical Trial Number (CTRI/2022/11/047414). The children were screened for a hyperactive

gag reflex according to the Gag Severity Index (GSI) (Fig. 1).[1] The study procedure was explained to the child, and parental consent was obtained. Sixty healthy children with GSI scores of 2 and above who required impression making were included in the study. Medically compromised children were excluded. The study procedure was explained to the child and the parent, and parental consent was obtained (Fig. 2).

Sixty children's mandibular impressions were made with a standardized distraction technique [Leg-lift technique[4] (Figs 3 and 4)]. The Gag Prevention Index (GPI) (Fig. 5 and Table 1) was measured at 0, 30, and 60 seconds. This provided the baseline amount of gag level for each patient. Baseline anxiety was evaluated with heart rate (Table 2) and oxygen saturation (Table 3) immediately after making an impression. The patient perception rate was recorded with the Faces Version of the Modified Child Dental Anxiety Scale (MCDAS) (Table 4 and Fig. 6).

A sensory washout period of 5 minutes was implemented. Further, children were randomly assigned, and 30 patients' maxillary

| Severity grading | Description |
|---|---|
| Grade I<br>Normal gagging reflex | Very occasional gagging occurs during high-risk dental procedures such as maxillary impression taking or restoration to the distal, palatal or lingual surfaces of molar teeth. This is basically a 'normal' gag reflex under difficult treatment circumstances. Generally controlled by the patient. |
| Grade II<br>Mild gagging | Gagging occurs occasionally during routine dental procedures such as fillings, scaling and impressions. **Control can usually be regained by the patient,** but may need assistance and reassurance from members of the dental team, and treatment continued. No special measures are generally needed to facilitate routine treatment but may be required for more difficult procedures. |
| Grade III<br>Moderate gagging | Gagging occurs routinely during normal dental procedures. This may include simple physical examination of high-risk areas, such as the lingual aspect of lower molars. Once instigated, control is difficult to regain without cessation of the procedure. Recommencement may be difficult. **Gagging prevention measures are usually required.** The gag may influence treatment planning and may limit treatment options. |
| Grade IV<br>Severe gagging | **Gagging occurs with all forms of dental treatment including simple visual examination.** Routine treatment is impossible without some form of special measure to attempt to control the gag reflex. Treatment options may be limited and the gagging problem will be a major factor in treatment planning. |
| Grade V<br>Very severe gagging | Gagging occurs easily and may not necessarily require physical intervention to trigger the reflex. **The patient's behavior and dental attendance may be governed by the gagging problem and it will be one of the prime factors when planning treatment.** Treatment options may be severely limited. Dental treatment will be impossible to carry out without specific, special treatment for control of the gagging problem. |

**Fig. 1:** Gag Severity Index as given by Dickinson and Fiske

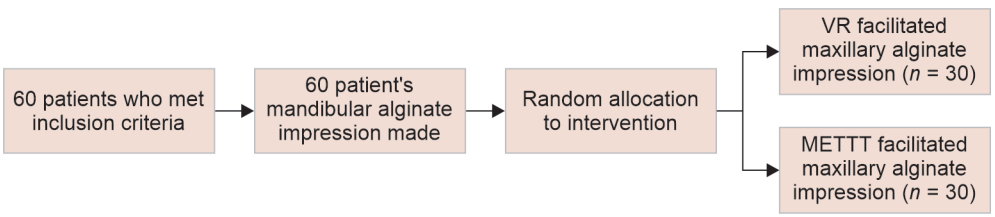


**Fig. 2:** Study design


**Figs 3A and B:** (A) Mandibular impression making using normal distraction technique; (B) Maxillary impression making using VR device


**Figs 4A and B:** (A) Mandibular impression making using normal distraction technique; (B) Maxillary impression making using METTT

| Prevention grading | Description |
|---|---|
| Grade I<br>Gagging reflex obtunded | Treatment and management methods employed at this visit totally obtund the gag reflex. **Proposed treatment was completely successful.** |
| Grade II<br>Partial control | Partial control of the gag reflex. **The proposed treatment was possible but occasional gagging occurred.** |
| Grade III<br>Partial control | Partial control of the gag reflex. **The proposed treatment was part completed or alternative treatment was carried out.** This involved simpler procedures at lower risk of producing gagging. Gagging occurred frequently. |
| Grade IV<br>Inadequate control | Inadequate control of the gag reflex. The proposed treatment was not possible. **Some 'treatment' was carried out but only very simple procedures.** Gagging occurred regularly. |
| Grade V<br>No control | Failure to control the gag reflex. **Gag reflex was so severe that even simple treatment was not possible.** No treatment was provided or possible using these gagging control methods. |

**Fig. 5:** Gag prevention index

**Table 1:** Gag prevention index scores at 0, 30, and 60 seconds

| | | | *Score 1 (%)* | *Score 2 (%)* | *Score 3 (%)* | *Score 4 (%)* | *Mean rank* | *p-value* |
|---|---|---|---|---|---|---|---|---|
| Mandibular impression without VR (normal leg-lift distraction) | Mandible | 0 second | 3 (10) | 25 (83.3) | 2 (6.7) | 0 | 29.13 | 0.368 |
| | | 30 seconds | 1 (3.3) | 20 (66.7) | 9 (30) | 0 | 31.63 | 0.576 |
| | | 60 seconds | 2 (6.7) | 25 (83.3) | 1 (3.3) | 2 (6.7) | 32.70 | 0.249 |
| VR-facilitated maxillary impression | Maxilla | 0 second | 2 (6.7) | 24 (80) | 4 (13.3) | 0 | 31.87 | 0.368 |
| | | 30 seconds | 7 (23.3) | 12 (40) | 11 (36.7) | 0 | 29.37 | 0.576 |
| | | 60 seconds | 10 (33.3) | 14 (46.7) | 2 (6.7) | 4 (13.3) | 28.30 | 0.249 |
| Mandibular impression without METTT (normal leg-lift distraction) | Mandible | 0 second | 1 (3.3) | 26 (86.7) | 3 (10) | 0 | 30.50 | 1.000 |
| | | 30 seconds | 0 | 21 (70) | 9 (30) | 0 | 33.95 | 0.076 |
| | | 60 seconds | 1 (3.3) | 27 (90) | 2 (6.7) | 0 | 32.67 | 0.205 |
| METTT-facilitated maxillary impression | Maxilla | 0 second | 1 (3.3) | 26 (86.7) | 3 (10) | 0 | 30.50 | 1.000 |
| | | 30 seconds | 7 (23.3) | 16 (53.3) | 7 (23.3) | 0 | 27.05 | 0.076 |
| | | 60 seconds | 8 (26.7) | 18 (60) | 0 | 4 (13.3) | 28.33 | 0.205 |
| Intragroup comparison | VR-facilitated maxillary impression | 0 second | 2 (6.7) | 24 (80) | 4 (13.3) | 0 | 30.53 | 0.982 |
| | | 30 seconds | 7 (23.3) | 12 (40) | 11 (36.7) | 0 | 32.03 | 0.463 |
| | | 60 seconds | 10 (33.3) | 14 (46.7) | 2 (6.7) | 4 (13.3) | 30.23 | 0.896 |
| | METTT-facilitated maxillary impression | 0 second | 1 (3.3) | 26 (86.7) | 3 (10) | 0 | 30.47 | 0.982 |
| | | 30 seconds | 7 (23.3) | 16 (53.3) | 7 (23.3) | 0 | 28.97 | 0.463 |
| | | 60 seconds | 8 (26.7) | 18 (60) | 0 | 4 (13.3) | 30.77 | 0.896 |

**Table 2:** Heart rate after impression making

| | | *Mean* | *SD* | *p-value* |
|---|---|---|---|---|
| Mandibular impression without VR (normal leg-lift distraction) | Mandible | 97.40 | 11.65 | 0.296 |
| VR-facilitated maxillary impression | Maxilla | 93.47 | 16.77 | |
| Mandibular impression without METTT (normal leg-lift distraction) | Mandible | 99.97 | 12.96 | 0.039* |
| METTT-facilitated maxillary impression | Maxilla | 91.63 | 17.24 | |
| Intragroup comparison | VR-facilitated maxillary impression | 93.47 | 16.77 | 0.687 |
| | METTT-facilitated maxillary impression | 91.63 | 17.24 | |

*, significant reduction in heart rate using METTT during making of maxillary impression compared to normal leg lift distraction method

**Table 3:** Oxygen saturation after impression making

| | | *Mean* | *SD* | *p-value* |
|---|---|---|---|---|
| Mandibular impression without VR (normal leg-lift distraction) | Mandible | 99.13 | 3.75 | 0.771 |
| VR-facilitated maxillary impression | Maxilla | 98.90 | 2.26 | |
| Mandibular impression without METTT (normal leg-lift distraction) | Mandible | 98.20 | 2.06 | 0.151 |
| METTT-facilitated maxillary impression | Maxilla | 98.87 | 1.43 | |
| Intragroup comparison | VR-facilitated maxillary impression | 98.90 | 2.26 | 0.946 |
| | METTT-facilitated maxillary impression | 98.87 | 1.43 | |

**Table 4:** Faces version of MCDAS scores

| | | *Score 1* | *Score 2* | *Score 3* | *Score 4* | *Score 5* | *Mean rank* | *p-value* |
|---|---|---|---|---|---|---|---|---|
| Mandibular impression without VR (normal leg-lift distraction) | Mandible | 9 (30) | 12 (40) | 4 (13.3) | 3 (10) | 2 (6.7) | 31.95 | 0.500 |
| VR-facilitated maxillary impression | Maxilla | 12 (40) | 9 (30) | 6 (20) | 3 (10) | 0 | 29.05 | |
| Mandibular impression without METTT (normal leg-lift distraction) | Mandible | 10 (33.3) | 11 (36.7) | 3 (10) | 4 (13.3) | 2 (6.7) | 31.65 | 0.592 |
| METTT-facilitated maxillary impression | Maxilla | 12 (40) | 10 (33.3) | 3 (10) | 4 (13.3) | 1 (3.3) | 29.35 | |
| Intragroup comparison | VR-facilitated maxillary impression | 12 (40) | 9 (30) | 6 (20) | 3 (10) | 0 | 30.40 | 0.963 |
| | METTT-facilitated maxillary impression | 12 (40) | 10 (33.3) | 3 (10) | 4 (13.3) | 1 (3.3) | 30.60 | |

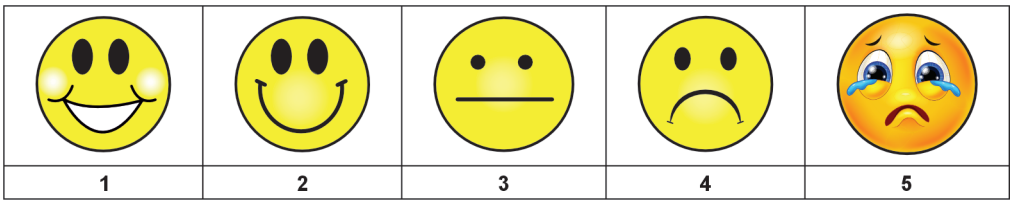


**Fig. 6:** Faces version of MCDAS

impressions were facilitated with VR (Fig. 3), while another 30 patients were facilitated with the musical earplug temporal tap (METT) (Fig. 4). These interventions were applied 2 minutes before the maxillary impression. The GPI was measured at 0, 30, and 60 seconds (Table 1). Heart rate (Table 2) and oxygen saturation (Table 3) were measured immediately after making the maxillary impression, and patient experience was rated (Table 4) using the Faces Version of the MCDAS. All impressions were made with alginate material.

### Statistical Analysis

Intragroup and intergroup comparisons for GPI, pulse rate, oxygen saturation, and the anxiety scale were performed. Statistical analysis of the data was conducted using an independent *t*-test and Mann–Whitney test, with the *p*-value set at 0.005 for significance.

## Results

- Intragroup comparison of VR-facilitated mandibular and maxillary impressions showed no statistical significance between parameters: GPI ($p = 0.249$), heart rate ($p = 0.296$), oxygen saturation ($p = 0.771$), and anxiety scale ($p = 0.500$) (Tables 1 to 4).
- Intragroup comparison of METTT-facilitated mandibular and maxillary impressions showed a significant difference in heart rate ($p = 0.039$). However, no statistical significance was observed with GPI ($p = 0.205$), oxygen saturation ($p = 0.151$), and anxiety scale ($p = 0.592$) (Tables 1 to 4).
- Intergroup comparison for maxillary and mandibular impressions showed no statistically significant results between parameters: GPI ($p = 0.896$), heart rate ($p = 0.678$), oxygen saturation ($p = 0.946$), and anxiety scale ($p = 0.963$) (Tables 1 to 4).

## Discussion

Dental anxiety and fear are frequently encountered problems while treating pediatric patients. They evoke physical, cognitive, emotional, and behavioral responses in an individual, which may exaggerate any stimulus perceived by them.[1] Anxiety is an emotional state that precedes the actual encounter with the threatening stimuli, which sometimes is not even identifiable. According to Cohen et al., dental anxiety has both physiological and cognitive effects, with the physiological effects including signs and symptoms of the fright reaction and feelings of weariness following a dental appointment. The behavioral impacts include not only avoidance but also other behaviors related to eating, oral hygiene, self-medication, crying, and aggression.[5]

The prevalence of the gag reflex ranges from 15 to 34% in pediatric patients according to studies by Katsouda et al.[6] and Gucyetmez Topal et al.[7] Local, iatrogenic, psychological, medical, and prosthetic factors are involved in the etiology of gagging.[8] The neurophysiology of gagging explains that receptors send impulses from the sensory neurons to the gag center in the medulla oblongata through afferent neurons. Motor neurons then transmit these impulses *via* efferent fibers to the throat muscles, inducing gagging.[9] Methods involved in the management of gagging work on these sensory receptors to either mask the transmission of the gag impulse or nullify it completely.[1]

Researchers have tried to classify gagging based on its etiology, risk factors, and severity. The GSI is used to classify gagging in the present study, as the index separates gagging problems into five grades of increasing severity and can be used to compare the treatment a patient requires, allowing for the assessment of the level and type of gagging management techniques needed.[1] The GPI is used to assess the amount of gag reflex mitigated, as it records the effectiveness of the management methods employed to control the gag reflex and links it to the complexity of the dental treatment.[1]

Several pharmacological and nonpharmacological approaches for the management of dental anxiety have been proposed.[10]

These procedures, while successful, have limitations during impression making since each patient's reaction to the procedure is instinctual. The two noninvasive treatments used in the present study were distraction[11] and acupuncture.[12] Therefore, the current study included a comparison of the effects of a VR device and METTT on the management of the gag reflex during impression making.

Virtual reality (VR) is a human-computer interface using three-dimensional (3D) head-mounted displays with a wide field of view.[13] The VR device works on the principle of sensory shielding explained by McCaffery and Pasero,[14] wherein the child is protected from the painful stimulus by increased sensory input from VR distractors.

The METTT is an amalgamation of distraction, sensory depression, and acupuncture. Current research suggests that oropharyngeal and ear skin sensations merge with those in the cortex and brainstem.[15] The trigeminal nerve and its spinal nucleus frequently transmit oral pain to the ear (otalgia), which may be a result of the ear's distinct representation in the somatosensory cortex. This connects the ear to the oropharyngeal regions. Additionally, it is hypothesized that activating the auricular acupuncture site can reduce muscle activation in gag reflex (GR). The external auditory canal (EAC) skin, which is innervated by the auricular branch of the vagus nerve, and the skin next to the auricle correspond to this location on the ear, which is the antigagging point 5 (innervated by the auriculotemporal branch of the mandibular division of the trigeminal nerve). In light of this, it is possible to postulate that stimulation of the EAC caused by an earplug may affect or inhibit gag reflex sensory pathways in the somatosensory cortex, brainstem, or as antidromic stimulation of the neuronal pathways of mouth-referred pain (otalgia) over the EAC skin. George Goodheart invented the temporal tap method. It is carried out by tapping (with the palm surface of the fingertips) along the temporal-sphenoidal diagnostic line,[16] beginning in front of the ear and progressing forward, up, and then along the line. After each mild stroke, tapping is done forcefully enough to penetrate the hair and spring away from the head. Sensory input is provided prior to, during, and shortly following temporal tapping. It assists the patient in better understanding the supplied instructions and provides the power required to achieve the desired impact. It is especially effective in suppressing involuntary processes like gagging.[15] Music was used to facilitate this distraction tool. The use of music helps reduce anxiety in pediatric patients according to studies done by Navit et al.,[17] Alkahtani et al.,[18] and Tshiswaka and Pinheiro.[19]

This research focused on children aged 6–12 years. This age range was chosen because children have established the cognitive ability to interpret instructions and distinguish emotions by the age of 6. Children older than 12 were omitted because they are generally more cooperative. This approach aligns with the study conducted by Samaleti and Jawdekar.[20]

The Faces Version of the MCDAS was used as a subjective self-reporting tool in the present study after impression making. Self-report scales are the simplest way to determine whether a child is scared or anxious. One benefit of self-report assessments is their simplicity of administration, which requires only a short amount of time to complete. Additionally, they can gauge how patients are responding to different aspects of the dental experience. The facial version of the MCDAS scale was employed to minimize any bias that could have resulted from impaired cognitive function and comprehension under potentially anxiety-inducing situations.[21]

In the present study, the intragroup comparison of VR-facilitated maxillary impression making and standard mandibular impression making showed no discernible impact on the reduction in gag reflex (GPI scores). This might be because when a child uses VR, the bulky size of the gadget blocks their full field of vision, causing fear of the unknown. The technology blinds the child, preventing them from seeing or anticipating what is coming, even if the dentist has properly explained it. Statistically insignificant changes were observed in heart rate, oxygen saturation, and self-reported dental anxiety scale. This could be explained by the fact that the mandibular impression was made by a skilled and experienced operator who guided the children well and made them comfortable, using the standard method of impression making (leg-lift).[4] Hence, VR could not show significant anxiety reduction or improve patient comfort during impression making. Since no other studies have been conducted using VR for the reduction of gag reflexes, we cannot substantiate the results of our study.

The intragroup comparison of METTT-facilitated maxillary impression making and standard mandibular impression making showed a significant reduction in heart rate. This indicates that METTT can be used to reduce anxiety during impression making. However, no significant changes were observed in GPI scores (gag

reduction), oxygen saturation, or the self-reported dental anxiety scale. Partial effectiveness of METTT on anxiety was observed in our study.

Intergroup comparison for all four parameters showed no significant differences. Hence, no technique proved better than the other. Samaleti and Jawdekar.[20] compared the earplug and temporal tap technique with the standard distraction method for gag reflex related to maxillary impression making and concluded that the ETTT did not mitigate the gag reflex but led to a better patient experience. This was consistent with the results of the present study. To alleviate anxiety and ameliorate the gag reflex in pediatric patients, studies have been conducted using intellectual colored games,[2] stress balls,[22] and low-level laser therapy.[23] In contrast to the current study, the authors found that these distraction tactics resulted in a significant reduction in gag reflex and anxiety.

Much research has not been conducted to assess the presence and treatment of the gag reflex in pediatric patients. As a result, this randomized clinical trial provided the information needed to prompt further investigation into evidence-based management of the gag reflex.

However, the present study's shortcomings included not being a crossover study, having a wide age range, and the impossibility of triple blinding, which led to operator-generated biases.

## Conclusion

The significance of first impressions and the ensuing events that lead to gagging and dental anxiety cannot be overstated in pediatric dentistry.

According to the findings of the current study,

- METTT can help patients feel less anxious during maxillary impression making. As a result, it can be utilized as an adjuvant to help the child have a positive impression-making experience.
- However, neither VR nor METTT helped mitigate the gag reflex.
- There is minimal literature evidence; therefore, more research is needed to manage or reduce the gag reflex during impression making and to create a comfortable experience for the patient.

### Clinical Significance

Impression making is one of the most routine procedures in clinical practice. The anxiety and discomfort it can cause cannot be underestimated. Thus, this study aimed to make impression making a more tolerable experience, especially for pediatric patients, by using various newer distraction methods.

## Orcid

*Mehek Gandhi* https://orcid.org/0009-0002-7980-1048

## References

1. Dickinson CM, Fiske JA. Review of gagging problems in dentistry: etiology and classification. Dent Update 2005;31:26–28, 31–32. DOI: 10.12968/denu.2005.32.1.26
2. Debs NN, Aboujaoude S. Effectiveness of intellectual distraction on gagging and anxiety management in children: a prospective clinical study. J Int Soc Prev Community Dent 2017;7(6):315–320. DOI: 10.4103/jispcd.JISPCD_397_17
3. Pisulkar SK, Agrawal R, Godbole SR, et al. Addressing the gag reflex: a literature review. Int J Recent Surg Med Sci 2018;4(1):2–4. DOI: 10.5005/jp-journals-10053-0061
4. Kroll AJ. A new approach to the gagging problem. J Prosthet Dent 1963;13:611–616. DOI: 10.1016/0022-3913(63)90131-8
5. Cohen SM, Fiske J, Newton JT. The impact of dental anxiety on daily living. Br Dent J 2000;189(7):385–390. DOI: 10.1038/sj.bdj.4800777
6. Katsouda M, Coolidge T, Simos G, et al. Gagging and cooperation in 4–12-year-old children over a series of dental appointments. Eur Arch Paediatr Dent 2021;22(5):937–946. DOI: 10.1007/s40368-021-00654-x
7. Gucyetmez Topal B, Falay Civelek SB, Tiras M, et al. The prevalence and influencing factors of gag reflex in children aged 7–14 years in the dental setting. J Oral Rehabil 2023;50(5):376–382. DOI: 10.1111/joor.13432
8. Saita N, Fukuda K, Koukita Y, et al. Relationship between gagging severity and its management in dentistry. J Oral Rehabil 2013;40:106–111. DOI: 10.1111/joor.12014
9. Shrivastav VK, Mahajan S. Effective management of gag reflex in clinical practice. Indian J Stomatol 2012;3(1):27–31.
10. Colvenkar S, Reddy V, Thotapalli S, et al. A simple step-by-step technique for the management of gagging in edentulous patient. Cureus 2022;14(4):e24423. DOI: 10.7759/cureus.24423
11. Aartman IH, van Everdingen T, Hoogstraten J, et al. Self-report measurements of dental anxiety and fear in children: a critical assessment. ASDC J Dent Child 1998;65:252–258, 229–230.
12. Vachiramon A, Wang WC. Acupressure technique to control gag reflex during maxillary impression procedures. J Prosthet Dent 2002;88:236. DOI: 10.1067/mpr.2002.127952
13. Nunna M, Dasaraju RK, Kamatham R, et al. Comparative evaluation of virtual reality distraction and counter-stimulation on dental anxiety and pain perception in children. J Dent Anesth Pain Med 2019;19(5):277–288. DOI: 10.17245/jdapm.2019.19.5.277
14. McCaffery M, Pasero C. Pain: Clinical Manual, 2nd edition. In: McCaffery M, Pasero C (Eds). Practical nondrug approaches to pain. St Louis: Mosby; 1999. pp. 399–427.
15. Frost RA. Temporal tapping. Touch For Health Int J 1990:55–58.
16. Nihashi T, Kakigi R, Okada T, et al. Functional magnetic resonance imaging evidence for a representation of the ear in human primary somatosensory cortex: comparison with magnetoencephalography study. Neuroimage 2002;17(3):1217–1226. DOI: 10.1006/nimg.2002.1216
17. Navit S, Johri N, Khan SA, et al. Effectiveness and comparison of various audio distraction aids in management of anxious dental paediatric patients. J Clin Diagn Res 2015;9(12):ZC05–ZC09. DOI: 10.7860/JCDR/2015/15564.6910
18. Alkahtani ZM, Zakirulla M, Alshehri ES, et al. The effect of music on children's anxiety during dental treatment. J Res Med Dent Sci 2020;8(3):39–43.
19. Tshiswaka SK, Pinheiro SL. Effect of music on reducing anxiety in children during dental treatment. Rev Gaúch Odontol 2020;68:e20200033. DOI: 10.1590/1981-86372020000332019004 9
20. Samaleti SS, Jawdekar AM. Comparison of "earplug and temporal tap technique" with standard distraction method on gag reflex related to maxillary impression making in 6–12-year-old children: a crossover study. J South Asian Assoc Pediatr Dent 2020;3(2):49–53.
21. Howard KE, Freeman R. Reliability and validity of a faces version of the Modified Child Dental Anxiety Scale. Community Dent Oral Epidemiol 2007;35(4):281–288. DOI: 10.1111/j.1365-263x.2007.00830.x
22. Arambam L, Kaur H, Choudhary R, et al. Effectiveness of intellectual color game, audio-visual, and stress ball distraction methods on gagging and anxiety management in children. J Clin Pediatr Dent 2022;46(6):6–10. DOI: 10.22514/jocpd.2022.019
23. Goel H, Mathur S, Sandhu M, et al. Effect of low-level laser therapy on P6 acupoint to control gag reflex in children: a clinical trial. J Acupunct Meridian Stud 2017;10(4):217–223. DOI: 10.1016/j.jams.2017.07.002