J Acupunct Meridian Stud 2017;10(5):317—323

Available online at www.sciencedirect.com

Journal of Acupuncture and Meridian Studies

journal homepage: www.jams-kpi.com

RESEARCH ARTICLE

Effect of Low-level LASER Therapy on P6 Acupoint to Control Gag Reflex in Children: A Clinical Trial

Himani Goel*, Shivani Mathur, Meera Sandhu, Pulkit Jhingan, Vinod Sachdev

Department of Pedodontics and Preventive Dentistry, ITS Dental College, Ghaziabad, India

Available online 28 July 2017

Received: May 16, 2017
Revised: Jul 9, 2017
Accepted: Jul 24, 2017

Abstract

Objective: To investigate the effect of low level laser therapy (LLLT) on PC6 acupuncture point in suppressing gag reflex, regulating pulse rates and oxygen saturation, thereby reducing the anxiety levels.

Materials and Method: A total of 40 patients who demonstrated hyperactive gag reflex in the age group of 4-14 years were included in the study. In Group A (20 patients), maxillary impression was recorded. In the second step, PC6 acupuncture point was stimulated with LLLT followed by recording of second maxillary impression. In group B (20 patients), steps were reversed. Gag reflex, anxiety levels, pulse rate and oxygen saturation levels were assessed.

Results: Values of pulse rate and oxygen saturation were regulated to normal, signifying lowered anxiety levels. Gag reflex was also significantly decreased after stimulating PC6 acupuncture point with LLLT.

Conclusion: LLLT on PC6 point was found to be effective in lowering anxiety levels as observed by faces modified anxiety rating scale. Further, it was authenticated as the pulse rates were significantly reduced and oxygen saturation levels were significantly increased. Also, gag reflex was significantly controlled when LASER stimulation was done at PC6.

1. Introduction

Impression making is a preliminary yet important step in dentistry, and especially while dealing with a child, compliance is a limiting factor. Patient compliance is not only important to establish communication, alleviate fear and anxiety, but also to deliver quality dental care, build a trusting relationship between dentist/staff and child/

* Corresponding author. Department of Pedodontics and Preventive Dentistry, ITS Dental College, Delhi-Meerut Road, Muradnagar, Ghaziabad, Uttar Pradesh 201206, India.
E-mail: goelhimani90@gmail.com (H. Goel).

pISSN 2005-2901 eISSN 2093-8152
http://dx.doi.org/10.1016/j.jams.2017.07.002

parent, and promote the child's positive attitude toward oral health care. However, frequently, while taking alginate impression of upper arch, the patient goes through an episode of hyperactive gagging. Gagging is a stimulated, protective reflex to prevent any material from entering the mouth or oropharynx [1].

The etiology of gagging has been categorized as somatic or psychogenic. Somatic gagging is induced by touching a trigger area in the oral cavity such as the lateral border of the tongue or the palate. Psychogenic gagging is induced without any direct contact, and the thought of the stimulus, such as a dental intervention, is sufficient to induce the reflex [2,3]. Pronounced gag reflexes can compromise all spheres of dentistry. It results in the delay of a procedure which creates an embarrassing situation for both the dentist and the patient, finally aborting the appointment, and further causing avoidance of dental care because of extreme stress and anxiety.

Various methods have been proposed to manage the gag reflex. They include relaxation, distraction, and desensitization techniques; psychological and behavioral therapies; local anesthesia, conscious sedation, and general anesthesia techniques; and other complementary medicine therapies like hypnosis [1,3,4]. Acupuncture is another modality which has been reported to control gag reflex. It is defined as the insertion of a solid needle into specific parts of the human body for disease prevention, therapy, or the maintenance of health. Acupuncture points on the body are stimulated by needles, pressure (acupressure), vacuum (cupping), LASER, or electrical stimulus [5]. The use of needle acupuncture in children is a very difficult procedure since it is an invasive technique. To overcome this difficulty, LASER acupuncture and acupressure were developed. These are not only painless, but also help in achieving better patient compliance. According to ancient Chinese Medicine, energy flows in the human body along 14 meridians. On these meridians lie certain points (Qi) which when stimulated, produce specific effects on the body. Various anti-gagging points have been recognized, such as Pericardium 6 (PC6), large intestine point called as He Gu point (Li4), and Conception Vessel 24 (CV24). Stimulating these points activate mechanisms that inhibit the muscle activity of gag reflex. Neiguan point or PC6 is an acupressure point which is considered to be one of the best determined acupressure points to control nausea and vomiting. It is a concave area at the medial aspect of the forearm, slightly below the palm, and measuring approximately one horizontal finger in width (Fig. 1). Low-level LASER therapy (LLLT) is being used in medicine to promote pain attenuation, also called as needleless acupuncture.

This study was conducted to understand the effect of light amplification by stimulated emission of radiation (LASER) at PC6 acupressure point in controlling gag reflex.

2. Materials and methods

The present study was conducted in the Department of Pedodontics and Preventive Dentistry, ITS-CDSR, Muradnagar, Ghaziabad, India, with prior approval from the ethical committee of the institute. All the guidelines of the committee are conversant with the guidelines required for conducting clinical trials in India safeguarding the rights, safety, and well-being of the patients being further in accordance with the World Medical Association Declaration of Helsinki.

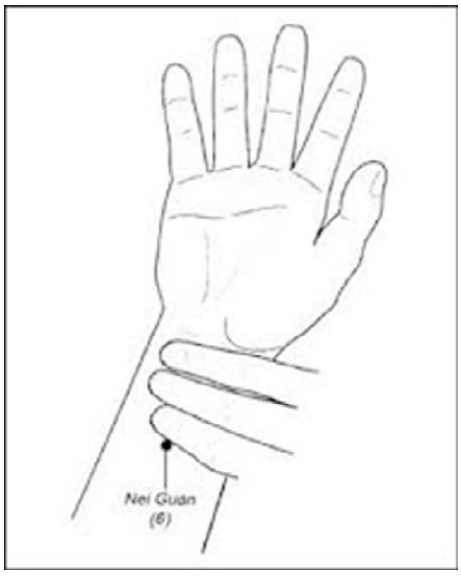


Figure 1 Diagrammatic representation of Neiguan point.

The purpose of the study was explained and a written consent was obtained from the patients' parents who were willing to participate in the study. Thus, 40 patients (23 females and 17 males) in the age group of 4—14 years who required impression of the maxillary arch were seated on a dental chair and were assessed for hyperactive gag reflex by touching the posterior palate with back of the mirror handle. They were scored using the Dickinson's criteria [1]. Those with gagging severity index scores of 3—5 were selected.

Sample size was calculated using the formula:

$$n = \frac{\left(Z_{\alpha/2} + Z_{\beta}\right)^2 * 2 * S^2}{d^2}$$

where $Z_{\alpha/2}$ is the critical value of the normal distribution at $\alpha/2$ (for a confidence level of 95%, α is 0.05 and the critical value is 1.96); Z_{β} is the critical value of the normal distribution at β (e.g., for a power of 80%, β is 0.2 and the critical value is 0.84); S^2 is the pooled variance; and d is the difference of means between two groups. Using this formula and data collected by pilot study, we took pooled variance $S^2 = 1.58$ and mean difference $d = 1.385$.

The patients were randomly assigned into two groups, Group A and Group B, as shown in Fig. 2. A cross-over design was planned in which Group A consisted of 20 patients where the first alginate impression of the maxillary arch (Tropicalgin, mango flavor) was recorded. The second impression of the same patient was then recorded after 30 minutes where Diode LASER (iLase LASER System, Biolase, Inc., 4 Cromwell, Irvine, CA 92618, USA) with power output 0.5 mW, wavelength 940 nm, energy 4J, and 3—4 mm away from the tissue with a penetration depth of few millimeters in a defocused continuous mode was applied on PC6 acupressure point keeping the tip of diode LASER 3—4 mm away with 1 inch spot size for 1 minute (Fig. 3). In Group B, the first maxillary impression was

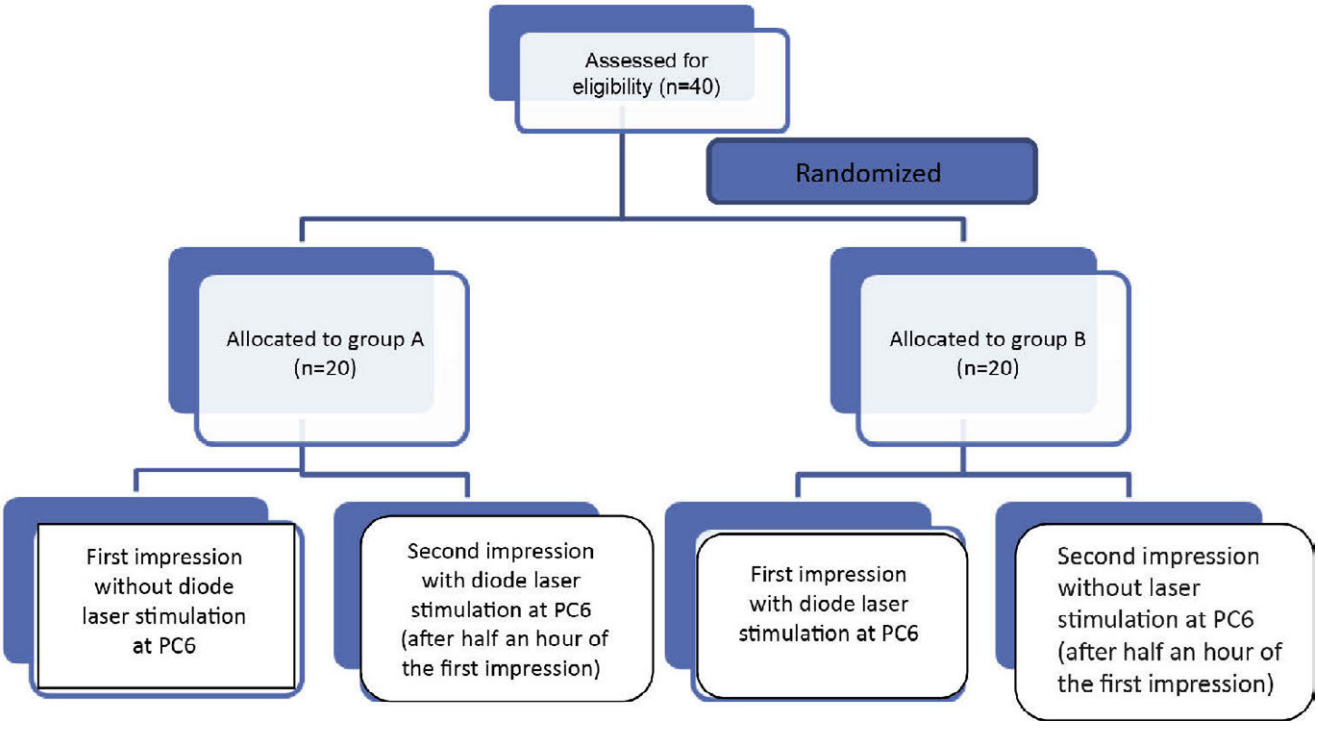


Figure 2 Study design.

Figure 3 Low-level LASER therapy on Neiguan point.

Table 1 Intra group comparison of the mean scores of pulse rate and oxygen saturation level in a group at different stages using paired *t* test (intragroup comparison).

Group	Comparison of mean scores of pulse rate and oxygen saturation	Mean difference ± SD	*p*
A	P1 − P2	18.700 ± 12.274	0.001
B	P1 − P2	−6.600 ± 8.185	0.002
A	OS1 − OS2	−2.350 ± 1.309	0.011
B	OS1 − OS2	0.950 ± 1.504	0.001

OS1 = oxygen saturation during first impression; OS2 = oxygen saturation during second impression; P1 = pulse rate during first impression; P2 = pulse rate during second impression; SD = standard deviation.

Figure 4 Faces version of the Modified Child Dental Anxiety Scale.

recorded immediately after the stimulation of PC6 point by LLLT; after 30 minutes, the second maxillary impression was recorded without the stimulation of PC6 acupressure point. A time gap of 30 minutes was kept to reinforce the concept of sensory flooding where the strength of initial response diminishes within 30 minutes [6]. Consequently, patient does not retain the effect of previous stimulation, thus removing bias.

While taking both the impressions, pulse rate, oxygen saturation, and gag were assessed. Pulse rate and oxygen saturation were recorded using pulse oximeter initially and while taking both the impressions for every patient. The level of anxiety due to pronounced gag reflex was determined using Faces version of the Modified Child Dental Anxiety Scale (Fig. 4) after taking each impression by asking the child "how did the child feel while taking the impression?" It has been shown to be a reliable and valid indicator of child's dental anxiety [7].

2.1. Statistical analysis

Intragroup comparisons of the mean scores of pulse rate and oxygen saturation in a group at different stages were calculated using paired *t* test. Comparison of mean scores of pulse rate and oxygen saturation was calculated using Student *t* test for two independent groups. Comparison of anxiety levels between the two groups after taking the first and second impression was calculated using Mann Whitney *U* test.

Table 2 Comparison of mean scores of pulse rate and oxygen saturation using Student *t* test for two independent groups.

Variables	Comparison between groups	Mean difference ± SD	*p*
P1	A and B	11.950 ± 2.445	0.001
P2	A and B	−13.350 ± 2.614	0.001
OS1	A and B	−0.900 ± 0.411	0.637
OS2	A and B	2.400 ± 0 .437	0.001

OS1 = oxygen saturation during first impression; OS2 = oxygen saturation during second impression; P1 = pulse rate during first impression; P2 = pulse rate during second impression; SD = standard deviation.

3. Results

On intragroup comparison of mean scores of pulse rate and oxygen saturation levels using paired *t* test after the first and second impression, it was observed that the values of pulse rate significantly decreased ($p < 0.05$) during second impression in Group A (i.e., P2) and during first impression in Group B (i.e., P1). Also, oxygen saturation values significantly increased during second impression in Group A (i.e., OS2) and during first impression in Group B (i.e., OS1) when LASER beam was used to stimulate PC6 point (Table 1).

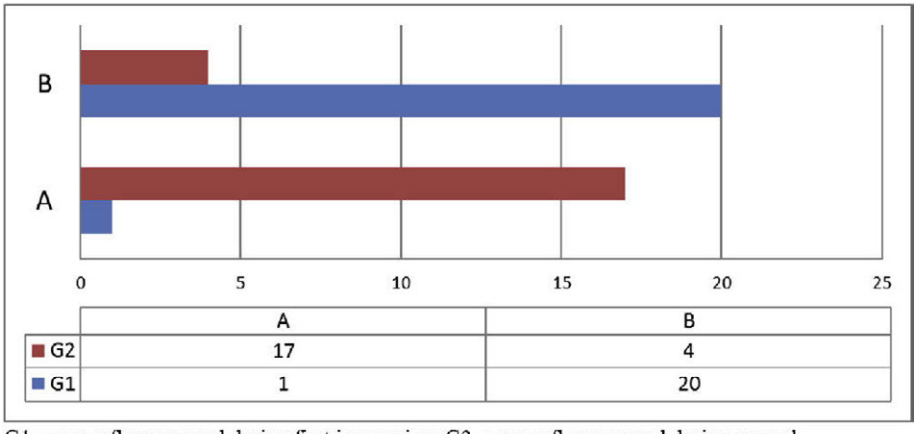
On intergroup comparison using Student *t* test, it was observed that the pulse rate was significantly higher ($p < 0.001$) during first impression in Group A (i.e., P1) and during second impression in Group B (i.e., P2) ($p < 0.001$) i.e., when impressions were taken without LASER stimulation at PC6 (Table 2).

Further, intergroup comparison of oxygen saturation levels while recording first impression was significantly higher ($p < 0.001$) in Group A (i.e., where PC6 point was stimulated by LLLT) than in Group B, suggesting that oxygen

Table 3 Comparison of anxiety levels between the two groups after taking first impression using Mann Whitney *U* test.

A1					
Group	*n*	Mean rank	Mann Whitney *U*	Z	*p*
A	20	29.60	18.000	−5.074	0.001
B	20	11.40			

A1 = anxiety scores after first impression; Z = Z score.



G1 = gag reflex assessed during first impression; G2 = gag reflex assessed during second impression.

Figure 5 Frequency distribution of patients with controlled gag reflex in the two groups (A and B) during both the impressions. G1 = gag reflex assessed during first impression; G2 = gag reflex assessed during second impression.

Table 4 Comparison of anxiety levels between the two groups after taking second impression using Mann Whitney *U* test.

A2					
Group	*n*	Mean rank	Mann Whitney *U*	Z	*p*
A	20	12.30	36.000	−4.683	0.001
B	20	28.70			

A2 = anxiety scores after second impression; Z = Z score.

saturation levels showed better values when LASER stimulation was done at PC6. However, while recording second impression, no statistically significant differences in oxygen saturation levels were observed between the two groups (Table 2).

Moreover, gag reflex was absent in only 1 patient in Group A during first impression, whereas the number increased to 17 during second impression when diode LASER was used to stimulate the PC6 point. Further, it was seen that gag reflex was suppressed in all the 20 patients in Group B during first impression when PC6 was stimulated, whereas only 4 patients experienced no gagging during second impression (Fig. 5). It has been observed that a time gap of 30 minutes after the first impression leads to a diminished effect of the initial response because of sensory flooding.

On using Mann Whitney *U* test, it was observed that while taking the first impression, the values of mean rank for anxiety scores were significantly higher ($p < 0.001$) in Group A (29.60) than in Group B (11.40) (Table 3).

Similarly, the mean rank for anxiety scores during second impression was 12.30 in Group A which is significantly lower ($p < 0.001$) due to the PC6 stimulation by LASER than in Group B, i.e., 28.70 (Table 4).

4. Discussion

A severe gag reflex is an impediment in successful completion of certain dental procedures as it leads to avoidance of dental treatment for some and for others sedation or general anesthesia remains the only option to cope with the dental treatment. Even the basic dental procedures like impression making especially of the upper arch leads to increased levels of stress suffered by patients, particularly pediatric patients, and often lead to salivation, lacrimation, or even vomiting. According to Davies et al [8], gag reflex does not exist in 37% of the healthy population, whereas some people suffer from severe gag reflex, thereby making dental treatment procedures intolerable for them [3,9–13].

Several strategies have been employed to control gag reflex, ranging from distraction, hypnosis, to general anesthesia; however, to date no single strategy proves to be efficient. Scarborough et al [3,14] applied acupressure, Yoshida et al made use of intravenous sedatives [3,9], and Kaviani et al and other researchers applied inhaled sedatives to control the gag reflex [3,15–17].

Acupuncture is a therapy that has been practiced for thousands of years. While it is now practiced worldwide, it has strong cultural ties with China and the Far East. It is defined as "the insertion of a solid needle into any part of the human body for disease prevention, therapy, or maintenance of health" (Acupuncture Regulatory Working Group, 2003) [18]. As a traditional therapy, acupuncture explains that the balance between the Yin and the Yang—the positive and negative forces of the universe—forms a core in the understanding of illness. The primary mechanism by which acupuncture works is that the application of a needle stimulates the nervous system, specifically fine nerve fibers that respond to sharp pain. These carry the stimulus to the central nervous system where signals can block incoming pain signals from other sites supplied by the same part of the nervous system or segmentally linked. This is called "gating" after the Gate theory of pain described by Melzac and Wall in the 1960s (Melzac and Wall, 1996) [18].

The second mechanism is much more localized and targets muscular trigger points which leads to pain relief as the action of needling leads to vasodilation, and thus improved oxygen supply to the areas, terminating the muscle contraction as well as a gating effect as described above. These nerve points or pressure points are located along 14 major meridians or power lines inside the body. These power lines carry energy or qi-chi which is distributed evenly in case of a healthy body [19]. By using pressure or LASER light instead of needles, acupressure works to stimulate (tonify or sedate) specific reflex points located along these meridians [20]. Acupuncture therapy activates small myelinated nerve fibers in the muscles, which send impulses to the spinal cord and then activate the midbrain and pituitary-hypothalamus. The involvement of enkephalin, beta-endorphin, dynorphin, serotonin, and noradrenalin in this process has been known [19].

LASER was developed in the early 1960s [20]. Acupuncturists first began experimenting with soft LASERs during the 1970s [21]. In LASER acupuncture, low-intensity LASERs are used to stimulate the trigger points, thereby curing many medical conditions (LLLT). The earliest experimental application of LASERs in acupuncture was by using low-power LASER. In medicine, its use was first reported by Endre Mester in Hungary. He described the use of Ruby and Argon LASERs in the promotion of healing of chronic ulcers and the use of terms like "needleless acupuncture" and "pain attenuation" started then [22]. LASER acupuncture relies on the absorption and scattering of light within tissues in contrast to needle acupuncture, in which input begins with the micro-traumatic mechanical effects of the needle on local tissue. Photons from the LASER create a stimulating, bio-modulatory effect. Magnetic resonance imaging has shown that LASER acupuncture activates specific regions of the brain that release endorphins and enkephalins and thus promote healing [20]. Various studies suggest the use of acupuncture on certain points which lie on the 14 meridians on the body, namely conception vessel 24 (CV-24), PC6, and Li-4 (Hegu Point) [3,23,24]. Research shows that these are as effective as conventional medicine for the control of nausea and may actually be better [25,26].

In the present study, PC6 (Neiguan point) was taken as the acupuncture point to control gag reflex. As needle acupuncture is difficult to achieve in pediatric patients, LASER acupuncture allows painless stimulation. Sudden

unwanted movement by children makes CV24 difficult to stimulate. This is less difficult in PC6 under such conditions. Furthermore, no side effects of LLLT have been reported so far.

In the present study, results showed that values of pulse rate were decreased and values of oxygen saturation were increased when impression was taken after LASER stimulation at PC6 point, i.e., during second impression in Group A and during first impression in Group B both on intragroup comparison ($p < 0.05$) and intergroup comparison ($p < 0.05$), signifying decrease in anxiety levels when PC6 acupressure point was stimulated with LLLT. Furthermore, our results showed that painless LASER acupuncture stimulation of PC6 point reduced the gag reflex without any side effects, i.e., 17 patients with suppressed gag reflex were seen during second impression in Group A and 20 patients during first impression in Group B. This is in accordance with the study conducted by Lu et al [27] who observed that needle acupuncture on PC6 point was effective in controlling gag reflex. In another study by Fiske and Dickinson [4], needle insertion on specific anti-gagging points on each ear was effective in controlling gag reflex.

Acupuncture to point CV 24 has been reported to be equally effective by Rosted [23]. However, Dundee and McMillan [28] found that the stimulation of PC6 alone was insignificant in preventing postoperative vomiting in children after strabismus surgery, while Schlager et al [29] investigated the effect of 670 nm low-level LASERs on the acupuncture point PC6 in children with vomiting after strabismus surgery and found that LASER stimulation of acupuncture point PC6 reduced the incidence of vomiting. Sari and Sari [3] undertook a combination of LASER stimulation of CV 24 and acupressure of PC6 and found that both CV 24 and PC6 points have a synergistic effect in controlling gag reflex.

Our study showed that anxiety scores were also significantly decreased in both the groups when impression was taken by LASER stimulation of PC6.

4.1. Limitations of the study

- LASER was not compared with any other distraction techniques
- Sample size of the study was small; therefore, further studies are warranted with larger sample size.

5. Conclusion

When PC6 acupuncture point was stimulated by LLLT, not only did the pulse rate decrease, but the oxygen saturation levels were also improved. Anxiety levels were lowered and gag reflex was effectively suppressed. Hence, the results of our study indicate that LLLT is an effective technique to control gag reflex during impression taking in pediatric patients. However, further studies with larger sample size are warranted in future to authenticate its effects.

Conflict of interest

No.

Acknowledgement

No.

Funding source

No.

References

[1] Dickinson CM, Fiske JA. Review of gagging problems in dentistry: etiology and classification. *Dental Update*. 2005;31:26—32.
[2] Miles TS, Nauntofte B, Svenson P. *Clinical oral physiology*. Copenhagen: Quintessence Publishing Co Ltd; 2004. ISBN: 1-85097-091-2; 1850970912.
[3] Sari E, Sari T. The role of acupuncture in the treatment of orthodontic patients with a gagging reflex: a pilot study. *Br Dent J*. 2010;208:E19.
[4] Fiske J, Dickenson C. The role of acupuncture in controlling the gagging reflex using a review of ten cases. *Br Dent J*. 2001;190:611—613.
[5] Thayer ML. The use of acupuncture in dentistry. *Dent Update*. 2007;34:244—250.
[6] Saunders RM, Cameron J. Psychogenic gagging: Identification and treatment recommendations. *Compend Contineduc Dent*. 1997;18:430—440.
[7] Howard KE, Freeman R. Reliability and validity of a faces version of the Modified Child Dental Anxiety Scale. *Int J Paediatr Dent*. 2007;17:281—288.
[8] Davies AE, Kidd D, Stone SP, MacMahon J. Pharyngeal sensation and gag reflex in healthy subjects. *Lancet*. 1995;345:487—488.
[9] Yoshida H, Ayuse T, Ishizaka S, Ishitobi S, Nogami T, Oi K. Management of exaggerated gag reflex using intravenous sedation in prosthodontic treatment. *Tohoku J Exp Med*. 2007;212:373—378.
[10] Ardelean L, Bortun C, Motoc M. Gag reflex in dental practice etiological aspects. *TMJ*. 2003;53:312—315.
[11] Bassi GS, Humphris GM, Longman LP. The etiology and management of gagging: a review of the literature. *J Prosthet Dent*. 2004;91:459—467.
[12] Packer ME, Joarder C, Lall BA. The use of relative analgesia in the prosthetic treatment of the 'gagging' patient. *Dent Update*. 2005;32:544—546, 548—50.
[13] Dickinson C, Fiske J. A review of gagging problems in dentistry: 2. Clinical assessment and management. *Dent Update*. 2005;32:74—76, 78—80.
[14] Scarborough D, Bailey-Van Kuren M, Hughes M. Altering the gag reflex via a palm pressure point. *J Am Dent Assoc*. 2008;139:1365—1372.
[15] Kaviani N, Feizi G, Shirani A. Evaluation of the effect of inhalation sedation on gag reflex in hyperactive gag reflex patients during dental treatment. *J Dent Shiraz Univ Med Sci*. 2006;7:105—113.
[16] Chidiac JJ, Chamseddine L, Bellos G. Gagging prevention using nitrous oxide or table salt: A comparative pilot study. *Int J Prosthodont*. 2001;14:364—366.
[17] Peretz B, Katz J, Zilburg I, Shemer J. Response to nitrous-oxide and oxygen among dental phobic patients. *Int Dent J*. 1998;48:17—23.
[18] Thayer T. Understanding the use of acupuncture in dentistry. *Dental Nursing*. 2013;9:80—84.
[19] Raghavan R, Sathish S. Acupuncture in Prosthodontics. *Guident*. 2016:24—29.

[20] Duggal P. Laser acupuncture the emerging light of hope…. *Guident*. 2013:60—62.
[21] Silva Júnior AN, Pinheiro AL, Oliveira MG, Weismann R, Pedreira Ramalho LM, Amadei Nicolau R. Computerized morphometric assessment of the effect of low-level laser therapy on bone repair: an experimental animal study. *J Clin Laser Med Surg*. 2002;20:83—87.
[22] Bjordal JM, Couppe Roberta C, Chow RT, Tuner J, Ljunggren EA. A systematic review of low level laser therapy (llllt) with location-specific doses for pain from chronic joint disorders. *Aust J Physiother*. 2003;49:107—116.
[23] Rosted P. Use of acupuncture in dentistry. *Aust Dent J*. 1998; 43:437.
[24] RenXianyun. Making an impression of a maxillary edentulous patient with gag reflex by pressing caves. *J Prosthet Dent*. 1997;78:533.
[25] Lee A, Done ML. The use of nonpharmacological techniques to prevent postoperative nausea and vomiting: a metaanalysis. *Anesth Analg*. 1999;88:1362.
[26] Lee A, Fan L. Stimulation of the wrist acupuncture point PC6 for preventing postoperative nausea and vomiting. *Cochrane Database Syst Rev*. 2009;2:GD003281.
[27] Lu DP, Lu GP, Reed 3rd JF. Acupuncture/acupressure to treat gagging dental patients: A clinical study of anti-gagging effects. *Gen Dent*. 2000;48:446—452.
[28] Dundee JW, McMillan CM. PC6 acupressure and postoperative vomiting. *Br J Anaesth*. 1992;68:225—226.
[29] Schlager A, Offer T, Baldissera I. Laser stimulation of acupuncture point PC6 reduces postoperative vomiting in children undergoing strabismus surgery. *Br J Anaesth*. 1998; 81:529—532.