Effects of auricular laser puncture at the depressing, tranquilizer, and master cerebral points in patients with dental anxiety

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Abstract: Dental anxiety is an acute anxiety reaction that often occurs in several individuals. Severe cases of dental anxiety may negatively affect oral health because of the avoidance of and delays in dental treatments. Medical therapy has been the first-line therapy in managing dental anxiety. However, it can cause respiratory depression and prolonged sedation. The present study aimed to identify the effects of auricular laser puncture at the depressing, tranquilizer, and master cerebral points on anxiety levels using the Spielberger State-Trait Anxiety Inventory. Moreover, the effects were compared between the treatment (sham auricular laser puncture) and control groups. In the treatment group, the same procedure was performed, except for the laser pen that was turned off. Results showed that the mean score of the treatment group (15.56 ± 7.188) was higher than that of the control group (5.39 ± 3.867). Auricular laser puncture is more effective than sham laser puncture in decreasing the anxiety levels in patients with dental anxiety.

1. Introduction
Anxiety is a common psychiatric disorder. Anxiety disorders are caused by interactions between biopsychosocial factors, including genetic susceptibility, and conditions such as stress or trauma, which subsequently result in a significant clinical syndrome [1]. According to the Riset Kesahatan Dasar Nasional in 2007, the prevalence rate of mental disorder (emotional) in individuals aged >15 years was 14.1% in Jakarta and 5.15%–20% among other provinces in Indonesia [2].

Acute anxiety or acute stress disorder is also common in patients who will undergo surgery [3] and tooth extraction or other dental treatments (dental anxiety) [4,5]. Patients with dental anxiety often delay or even cancel treatment plans because they cannot cope with their anxiety, and, consequently, these patients use sedatives for routine dental treatment. Moreover, the rescheduling of dental treatment negatively affects oral health [4]. Michalek-Saubarer et al. (2012) have reported that approximately 40%–60% of adults in the Western countries present with dental anxiety [6]. However, valid data on acute anxiety associated with dental treatments are not available at the Department of Oral and...
Maxillofacial Surgery of Dr. Cipto Mangunkusumo National Central General Hospital and elsewhere in Indonesia.

Pharmacologic or medical interventions are more commonly applied in patients with dental anxiety [4]. Benzodiazepine is prescribed to individuals with dental anxiety [7]. However, this medication causes respiratory depression and prolonged sedation. Acupuncture is one of the most commonly used nonpharmacological interventions for dental anxiety [6]. Currently, treatment with acupuncture has rapidly increased not only in the Eastern countries but also in some Western countries because where it is considered as an alternative and complementary therapeutic modality [8-10]. Studies conducted by Michalek-Sauberer A et al. (2012) and Karst M et al. (2007) have shown that auricular acupuncture at the relaxation, tranquilizer, and master cerebral points significantly decreases anxiety levels of patients with dental anxiety [4,6]. Laser puncture is a non-invasive therapy that stimulates acupuncture points with a low-intensity laser beam. It is a painless procedure and is more convenient for patients with anxiety. In addition, this method is relatively safe because it cannot cause microtrauma. Thus, individuals who are on this therapy are not at risk for infection [11].

2. Methods
This was a single-blind randomized controlled trial conducted from July 2013 to December 2013. A total of 36 patients with dental anxiety who came to the Oral and Maxillofacial Surgery Clinic of Cipto Mangunkusumo Hospital, Jakarta, were included. The study was approved by the Health Research Ethics Committee of Faculty of Medicine, Universitas Indonesia-Cipto Mangunkusumo Hospital (Approval number: 472/H2.F1/ETIK/2013). Informed consent was obtained from patients who met the inclusion criteria.

Male and female patients aged 17–65 years who will undergo tooth extraction or odontectomy were included in the ASA I and their anxiety levels were assessed using the visual analog scale (≥3). Meanwhile, women who were pregnant, those with lesions or infections in the earlobes, and those with a history of mental disorders were excluded. The mini-international neuropsychiatric interview was conducted by researchers to assess for other psychiatric disorders [12]. If the respondents did not complete the research procedure or used anxiolytic drugs, then the interview was considered void.

Random allocation was performed by independent parties using random tables after the stratification of the type of dental treatment, which included tooth extraction and odontectomy. The result of the random allocation was then entered into a sealed envelope, which was opened at the time of the intervention, and the participants did not know the intervention that they will receive. The participants were divided into two intervention groups, namely treatment and control groups, and then asked to fill the self-evaluation questionnaire [state anxiety inventory (SAI)] to assess the degree of anxiety associated with the feelings they experienced at that time. The SAI is an instrument established by Spielberger et al. and is widely used for patients with anxiety, including dental anxiety [4, 6]. This questionnaire comprises 20 questions evaluating an individual’s feelings about acute stress reactions experienced when facing a specific stressor [13]. Furthermore, while the participants were in a sitting position, auricular laser puncture or laser puncture sham was performed in accordance with the results of the randomization.

In this study, the GIR30+ laser device (class IIA, Sedatelec, France) was used. Laser puncture stimulation was performed using infrared light (880 nm), resonant modulated waves with a frequency of 146 Hz, and a therapeutic dose of 0.942 J/min. Both the research participants and the researchers used special protective glasses. The depressing, tranquilizer, and master cerebral points were used in this study [4, 6, 14]. In the treatment group, auricular laser puncture was performed at each point for 1 min, whereas in the control group, laser puncture sham was conducted at the same points and only the laser pen appliance treatment was not turned on. Thirty minutes after the intervention, the participants were asked to fill the SAI questionnaire again. Tooth extraction or odontectomy was then performed. After the completion of dental treatment, the research participants were again asked to fill the post-auricular laser puncture and dental treatment questionnaires, and the changes in SAI scores obtained from
participants in each intervention group were recorded. Data were analyzed using the SPSS software after data collection. p < 0.05 was considered statistically significant [6].

3. Results
A total of 36 patients were included, of which 18 were in the treatment group (auricular laser puncture) and 18 were in the control group (auricular laser puncture sham). All respondents completed the entire research procedure. Statistical analysis of all respondents was conducted.

Statistical analysis was performed using characteristics such as age, sex, education level, previous history of tooth extraction, and the type of dental treatment (p > 0.05) (see Table 1 and 2). Results showed that the initial characteristics of respondents in both intervention groups did not significantly differ. The mean statistical test scores (SAI questionnaire) before the intervention showed a significant difference between the treatment and control groups (p < 0.05) (Table 3). After the intervention, the mean SAI scores of both groups significantly decreased (p < 0.05) (treatment group: from 48.33 ± 10.672 to 32.78 ± 7.175 and control group: from 37.94 ± 8.868 to 32.56 ± 8.733) (Table 4). The mean difference in the SAI scores of the treatment group was 15.56 ± 7.188, whereas that of the control group was 5.39 ± 3.867 (Table 5). Statistical analysis was performed using independent t-test, and a p value of 0.000 (p <0.05) was obtained, suggesting a significant difference in the SAI scores between the treatment and control groups.

Table 1. Characteristics of respondents in terms of age.

| Groups                  | Treatment (n = 18) | Control (n = 18) | p value |
|-------------------------|-------------------|-----------------|---------|
| Median (min–max)        | Median (min–max)  |                  |
| Age (years)             | 31.00 (17–63)     | 32.50 (22–64)   | 0.308*  |

*Mann–Whitney U test

Table 2. Characteristics of respondents in terms of sex, education, and history of tooth extraction and dental treatment.

|                          | Treatment group | Control group | Total | p value |
|--------------------------|-----------------|---------------|-------|---------|
|                          | N   | %   | N   | %   | N   | %   |       |
| Sex                      |     |     |     |     |     |     |       |
| Male                     | 8   | 44.4| 7   | 38.9| 15  | 41.7| 0.735*|
| Female                   | 10  | 55.6| 11  | 61.1| 21  | 58.3|        |
| Education                |     |     |     |     |     |     |       |
| SMP                      | 1   | 5.6 | 1   | 5.6 | 2   | 5.6 | 0.766**|
| SMA                      | 10  | 55.5| 6   | 33.3| 16  | 44.4|        |
| D3/S1                    | 7   | 38.9| 11  | 61.1| 18  | 50.0|        |
| History of tooth extraction |     |     |     |     |     |     | 0.691***|
| None                     | 5   | 27.8| 3   | 16.7| 8   | 22.2|        |
| Yes                      | 13  | 72.2| 15  | 83.3| 28  | 77.8|        |
| Dental treatment         |     |     |     |     |     |     | 1.000*|
| Tooth extraction         | 7   | 38.9| 7   | 38.9| 14  | 38.9|        |
| Odontectomy              | 11  | 61.1| 11  | 61.1| 22  | 61.1|        |

*Chi-square test
**Kolmogorov–Smirnov test
***Fisher’s exact test
Table 3. Mean score from the self-evaluation questionnaire (SAI) of the treatment and control groups before the intervention.

| Group          | Treatment (n = 18) | Control (n = 18) | p value* |
|----------------|-------------------|------------------|----------|
| SAI score      | Mean ± SD         | Mean ± SD        |          |
| Treatment      | 48.06 ± 10.608    | 38.22 ± 9.271    | 0.006**  |
| Control        |                   |                  |          |

*Independent sample t-test ; **p<0.05

Table 4. Comparison of average SAI scores of the treatment and control groups before and after the intervention.

| Group | Initial SAI score Mean ± SD | Final SAI score Mean ± SD | p value* |
|-------|-----------------------------|---------------------------|----------|
| Treatment | 48.33 ± 10.672             | 32.78 ± 7.175             | 0.000**  |
| Control    | 37.94 ± 8.868               | 32.56 ± 8.733             | 0.000**  |

*Paired sample t-test ; **p<0.05

Table 5. Comparison of the average difference in SAI scores of the treatment and control groups before and after the intervention.

| Group          | Treatment (n = 18) | Control (n = 18) | p value* |
|----------------|-------------------|------------------|----------|
| Mean difference in the SAI score | 15.56 ± 7.188 | 5.39 ± 3.867 | 0.000** |

*Independent sample t-test ; **p<0.05

4. Discussion

Studies have not been conducted on the effects of acupuncture in patients with dental anxiety in Indonesia. Moreover, studies on auricular acupuncture that have been conducted in the Western countries have provided significant results on the management of acute anxiety disorders. In the present study, laser puncture was used because it is a non-invasive and painless procedure and can help prevent feelings of anxiety among patients who will undergo dental treatments because it is a needleless procedure [11,15]. Thus, this randomized controlled trial was conducted with an aim to investigate the effects of laser puncture in patients with dental anxiety. A total of 36 patients were included and assessed using the SAI. The participants were divided into two groups—treatment group (18 patients, auricular laser puncture) and control group (18 patients, laser puncture sham). All participants successfully finished the research procedure.

Analyses were performed using variables such as age, sex, education level, the type of dental treatment, and previous history of tooth extraction (p > 0.05), and results showed no significant differences between the treatment and control groups in terms of the baseline characteristics. Previous studies have reported that the psychic vulnerability of individuals with traumatic experience is affected during stressful conditions [16,17]. However, according to the SAI scores before the intervention, not all respondents with a previous history of tooth extraction had a high initial SAI score, whereas some respondents without a history of tooth extraction had a high initial SAI score. Based on the above-mentioned data, genetic susceptibility or stressors, such as dental treatment, may play an important role in triggering anxiety symptoms.
Moreover, t-test was performed, and a p value <0.05 was obtained. Results showed a significant difference in terms of the SAI scores of the treatment and control groups before the intervention. This result is possible because anxiety levels were evaluated using the SAI, which is a tool that assesses an individual’s subjective feelings during stressful conditions [13,18]. The participants provided a self-assessment of their anxiety levels by filling out the SAI. The results varied, and a significant difference was observed in the initial SAI scores of the treatment and control groups. Second, the sample size of the present study was small. A larger sample size provides more equitable randomization results. Thus, the initial SAI scores were not significantly different.

In the treatment group, the mean SAI scores decreased before and after the intervention (48.33 ± 10.672 and 32.78 ± 7.175, respectively), whereas in the control group, the mean SAI scores were 37.94 ± 8.868 and 32.56 ± 8.733 before and after the intervention, respectively. Statistical analyses revealed a significant decrease in the SAI scores before and after the intervention in both groups (p = 0.000). Moreover, the anxiety levels of individuals who underwent laser puncture sham significantly decreased. This may be attributed to the fact that the same treatment was provided and in the control group, the laser pen was not turned. Thus, it may be helpful to turn on the laser pen during the treatment and to let patients rest for 30 min, which may help reduce acute anxiety levels and make patients more calm and relaxed, thereby resulting in lower SAI scores.

The mean difference in the SAI scores of the treatment group was 15.56 ± 7.188 and that in the scores of the control group was 5.39 ± 3.867. Statistical analysis showed a significant difference in terms of the mean difference in the SAI scores of the treatment and control groups (p = 0.000), which suggests that although the control group also experienced a significant decrease in SAI scores before and after the intervention, auricular laser puncture at the depresssing, tranquilizer, and master cerebral points was more effective in reducing the anxiety levels of individuals with dental anxiety than was the laser puncture sham, with the mean difference in the SAI scores being significant (almost three times).

Karst et al. (2007) and Michalek-Sauberer et al. (2012) have conducted studies on auricular acupuncture in individuals with dental anxiety and compared the effects of using the depressing, tranquilizer, and master cerebral points in the ears with other points (finger, heart, shoulder, and tonsil points) as an intervention for their control group. The anxiety levels of patients in the treatment group significantly decreased than those of patients in the control group [4,6]. Both studies also used auricular acupuncture because it is easy to perform. In addition, the method is more practical for patients with dental anxiety. The depressing, tranquilizer, and master cerebral points in the ear were used in the present study because the same points were also used in previous studies and were shown to significantly reduce the anxiety levels. However, needles were used in previous studies [4,6]. In addition, Karst et al. has reported that auricular acupuncture at all three ear points has the same efficacy as midazolam in reducing the anxiety levels [4]. In this study, only auricular laser puncture was used for patients with dental anxiety, and the results were in accordance with those of the studies by Karst et al. and Michalek-Sauberer et al. suggesting that single auricular laser puncture and auricular laser puncture at the depressing, tranquilizer, and master cerebral points were effective and beneficial in managing acute anxiety in patients who will undergo dental treatments.

Laser puncture is a combination of traditional acupuncture and modern treatment methods with lasers [15]. It is non-invasive and is performed by stimulating acupuncture points with low-intensity irradiated laser light [11,15]. In the present study, laser puncture used infrared light with a frequency of 146 Hz, which is in accordance with that used by Noigier and is indicated for psychiatric or psychosomatic disorders [11]. The suppression of the sympathetic nervous system via the modulation of the autonomic nervous system is the mechanism of action involved in auricular laser puncture. As a result, the parasympathetic nervous system becomes more dominant, and the inhibition of noradrenaline production in the adrenal cortex, which results in the sympathetic hyperactivity of the patients, is reduced [19]. In addition, excitation by laser light causes the degranulation of mast cells via the activation of TRPV2 and the increased production of adenosine triphosphate (ATP) [20,21]. ATP and its mediators that are secreted during the degradation of mast cells stimulate the ends of the sensory nerve fibers. Anxiety reactions can occur because of an imbalance in neurotransmitters such as GABA in the brain.
In the studies by Quah-Smith et al. (2010) that used fMRI, laser puncture with infrared light activated the brain’s neocortical limbic areas [23]. Laser puncture stimulation reaches the GABAergic cells in the amygdala and hippocampus that produce GABA and then stimulates the postsynaptic inhibitory transmission [24]. Excitants can also reach the anxiolytic 5-HT1A receptor on the erectorneric cells in the raphe, hippocampus, and amygdala nuclei that produce serotonin and restore serotonin balance. The increase in GABA and serotonin levels reduces the anxiety experienced by a patient. In addition, the hypothalamic aortic pituitary pathway is stimulated, which decreases the level of corticotrophin-releasing hormone and the release of beta endorphins, causing the reduction in noradrenaline and sympathetic activity [19,24]. Beta endorphins also play a role in the modulation of GABA and glutamate activity, which can reduce anxiety [24].

In the present study, none of the patients in the control group experienced any side effect, whereas those in the treatment group presented with some side effects, such as a sense of warmth at two point locations, which occurred in one (5.55%) patient and immediately disappeared after the stimulation, and a sense of drowsiness, which occurred in three (16.7%) patients for 15–20 min after the laser puncture. The thermal effect of the low-intensity laser beam cannot cause any sensation when applied. However, it can be felt by a patient in the form of a warm feeling. Thus, the warmth felt by the respondent can be attributed to the sensitivity of the patient’s skin. However, the drowsiness could have occurred by mere coincidence. The serpentine-stimulating laser puncture may also inhibit the suprachiasmatic nucleus as the circadian rhythm of the circulatory system, resulting in the release of melatonin cells, which cause drowsiness. After the patients underwent tooth extraction and odontectomy, each patient was provided with a questionnaire on laser puncture therapy, which is performed to help individuals manage acute anxiety. Based on the survey results, 11 (30.6%) patients believed that laser puncture therapy was extremely useful, 17 (47.2%) felt that it was quite useful, 5 (13.9%) believed that it was slightly helpful, and 3 (8.3%) did not find it beneficial. In terms of comfort, 10 (27.8%), 21 (58.3%), and 5 (13.9%) patients felt extremely comfortable, quite comfortable, and uncomfortable, respectively. Furthermore, 28 (77.8%) patients said they wanted to undergo laser puncture therapy again, 3 (8.3%) were hesitant, and 5 (13.9%) said no. In general, results showed that the patients believed that laser puncture was useful and comfortable and most respondents were willing to undergo the procedure again to help overcome their anxiety before tooth extraction or odontectomy.

5. Conclusion
Auricular laser puncture at the depressing, tranquilizer, and master cerebral points decreased the anxiety levels of patients who will undergo dental procedures.

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