



Original Research Article

Effectiveness of visual distraction tool in lowering the pain perception and anxiety levels of patients during surgical removal of impacted teeth: A randomized controlled study

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Abstract

Background: Surgical extraction of mandibular third molar has been a routine procedure in dental practice. Most patients often report with anxiety for such procedures which creates significant problems for the patients and dental practitioners. There are various techniques used to distract the patients' attention during clinical procedures. One such distraction tool is the use of virtual reality (VR). The objective of the study was to evaluate the effectiveness of visual distraction tool in lowering the pain perception and anxiety levels of patients during surgical removal of impacted teeth.

Materials and Methods: A Randomised controlled study was carried out over a period of 1 year on patients requiring surgical removal of impacted lower third molar, in the Oral and Maxillofacial Surgery outpatient department. Sixty patients, aged 18-30 years were divided into – study group (VR); control group. Perioperative evaluation of the vital parameters and pain and anxiety levels were tabulated using VAS and MDAS scale. The data obtained was subjected to statistical analysis using SPSS 26.0 software. Independent t-test and paired t-test was used to compare the variables.

Results: Highly significant difference was seen in the study group in terms of VAS and MDAS scale preoperatively and postoperatively at P value of 0.000. There was no statistically significant difference between study and control group at any given interval in terms of VAS and MDAS scale with P value>0.05. Intraoperatively, statistically significant difference was found in blood pressure between study and control group measured during administration of LA injection, bone guttering and closure with p value of 0.05.

Conclusion: The findings of the current study indicate that immersive VR distraction concept applied during impacted mandibular third molar surgery under local anesthesia can help reduce the patients' anxiety and acute pain levels.

Keywords: Behavioral modification, Dental anxiety, Surgical extraction, Virtual reality.

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1. Introduction

Surgical extraction of mandibular third molar has been a routine procedure in daily dental practice. Most patients often report with anxiety for such procedures. Dental anxiety is listed as the fifth most prevalent fear people experience.¹⁻³ The heightened anxiety experienced by patients during tooth extractions is linked to the administration of local anesthetic injections, the oral surgical procedure, and the anticipation of pain after surgery.^{4,5} Different clinical methods have been proposed and put into practice to help reduce dental anxiety in patients undergoing teeth extraction.⁶

Distraction or redirection is thought to divert focus and may help alter the perception of pain and anxiety.^{7,8} These techniques include methods such as relaxation, distraction, exposure therapy, hypnosis, and different forms of cognitive behavioral therapy.⁹⁻¹⁰ One effective distraction method is the use of virtual reality (VR).

Virtual distraction device is an innovative tool that involves a human technology interface utilizing 3D face-mounted displays with an extensive range of view.¹¹ VR generates virtual environments wherein the patients are engaged in a simulated environment that combines the audio,

visual, and kinesthetic sensory modalities sensations to divert the patient's attention into a virtual world, thereby alleviating both pain and stress associated with dental procedures^{12,11} Further, based on how engaging the presented stimuli are, the individual's concentration will be diverted from reality, resulting in less focus on real-world experiences, including painful stimuli.^{13,14}

Numerous studies in the literature emphasize the use of VR headsets to distract children during dental treatments and as a behavioral modification tool in pediatric dentistry.¹⁵⁻²¹ But there is lack of evidence on visual distraction tools and its application in reducing pain and anxiety during surgical removal of impacted teeth in adult patients. The number of studies addressing the management of anxiety and pain, especially during anesthetic block, is very limited. There is no study that has concluded the effectiveness, applicability and feasibility of virtual distraction tools for pain management and anxiety reduction during surgical removal of impacted teeth. The study aims to assess the efficiency of visual distraction tool in minimizing the pain perception and stress levels of individuals undergoing surgical removal of impacted teeth.

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2. Materials and Methods

Following institutional ethical committee approval (8467/IEC/2022), and in accordance with the Helsinki Declaration, this study was carried out for a duration of 1 year in Oral and Maxillofacial Surgery outpatient department on individuals requiring surgical removal of impacted lower third molar.



Figure 1. Following institutional ethical committee approval (8467/IEC/2022), and in accordance with the Helsinki Declaration, this study was carried out for a duration of 1 year in Oral and Maxillofacial Surgery outpatient department on individuals requiring surgical removal of impacted lower third molar.

2.1. Sample size estimation

The sample estimation was done with G-power statistics. Considering an anticipated incidence of around 0.071 to 0.429, with marginal error of 0.196 and a confidence level of 95%, the result suggested that minimum 30 participants were required for each group, leading to a total target sample size of 60.

$$n = (E^2 Z^2 \times p \times (1-p))$$

2.2. Inclusion and exclusion criteria

Patient selection included- age between 18 and 40 years, reporting with horizontally impacted lower third molar teeth (time-consuming and technique-sensitive), and fulfilling ASA criteria I and II. Patients of ASA criteria III and IV, psychiatric disorders, history of claustrophobia, and epilepsy were not considered in this study.



Figure 2. Patient selection included- age between 18 and 40 years, reporting with horizontally impacted lower third molar teeth (time-consuming and technique-sensitive), and fulfilling ASA criteria I and II. Patients of ASA criteria III and IV, psychiatric disorders, history of claustrophobia, and epilepsy were not considered in this study.

Before initiation of surgical procedure, all respondents were explained about the benefits, potential complications

and associated risks. Following this, valid informed consent was obtained from each patient. Participants were then assigned to two groups using computer-generated simple randomization.

1. Group 1: Study group (with the use of VR)
2. Group 2: control group (without the use of VR)

The study group's participants were exposed to Virtual reality technology starting from the administration of local anesthetic solution till closure of the wound. The VR technology consisted of a head-mounted immersive display and built-in headphones that were powered by a smartphone. Patients were shown relaxation videos created specifically for the VR format during the treatment. (Figure 1)

2.3. Surgical procedure

Under aseptic conditions, 2% lignocaine with adrenaline was used to give inferior alveolar nerve block and long buccal nerve block. (Figure 2) Local anesthesia was achieved. With no. 15 blade, standard Ward's incision was placed and the mucoperiosteal flap was elevated with Molt's no. 9 periosteal elevator. Buccal bone guttering was done using 702 bur, following which planned coronectomy was performed and extraction of the sectioned tooth fragment was done with desired armamentarium. Closure achieved by placing simple interrupted sutures with 3-O silk suture.

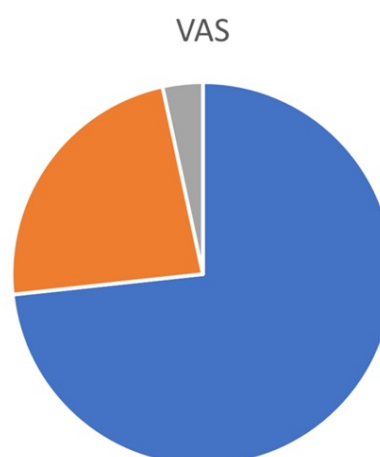


Figure 3. Modified dental anxiety scale of the study group
VAS - Visual Analogue Scale.

2.4. Assessment criteria

All the patients while sitting in the waiting area were asked to fill the preoperative Visual Analogue Scale (VAS), and Modified Dental Anxiety Scale (MDAS) to determine the preoperative pain and anxiety respectively. After completing the questionnaires, preoperative vital signs such heart rate (HR), blood pressure (BP), and oxygen saturation (SPO2) were assessed using pulse oximeter and digital BP apparatus.

Intraoperatively, the vital parameters were monitored during the time of LA administration, incision, bone guttering and closure. Following the surgical extraction, a postoperative VAS and MDAS scale was once more given to the patients to complete.

2.5. Statistical analysis

The data was analysed using SPSS 26.0 software (SPSS Inc., Chicago, IL), with $p < 0.05$ as level of significance. Descriptive statistics were employed to evaluate the mean and standard deviation of each group. For the testing of statistical hypotheses, independent t-test for dependent variables between the study and control group and paired t-test for pre-operative and post operative variables within the groups was used.

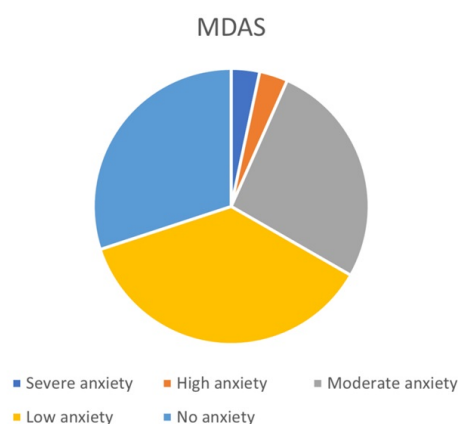


Figure 4. The data was analysed using SPSS 26.0 software (SPSS Inc., Chicago, IL), with $p < 0.05$ as level of significance.

Descriptive statistics were employed to evaluate the mean and standard deviation of each group. For the testing of statistical hypotheses, independent t-test for dependent variables between the study and control group and paired t-test for pre-operative and post operative variables within the groups was used.

MDAS - Modified Dental Anxiety Scale

3. Results

Of the 60 respondents, 33 were male and 27 were female, with an average age of 28 years. Among the respondents, 31 (17-males, 14-females) patients were operated on the left side and 29 (16-males, 13-females) on the right side.

Analysis of VAS scores obtained from patients intraoperatively in the study group has shown that 73.3% of the patients had mild pain, 23.3% patients have moderate pain and 3.4% had severe pain (Figure 3). The MDAS anxiety questionnaire obtained from all the participants of the study group during surgical extraction showed that about 3.33% of the patients had severe anxiety, 3.33% had high; 26.6% had moderate anxiety and about 36.6% of the patients had low anxiety. About 30% said that they were not anxious. (Figure 4)

Statistically, no significant difference was present between the two groups at any given interval in terms of VAS scale with p value > 0.05 . Similarly, no significant difference was evident respect to MDAS scale with p value > 0.05 .

Highly significant difference was present in the study group in terms of VAS scale preoperatively and postoperatively at p value of 0.000. Similarly, in the study group, there was a highly significant difference in the MDAS scale preoperatively and postoperatively with a p value of 0.000. (Table 1)

Intraoperatively, statistically significant difference was found in blood pressure between study and control group measured during administration of LA injection, incision, bone guttering and closure with p value of 0.05. However, there is not statistical difference in heart rate and oxygen saturation between the two groups. (Table 2)

Table 1. Comparison of VAS and MDAS within the study group

Parameter	Mean	N	Std. Deviation	t	p value
Visual analogue scale – Pre	1.8333	15	.53067	4.28	0.000*
Visual analogue scale – Post	1.3000	15	.53498	4.28	0.000*
Modified Dental Anxiety scale – Pre	3.2667	15	1.11211	5.19	0.000*
Modified Dental Anxiety scale – Post	2.1333	15	1.00801	5.19	0.000*

Statistical test applied: Paired samples t test; Asterick denotes highly significant at $p < 0.01$

Table 2. Comparison of intraoperative vital parameters between study and control group

Parameters	Group	N	Mean	Std. Deviation	T	P value
Heart rate	Study group	15	2.4667	.51640	0.00	1.00
Heart rate	Control group	15	2.4667	.51640	0.00	1.00
Oxygen saturation	Study group	15	2.0000	.00000	1.00	0.32
Oxygen saturation	Control group	15	1.9333	.25820	1.00	0.32
Blood pressure	Study group	15	2.4667	.51640	1.96	0.05*
Blood pressure	Control group	15	2.0667	.59362	1.96	0.05*

Statistical test applied: Independent t test. Asterick denotes highly significant at $p < 0.01$

4. Discussion

Dental anxiety can arise from various factors, including past negative experiences, exposure to alarming depictions of dentists by peers, the reclining position in the dental chair, the sight of needles, the sound of drills, and different odors present in the dental clinic.¹³⁻¹⁵ It results in heightened pain perception for the patient, regardless of the anesthetic methods employed^{22,23}. Wong and Lytle et al. reported that endodontic treatment and minor surgical procedures

were recognized as most anxiety-provoking treatments.²⁴ Therefore, a less invasive, safe and simple method should be used to reduce fear and anxiety caused by surgical treatment.²⁵ In this study, we utilized VR technology as a distraction tool to help minimize pain and anxiety during surgical removal of mandibular third molar impaction under local anaesthesia. VR works on the principle that nociception involves a significant cognitive element; by directing less attention to noxious stimuli, individuals may experience reduced pain.¹⁷ Hoffman et al. stated that the part of

brain involved in recognizing and signalling pain exhibit decreased activity when a patient is immersed in a virtual environment.²⁶

Heart rate and blood pressure are frequently used as dependent variables in behavioral studies, serving as parameters for assessing anxiety levels.²⁷ In this study, there was statistical difference found only in blood pressure recorded intraoperatively (p value of 0.05) with VR group showing decreased blood pressure. Similarly, in a study carried out by Alshatrat et al, he reported that intraoperative BP and HR were lower in participants exposed to VR than control or movie group.²⁸ Similar results were observed in a randomised control trial carried out by Pande et al where statistically significant difference was observed in vital parameters after treatment with maximum reduction in the VR group.²⁹ In this study, we found that during surgical extraction, 66.6% of the patients belonging to study group had low anxiety or no anxiety which is in contrast to the study conducted by Abhinav RP et al where he reported that 56% had moderate anxiety.¹³

Although the current study reported that no statistical significant difference was present between the two groups in respect to pain at any given interval but clinically patients with exposure to the VR were more comfortable during and after the surgical extraction of impacted teeth. However, Mladenovic et al stated that the respondents with the use of VR goggles had significantly lower pain values during the administration of anesthesia (p<0.001) as well as throughout the surgical procedure (p = 0.001).²⁵

The limitations of this study include less sample size. The VR technology model employed in this study is both easily accessible as well as straightforward to use. However, it has its own demerits such as huge size, limiting the surgeon's access to the operative field, which in turn prolonged the duration of surgery in the study group.³⁰

5. Conclusion

The study suggests that immersive VR is effective as a distraction tool in reducing pain and stress levels of patients during impacted mandibular third molar surgery. It is user-friendly, cost-effective, and eliminates the necessity for pharmacological agents to manage patient anxiety. In future, a customised VR device exclusively for minor oral surgical procedures need to be developed which will not hinder surgeon's access to the operative field and at the same time will not compromise patient's comfort.

6. Source of Funding

None.

7. Conflict of Interest

None.

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