Utilization of Virtual Reality to Reduce Anxiety in Odontectomy: A Scoping Review

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Abstract

Odontectomy, or wisdom tooth removal, is a common oral surgery that can lead to significant anxiety, affecting patient outcomes and experiences. Virtual reality (VR) has emerged as a potential noninvasive tool for managing anxiety in medical and dental settings. This scoping review explores the effectiveness of VR in reducing anxiety during odontectomy. Following the PRISMA-ScR guidelines, studies published between 2010 and 2024 were searched in PubMed, Scopus, and the Cochrane Library. Three studies met the inclusion criteria, with most showing a significant reduction in patient anxiety when VR was used. Various VR applications, from immersive environments to educational modules, were assessed, with the Visual Analog Scale (VAS) being the most common anxiety measurement. VR shows promise as an anxiety-reducing tool in odontectomy. However, further randomized controlled trials are necessary to evaluate long-term effects and identify the most effective VR content and delivery methods.

Keywords: Virtual Reality, Anxiety, Odontectomy, Dental Surgery.

Introduction

Odontectomy, the surgical removal of impacted wisdom teeth, is among the most commonly performed dental procedures worldwide. While generally considered routine, the process frequently triggers significant anxiety in patients, which can impact both the surgical experience and recovery outcomes. Anxiety in dental settings, particularly during odontectomy, is associated with heightened pain perception, increased stress, and, in some cases, the avoidance of essential dental care, which can exacerbate oral health issues over time. Conventional approaches for addressing preoperative anxiety, such as pre-operative counseling, sedative drugs, and the use of local anesthesia, are commonly employed but come with certain limitations. These methods can vary in effectiveness, and some patients experience adverse effects from sedatives, making alternative approaches worth exploring.[1], [2], [3]

Virtual reality (VR) has recently emerged as an innovative tool for managing perioperative anxiety in various medical and dental settings. VR technology immerses patients in a controlled, virtual environment that distracts them from potentially stressful experiences like surgery. VR can shift a patient's focus from the clinical environment to a calming, immersive experience by engaging multiple senses. This sensory diversion can reduce patients' perceptions of pain and

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anxiety by providing an alternative focus of attention, creating a promising new avenue for noninvasive anxiety management.[4], [5], [6]

Despite growing interest in the use of VR to alleviate anxiety in dental care, there is a gap in the literature regarding its application, specifically in odontectomy procedures. While some studies have evaluated VR's general effects on dental anxiety, focused exploration of its effectiveness for odontectomy-related anxiety is lacking. This scoping review addresses this gap by systematically mapping the current evidence on VR's role in reducing anxiety, specifically for odontectomy patients. The novelty of this review lies in its focused examination of VR interventions tailored to odontectomy, offering insights into how VR can be optimized for this specific dental procedure and identifying key areas for future research.[4], [7], [8]

The objective of this review is to evaluate the effectiveness of virtual reality (VR) in reducing anxiety in patients undergoing odontectomy, with a focus on the outcome measures used in the existing literature.

Methods

Study Design:

This review follows a scoping review methodology based on the framework outlined by Arksey and O'Malley, using the PRISMA-ScR checklist to guide reporting. The scoping review was selected to map the breadth and scope of the available research on VR for anxiety management in odontectomy.

Eligibility Criteria:

Studies were included if they met the following criteria:

1.   Investigated the use of VR in reducing anxiety related to odontectomy.

2.   Published between January 2010 and September 2024.

3.   Peer-reviewed articles written in English.

Exclusion Criteria:

●   Studies focused on dental procedures other than odontectomy.

●   Studies that only examined VR for educational or training purposes rather than patient anxiety.

Search Strategy:

A comprehensive search was conducted using PubMed, Scopus, Cochrane Library, and the EBSCOhost databases. The search strategy included a combination of Medical Subject Headings (MeSH) and free-text terms: "Virtual Reality," "VR," "Anxiety," "Odontectomy," "Dental Anxiety," and "Third Molar Extraction." Reference lists of relevant articles were also manually searched to identify additional studies.

Data Extraction and Synthesis:

Two reviewers independently performed data extraction, with disagreements resolved by consensus. Extracted data included:

●   Study characteristics (year, country, sample size, study design).

- VR interventions (type of VR, duration, content).

- Outcome measures (anxiety scales, patient satisfaction, physiological measures).

- Key findings related to the effectiveness of VR in reducing anxiety.

A sensitivity analysis was conducted to test the robustness of the findings, particularly regarding study inclusion criteria and methodological heterogeneity across studies. This involved reanalyzing data by excluding studies of lower quality or those with smaller sample sizes to assess the stability of the overall conclusions.

The risk of bias was assessed using the Cochrane Risk of Bias Tool for randomized controlled trials (RCTs) and the Newcastle-Ottawa Scale (NOS) for observational studies. Each study was evaluated on domains such as randomization, blinding, participant selection, and outcome reporting. Any high-risk studies were examined for potential impact on the review's overall conclusions.
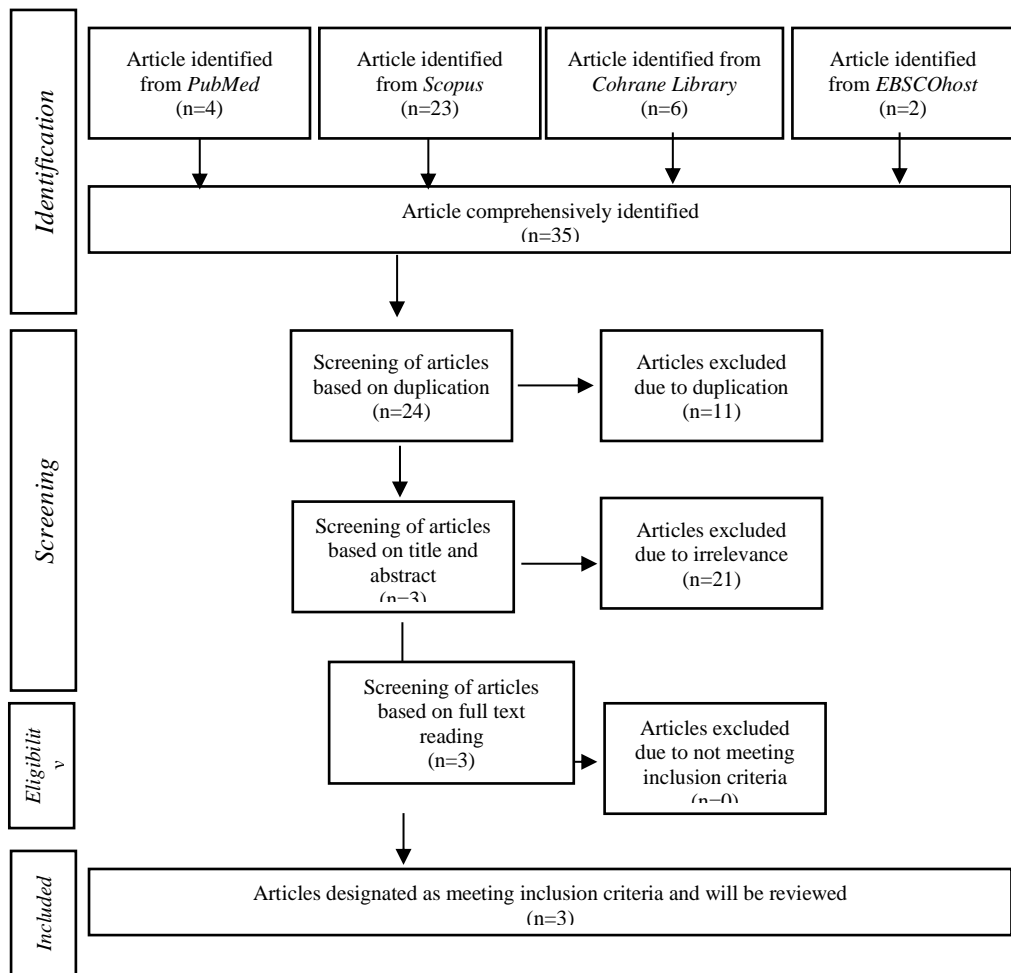
The primary effect measure was the standardized mean difference (SMD) in anxiety reduction between the VR intervention and control groups. Additional effect measures included odds ratios (OR) for binary outcomes, such as patient satisfaction. Confidence intervals (CI) were calculated for all effect estimates to provide an understanding of precision.

Results were synthesized using a thematic synthesis approach. A narrative synthesis was provided for quantitative studies, categorizing findings based on VR intervention types and anxiety outcomes. If qualitative data were present, they were analyzed using thematic coding to identify recurring themes and patterns. Where possible, meta-analyses were conducted using a random-effects model to account for heterogeneity across studies regarding design, intervention type, and outcome measures.

Result

This scoping review aims to determine the effect of virtual reality on reducing anxiety associated with tooth extraction. The article search process was conducted electronically using four predetermined databases, employing predefined keywords, and supplemented with a manual search. A total of 35 articles were obtained from the databases used in the initial search phase, with details as follows: 4 articles from PubMed, 23 articles from Scopus, 6 articles from the Cochrane Library, and 2 articles from EBSCOhost.

The screening was conducted in three stages, starting with the first stage, which involved identifying duplicate articles using tools in the Mendeley software. From this process, 24 articles were retained, and 11 were discarded. The next step was screening based on titles and abstracts, resulting in 3 relevant articles, while 21 articles with irrelevant titles and abstracts were excluded. Subsequently, all articles were read and filtered based on eligibility criteria, resulting in 3 articles that met the inclusion criteria. Thus, 3 articles were selected for further examination. The stages of article selection and screening are illustrated in the PRISMA-ScR flow diagram.

Identification

Article identified from *PubMed* (n=4)	Article identified from *Scopus* (n=23)

Article identified from *Cohrane Library* (n=6)

Article identified from *EBSCOhost* (n=2)

Article comprehensively identified
(n=35)

Screening

Screening of articles based on duplication
(n=24)

→ Articles excluded due to duplication
(n=11)

Screening of articles based on title and abstract
(n=3)

→ Articles excluded due to irrelevance
(n=21)

Eligibility

Screening of articles based on full text reading
(n=3)

→ Articles excluded due to not meeting inclusion criteria
(n=0)

Included

Articles designated as meeting inclusion criteria and will be reviewed
(n=3)

This scoping review limits the inclusion of articles published within the last 15 years (2010–2024), with the first published in 2019 and the most recent article in 2023. The examined articles include 3 randomized controlled trials (including those that combine crossover, prospective, and single-blinded interventional clinical trials). The characteristics of the literature studies reviewed in this research are presented in Table 1.

No.	Author	Year	Title	Research Design
1.	Yamashita *et al*.	2019	Clinical Effect of Virtual Reality to Relieve Anxiety During Impacted Mandibular Third Molar Extraction Under Local Anesthesia	*Randomized controlled trial*
2.	Kösem *et al*.	2021	Effect of virtual reality and music therapy on anxiety and perioperative pain in surgical extraction of impacted third molars	*Randomized controlled trial*
3.	Felemban *et al*.	2023	Effectiveness of virtual reality as a distraction in anxiety and pain during impacted mandibular third molar surgery under local Anesthesia	*Randomized controlled trial*

Table 1. Literature Study Characteristic

The total sample from the three reviewed articles consisted of 449 patients over 20 years old. Only nine articles reported the participants' gender. The participants were patients with systemic and mental health conditions in good standing, without cognitive developmental issues, and without any known allergies and/or sensitivities to local anesthesia.

Three articles with RCT study designs included in this review implemented VR interventions during dental treatments (intraoperative). These three articles also provided VR interventions during local anesthesia and odontectomy procedures. The virtual reality devices used varied, including VR glasses, VR boxes, ANTVR glasses, 3D audiovisual glasses, and headphones.

Discussion

The study highlights that many patients experience significant anxiety related to dental treatments, particularly surgeries involving local anesthesia, such as the extraction of impacted mandibular third molars. Traditional methods for managing this anxiety often involve pharmacological interventions, which may not be suitable for all patients due to potential side effects or contraindications. This underscores the need for alternative approaches to manage anxiety effectively. The findings from the study indicate that VR can serve as an effective tool for reducing anxiety during dental procedures. The results showed a notable decrease in anxiety levels among patients who used VR during their surgery.[9], [10]

The underlying mechanisms by which VR reduces anxiety may involve sensory immersion and cognitive distraction. By engaging multiple senses, VR creates an alternate reality that diverts attention from the clinical setting, potentially leading to lower perceived pain and anxiety levels. This sensory diversion is particularly beneficial in dental procedures, where the clinical environment can evoke fear and discomfort.[11], [12], [13]

Some studies examined physiological indicators such as heart rate variability (HRV) in addition to self-reported anxiety measures. The data indicated a shift from sympathetic dominance (associated with stress) to parasympathetic dominance (indicative of relaxation) during VR use.

This physiological response supports the notion that VR affects psychological states and influences bodily stress responses, contributing to an overall sense of calm.[13], [14], [15]

The review identified three studies that met the inclusion criteria, all reporting significant reductions in anxiety levels when VR was utilized during odontectomy procedures. VR effectively captured changes in patient anxiety before and after the intervention. The findings suggest that VR can serve as a valuable tool for distraction, helping patients shift their focus away from the surgical environment to a more immersive and calming virtual experience.[4], [6], [8]

Despite promising results, the review highlights several limitations of the existing studies. Small sample sizes and methodological heterogeneity challenge generalizing findings across broader populations. Moreover, while VR appears effective in reducing anxiety, its impact on pain perception remains less clear and may vary depending on the specific content of the VR experience. The review calls for further randomized controlled trials to explore these dimensions comprehensively.[8], [10], [16]

Future research should optimize VR content tailored for odontectomy procedures, assess its efficacy in reducing anxiety, and examine its influence on pain management and overall patient satisfaction. Investigating various types of VR applications from immersive environments to educational modules could provide insights into the most effective formats for patient demographics.

Conclusion

In conclusion, this study presents compelling evidence that virtual reality can be an effective adjunctive tool for reducing anxiety in patients undergoing dental surgeries like impacted mandibular third molar extraction. The significant reduction in self-reported anxiety levels and supportive HRV data suggest that VR may enhance patient comfort and experience during procedures typically associated with high levels of fear and discomfort. As healthcare continues to evolve with technological advancements, integrating VR into clinical practice could provide a safe and effective alternative to traditional anxiolytic methods, ultimately improving patient outcomes and satisfaction. Future research should focus on optimizing VR content and exploring its effects on pain management to harness its potential fully in clinical settings.

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