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Protocol

Novel dental anaesthetic and associated devices: a scoping review protocol

Kyung Hyuk Min*, Zac Morse

Department of Oral Health, School of Clinical Sciences, Auckland University of Technology, Auckland, New Zealand

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***Correspondence:**
Kyung Hyuk Min,
E-mail: mkh012895@gmail.com

ABSTRACT

Background: In oral health, local anaesthesia is crucial for managing pain and discomfort. Typically, anaesthesia is administered by injecting an anaesthetic solution using a needle and syringe. However, new technologies have been created to aid oral health therapists in reducing pain and discomfort during local anaesthesia administration. The purpose of this study is to analyse and investigate alternate local anaesthetic delivery systems, such as current equipment, technologies, and associated devices that help reduce injection discomfort. In addition, information gaps and limitations of existing studies will be highlighted to guide future studies. The protocol for scoping available evidence, mapping key concepts, and identifying gaps for future research is detailed in this manuscript.
Methods: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) and Joanna Briggs Institute (JBI) Manual for Evidence Synthesis guidelines were used to create this protocol. Six electronic databases such as MEDLINE, CINAHL, AMED, Dentistry and Oral Science Source, and Scopus, and two other search engines, Google and Google Scholar, will be searched for all relevant primary and secondary studies, grey literature, and other sources relating to new technologies have been developed to assist dentists in providing reduced pain and discomfort when administering local anaesthesia. Two reviewers will independently evaluate the sources retrieved using the eligibility criteria defined by the Population Concept, and Context (PCC) framework. To track the number of identified, included, and excluded sources, a PRISMA-ScR flowchart will be used. A data extraction table will display the extracted data and variables. The synthesised results will be accompanied by narrative explanations.
Conclusions: The findings of this review will be summarised to aid in identifying limitations in existing research and provide guidance and recommendations for future research for health professionals.

Keywords: Computer-controlled anaesthesia, Counter-stimulation, Electronic dental anaesthesia, Dental anaesthetic delivery device, Painless

INTRODUCTION

Patients can link pain and discomfort with oral health care, particularly those with poor dentitions due to multiple tooth extractions, periodontal disease requiring surgery, or symptomatic teeth requiring restorative treatment. General public believes that an experienced oral health professional can do their job with little to no pain. In turn, oral health practitioners define a good anaesthetic as one that allows them to focus entirely on treatment procedures without being distracted by pain-induced patient movements.[1] As a result, an oral health practitioner's daily practises depend on achieving proper and profound local anaesthesia. The prospect of pain during dental treatment and a dislike of needles are frequently cited as major patient concerns.[2]

The international association for the study of pain (ISAP) defines pain as a distressing sensory and emotional experience that is frequently associated with actual or potential bodily or tissue damage.[3] Pain is caused by

nociceptors, which are specialised peripheral sensory neurones that alert us to potentially harmful stimuli of the skin or soft tissue by detecting extremes in temperature, pressure, and injury-related substances and converting this stimulus into long-range electrical impulses that are transmitted to the central nervous system.[4] The intensity of these reactions emphasises the importance of avoiding potentially dangerous situations in order to survive and maintain homoeostasis. The most common method for numbing pain during dental procedures is intraoral administration of local anaesthetics, which has been shown to strongly correlate with pain-related dental phobia.[5] However, this approach is unpleasant because of the pain associated with injections and the perceived threat of needle penetration prior to injections. Patients who reported a high level of dental anxiety were also concerned about receiving oral injections, implying a link between high levels of dental anxiety, and missed or delayed appointments.[6] This article makes evident that poor pain management leads to fear and dental anxiety, which is a significant challenge for oral health practitioners to overcome because it can lead to dental avoidance and neglect.

In the field of oral health, managing pain and discomfort is critical because they act as impediments to providing patients with effective dental care.[7] Oral health practitioners who fail to manage pain and discomfort effectively may instil fear and a negative attitude towards dental treatment. As a result, treating patients with as little discomfort and pain as possible is an essential component of modern oral health therapy. Developing and creating new pain-relieving techniques and devices is critical to achieving an overall positive experience.

Local anaesthesia is still the foundation and an essential skill required of dental practitioners when it comes to pain control in dentistry.[8] However, local anaesthesia also contributes to the patient's fear and anxiety. Although local anaesthesia is used to anaesthetise the surrounding tissue so that a patient does not feel pain during dental procedures, the patient's reaction to local anaesthesia before and during administration creates an unpleasant patient experience.[5] Many studies investigated techniques for reducing pain during injections, such as slow injection rates, warming solution before administering it, narrow or sharp needles, and so on.[9] Despite all previous research to reduce pain during needle administration, an entirely painless injection is nearly impossible.[9] In this light, alternative methods, supplementary aids, and devices received increased attention in order to reduce painful experience of administering dental local anaesthesia.

The most common form of local anaesthesia in oral health is a syringe, needle, and cartridge containing the anaesthetic drug in solution form.[5] The depth of the needle inserted, the flow rate of the administered anaesthetic solution, and the temperature all contribute to discomfort and pain.[5] As a result, many researchers have continued investigating and developing alternative methods of delivering anaesthesia without using needle.[10] C-CLAD/ computer-controlled local anaesthesia delivery, comprises a microprocessor and an electrically controlled motor. C-CLAD allows for the adjustment of volume, pressure, and speed of the solution to be administered, which ideally aids in the reduction of pain prior to and during administration of local anaesthetic.[11] Many studies have been conducted over time that compared the traditional dental needle with a syringe and discovered that C-CLAD devices superior in reducing pain.[5]

Although several narrowly focused studies have reported the effectiveness of C-CLAD devices compared with conventional needles and syringe dental anaesthesia, other new technologies and associated devices to reduce discomfort and pain when administering dental anaesthesia have not been investigated. Although conventional local anaesthesia makes it possible to achieve an acceptable level of pain control during a dental procedure, administering conventional local anaesthesia, whether in preparation for or during the procedure itself, simultaneously causes discomfort and pain. As a result, this review aims to conduct additional research on and compile documentation regarding the various kinds of local anaesthesia and associated devices that are currently on the market and that help reduce the amount of pain experienced prior to and during the placement of dental local anaesthetic. The review will also help provide a clearer view of the effectiveness, advantages, and disadvantages of each currently available device by mapping out the various available devices through this research. In addition to this it will investigate recommendations for future research and analyse research gaps present in existing body of literature.

METHODS

The protocol and scoping review will adhere to the principles outlined in the PRISMA-ScR and JBI Manual for Evidence Synthesis.[12, 13]

On 20th of July 2022, a preliminary search of MEDLINE, Cochrane Database of Systematic Reviews, JBI Evidence Synthesis, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and PubMed revealed that no existing scoping review of alternative local anaesthetic delivery systems such as current equipment, technologies, and associated devices that help reduce injection discomfort, has been identified or is currently underway.

Eligible criteria

This scoping review will concentrate on studies evaluating alternative local anaesthetic delivery systems, such as current equipment, technologies, and associated devices that help reduce injection discomfort, to identify gaps in existing evidence. JBI's Population, Concept, and Context (PCC) framework defines the eligibility criteria for existing literature.[13] Any excluded studies will be displayed in the PRISMA flow diagram (Figure 1).[14]

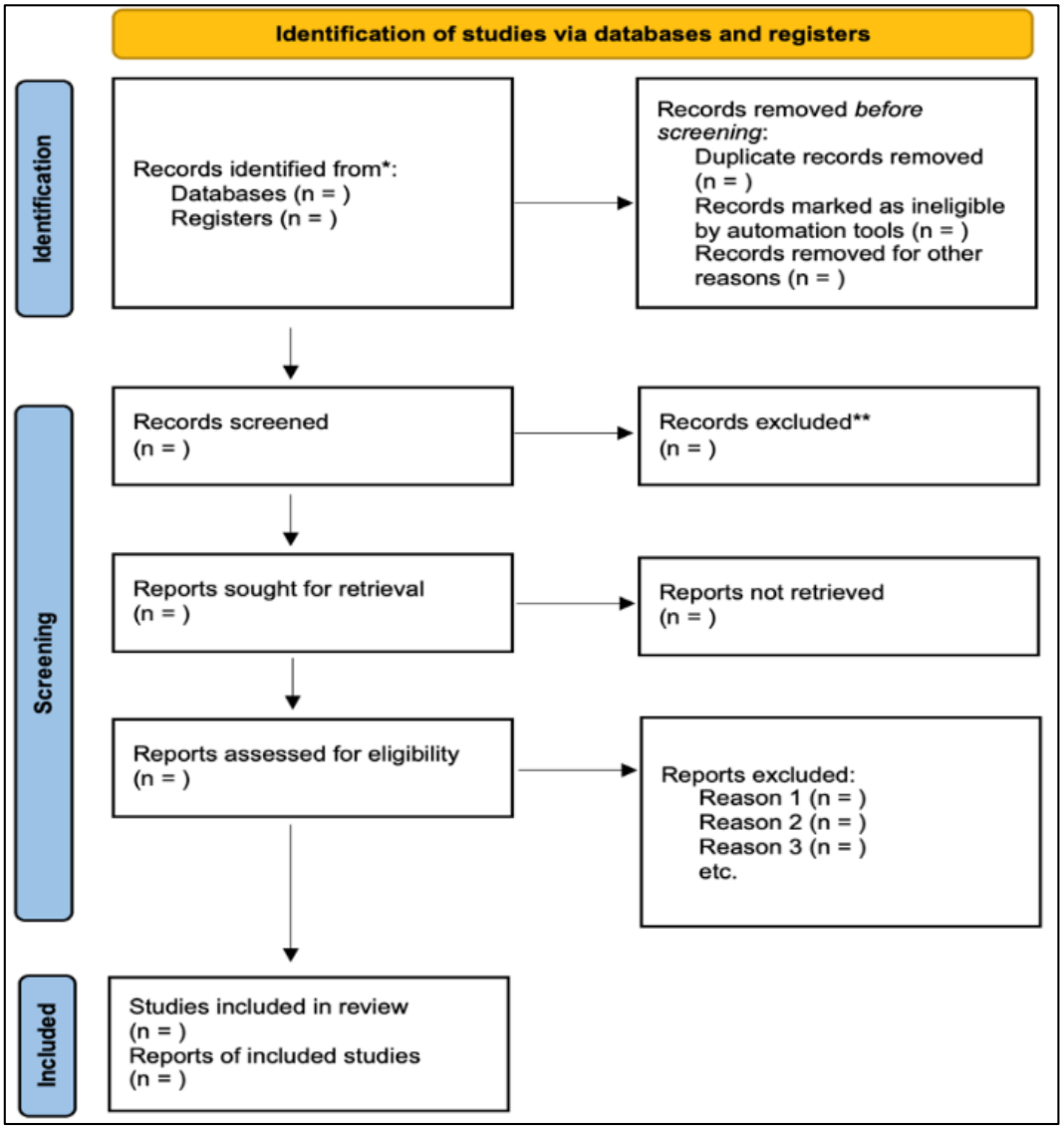

Figure 1: The PRISMA 2020 Flow diagram for systematic reviews.

Inclusion criteria

Population

Human participants of all age groups that have been administered with alternative local anaesthetic devices, including associated devices that aid in reducing pain or discomfort when administering local anaesthesia.

Concept

Any alternative local anaesthetic delivery systems or associated devices that aid in reducing discomfort prior to and during the administration of local anaesthesia.

Context

The context of the review is not limited to any geographical location, settings, ethnicity, culture, age, or gender factors.

Types of evidence sources

Review will include sources of information from primary and secondary research studies, reviews, guidelines, websites, reports and grey literature until Nov 2022.

Exclusion criteria

Primary and secondary studies, guidelines, webpages, and reports that examined needless jet-injector systems will not be included in the scoping review. Studies, letters, blogs, book reviews, editorials, commentaries, and brochures in languages other than English will be excluded from this study.

Search strategy

JBI recommends a three-step search strategy for scoping reviews.[13] The following databases were used for an initial, limited search: EBSCOHost (Dentistry and Oral

Sciences Source, CINAHL, MEDLINE) and Scopus. The text words included in the title, abstract, and index terms of the retrieved articles were then analysed.

A librarian with expertise in the field of health sciences was engaged before the second search began. This enabled the development of a comprehensive search strategy using identified keywords and index terms that can be integrated into databases for the second search using EBSCOHost (Dentistry and Oral Sciences Source, CINAHL, MEDLINE), Scopus, and Cochrane Library. This was done to ensure consistency across databases and to obtain a "fixed" number of identified sources, which will be presented in a PRISMA flow diagram during the final review (e.g., Figure 1).[14]

Additional sources will be searched from the reference list of all identified reports and articles that have been included in the review for the third search.

Grey literature will also be searched from the following sources: Google and Google Scholar. The first 100 items on Google and the first 100 sources on Google Scholar will be screened for eligible studies.

Comprehensive electronic strategy for EBSCOHost. This strategy will used throughout database (Table 1).

Table 1: Search strategy.

Search strategy	
#1	Anesthesia delivery system device or anaesthesia delivery system or computer-delivery anesthesia or computer-delivery anaesthesia or computerized local anesthesia or computerized local anaesthesia or computerized local anesthesia delivery systems or computerized local anaesthesia delivery systems or computerized local anesthetic delivery systems or computerized local aesthetic delivery systems or computer-controlled local anesthetic device or computer-controlled local anaesthetic device or cclad or wand injection system or wand or quicksleeper or calaject or smartject or morpheus or computer or comfort control syringe or anaeject or electronic anesthesia or electronic anaesthesia or single tooth anesthesia OR single tooth anaesthesia or single tooth anesthesia system or single tooth anaesthesia system or sta/ sta system or vibraject or dental vibe or counter-stimulation dental anaesthesia/ counter-stimulation local anaesthesia
#2	(pain* or discomfort) N3 (reduc* or control* or eliminat* or perception or perceive* or lower* or injection)
#3	#1 and #2

Selection of source of evidence

After the search is completed, all identified studies will be uploaded to Rayyan, a web-based collaboration and research tool, and duplicates will be removed.

The title and abstracts identified by the search strategy will be screened concurrently by two reviewers, and eligibility will be determined using the review's inclusion and exclusion criteria. Furthermore, the full text and citation details of potentially relevant sources will be retrieved for further review by both reviewers. Any disagreements that arise during the data selection and extraction process will be communicated and discussed between the two parties until they reach an agreement. If an agreement cannot be reached, a third party will decide.

Reasons for excluding full-text sources of evidence that do not meet the inclusion criteria will be documented and reported in the scoping review. The search results and the study inclusion process will be presented in a PRISMA-ScR flow diagram in the final scoping review (Figure 1).

Data extraction

The reviewers' designed data extraction table (Table 2) will be used to record and assimilate extracted data from eligible sources. The first reviewer will use the data extraction table to extract all relevant information and variables, and the second reviewer will confirm and verify the accuracy of the data collected. If unexpected valuable data can be charted during the charting process, the reviewers may revise the data extraction table. Modifications to the data extraction table will be documented and reported during the scoping review. Any disagreements that arise during the data extraction process will be resolved through dialogue between the two reviewers.

Table 2: Data extraction table.

Characteristics	Data
First author, date	
Study design	
Aims and objectives	
Population (If applicable)	
Methodology	
Data analysis methods	
Main findings	
Limitations (If required)	
Recommendations (if applicable)	

The authors intend to provide a broad overview of existing research studies rather than be limited by critically appraising the risk of bias in evidence, so an assessment of the risk of bias in evidence will not be performed.

Synthesis of results

In relation to the review question and objective, the results of the included sources will be summarised in a descriptive format. Furthermore, the characteristics of the

included sources concerning the research question and objective will be discussed.

DISCUSSION

No scoping review has been conducted on alternative local anaesthetic delivery systems, such as current equipment, technologies, and associated devices that help reduce dental injection discomfort. This study's literature search will be conducted over seven databases. The protocol's limitations are that only sources available in English will be included, potentially restricting information. A strength of this study is that the protocol adheres to the PRISMA-ScR and JBI guidelines.[13] The findings will be summarised and expanded upon in a discussion that may benefit clinical practitioners and guide future research on this topic.

CONCLUSION

Although several narrowly focused studies have reported the effectiveness of C-CLAD devices compared with conventional needle and syringe dental anaesthesia, other new technologies and associated devices to reduce discomfort and pain when administering dental anaesthesia have not been researched comprehensively as a scoping review. Although conventional local anaesthesia makes it possible to achieve an acceptable level of pain control during dental procedures, administering conventional local anaesthesia, whether in preparation for or during the procedure itself, simultaneously causes discomfort and pain. As a result, this review aims to conduct additional research on and compile documentation regarding the various kinds of local anaesthesia and associated devices that are currently on the market and that help reduce the amount of pain experienced prior to and during the placement of dental local anaesthetic. It will also help provide a clearer view of the effectiveness, advantages, and disadvantages of each currently available device by mapping out the various available devices. Additionally, the review will analyse the research gaps in the existing body of literature to provide recommendations for future research.

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