The Saudi Dental Journal 36 (2024) 1066–1071

Contents lists available at ScienceDirect

The Saudi Dental Journal

journal homepage: www.ksu.edu.sa
www.sciencedirect.com

Review Article

Computer-Controlled Local Anaesthesia Delivery efficacy – a literature review

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ARTICLE INFO

Keywords:
CCLAD
Local anaesthesia
Pain

ABSTRACT

Minimising pain with effective local anaesthesia is an essential step towards improving the level of dentally anxious patients' comfort during dental treatment. It can be provided by many different techniques. One of them is using the Computer-Controlled Local Anaesthesia Delivery systems (CCLADs). This study was conducted to compare the efficacy of computerised anaesthesia with the conventional technique in terms of perceived pain. A database literature search was performed on PubMed, Cochrane Library and Google Scholar, covering up the period between 2015 and 2023. Only the studies comparing computerised anaesthesia technique with the use of conventional carpule were included. An overview of 20 relevant studies (n = 1347 subjects) was provided including pediatric patients, as well as the adults. The evaluated parameters were: pain, child's behaviour, heart rate, blood pressure, level of satisfaction, anxiety, further anaesthesia method preference, need for additional anaesthetic, as well as the duration of anaesthesia, measured by different scales, devices and questionnaires. The present literature review led the authors to the conclusion, that the use of CCLADs is significantly less painful than the traditional anaesthesia and it is a promising technique for helping patients deal with pain perception. However, it is advisable to conduct further research on the use of CCLAD.

1. Introduction

The avoidance of dental treatment is often caused by fear of pain. Chapman et al.'s study identified five factors that contribute to the development and persistence of dental fear: fear of pain or anticipation of it, lack of trust or fear of betrayal, loss of control, fear of the unknown, and fear of intrusion.

Previous studies have proposed and demonstrated the existence of a vicious circle of dental fear. This theory suggests that individuals who fear dental procedures tend to avoid visiting the dentist. It is important to note that it is not universally accepted and some experts argue that it oversimplifies the complex nature of dental fear. This avoidance can result in decreased oral health and the development of dental pain. Consequently, more invasive treatments may be required during eventual dental visits, which can further increase their fear. Dental fear can develop at any stage of life, including childhood, adolescence, or adulthood (Silveira et al., 2021). The fear of injections is the most common source of fear among children (Rath and Sujata, 2021). In a study of adult respondents, 70 % reported being either very (19.7 %) or extremely (50.3 %) anxious about local anaesthetic injections (Yu et al., 2021).

As many dental procedures involve local anaesthesia, it is crucial to choose the most comfortable technique for the patient. Over the years, there has been a great deal of research aimed at finding a technique to reduce the discomfort associated with local anaesthesia. Neither warming or buffering of the anaesthetic (Colaric et al., 1998) nor pressure anaesthesia (J Johnson and RE Primosch, 2003) achieved the expected level of pain reduction. Finally, in 1997, Milestone Scientific Inc (Livingston, NJ, USA) invented the first Computer-Controlled Local Anaesthesia Delivery system (CCLADs) – the Wand. Other devices such as Quicksleeper (Dental Hi Tec, Cholet, France), Calaject (RØNVIG Dental Mfg. A/S, Daugaard, Denmark), Smartject (KMG, Jin-Gu, South Korea) or Morpheus (Meibach Tech Ltda., São Paulo, SP, Brasil) have come on the market over time. Each of these systems has a different injection speed, design, shape and weight, allowing dentists to choose a system that best suits their needs. Most of these systems consist of a

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https://doi.org/10.1016/j.sdentj.2024.05.012
Received 30 November 2023; Received in revised form 27 May 2024; Accepted 29 May 2024
Available online 31 May 2024

computer-controlled unit, a handpiece component and a foot pedal. The lightweight, pen-like handpiece allows for more controlled insertion of the needle, which improves patient comfort and reduces the perception of pain and therefore fear of injection (Clark and Yagiela, 2010). They also have a less threatening visual appearance, as the needle is close to the pen handle (Dempsy Chengappa and Prashanth, 2022; Violaine Smaïl-Faugeron et al., 2019). CCLADs allow the technology to automatically deliver the local anaesthetic solution at a constant pressure and slow rate, regardless of tissue resistance (AM Palm et al., 2004; Clark and Yagiela, 2010; Dempsy Chengappa and Prashanth, 2022; Violaine Smaïl-Faugeron et al., 2019; Wand Milestone Scientific, 1998; Yenisey, 2009). The slow flow setting allows the drops of solution to anaesthetise the tissue immediately in front of the needle, resulting in a potentially imperceptible injection (Versloot et al., 2005; Yenisey, 2009). Such devices can be used for all local anaesthetic techniques (AM Palm et al., 2004).

The use of CCLADs also involves a number of disadvantages, such as higher cost, longer time to administer the drug, more space needed to store the device, and its complexity compared to the traditional injection syringe (Violaine Smaïl-Faugeron et al., 2019). This review focuses on Computer-Controlled Local Anaesthesia Delivery systems (CCLADs) versus traditional carpule anaesthesia in terms of perceived pain.

2. Material and methods

2.1. Information source

A literature search was performed in such databases as PubMed, Cochrane Library and Google Scholar, using the keywords: „CCLAD" AND „local anaesthesia" AND „pain". The inclusion criteria were clinical studies comparing CCLADs and conventional anaesthesia in terms of perceived pain, written in English published between 2015—2023. The exclusion criteria were case reports, studies not performing both techniques on one patient and using other types of anaesthetic devices.

2.2. Article eligibility

After the removal of duplicated studies, 135 studies were selected for the title and abstract screening and after the screening, 92 studies were excluded as they did not fulfil the inclusion criteria [Table 1]. The remaining 43 studies were selected for full-text screening and out of the 43 studies, 20 articles were selected as they met the eligibility criteria and were included in the review, including 12 studies among children and 8 studies among adults [Fig. 1].

2.3 Data collection

The following data was extracted from each report: the authors, the year of publication; the sample size, age and gender; CCLAD device, the type of anaesthesia, the anaesthetic solution, the type of the treatment; evaluated parameters [Table 2, Table 3,].

3. Results

3.1. Studies on children

A total of 979 paediatric patients aged between 5 and 15 years old participated in 13 considered studies. The system used in most of the trials was The Wand. The others were respectively No Pain III, Quicksleeper and SleeperOne. El Hachem et al. observed that there was no significant difference between conventional and computerised anaesthesia neither in terms of pain nor in terms of disruptive behaviour. Moreover, the results of their study indicate that all patients demonstrated a higher heart rate at rest in the second session regardless of the injection technique received first. Chavhan et al. also noted no significant difference between both techniques in terms of pain perception and heart rate in the 6 and 9 year old age groups. However, in the group of 12-year-olds mean pain perception was significantly higher for the conventional technique (mean VAS score 2,12 ± 2,32) than for the CCLAD (mean VAS score 1,40 ± 1,71). A similar results were observed among all age groups of girls (mean VAS score for CCLAD 2,05 ± 2,34; mean VAS score for the traditional technique 2,55 ± 2,99). Mean heart rate scores among girls was significantly higher with the conventional technique (108,37 ± 18,75) than for the CCLAD (105,33 ± 15,38) as well.

Most of the considered studies showed significant differences between computerised anaesthesia and the conventional technique in terms of pain perception (Dempsy Chengappa and Prashanth, 2022; Helmy et al., 2022; Marina Consuelo Vitale et al., 2023; Violaine Smaïl-Faugeron et al., 2019), increase of systolic blood pressure and respiratory rate (Shetty et al., 2022), as well as the post-injection heart rate increase (Garret-Bernardin et al., 2017; Mittal et al., 2019; Patini et al., 2018; Thoppe-Dhamodhara et al., 2015), where CCLADs performed better. Furthermore, Garret-Bernardin et al.'s study showed that there was a significant mean reduction of 1,09 VAS points with CCLAD in comparison to traditional technique, for which additionally 61,2% of the patients had on average 3,4 beats per minute (BPM) higher heart rate after the injection. In their study 56,7% of the subjects pointed out the traditional technique as a more painful one and there was a significant mean reduction of 1,09 points on the scale of patient satisfaction with the mentioned technique in comparison to CCLAD. In a 2015 study of Mittal et al. it was observed that computerised anaesthesia provided significantly less painful injection (mean VAS score 2,94 ± 1,35 vs 2,38 ± 1,23) in palatal infiltration, while in buccal infiltration no significant differences were noted. In a 2019 study, Mittal et al. reported that the maxillary injections showed significantly higher heart rate values with conventional injections versus CCLAD (110,1 ± 13,6 vs 102,3 ± 12) in contrast to both arches analysed together, when no significant difference was found. Higher heart rate values in the maxillary arch could be due to more injection sites (3, as compared to 2 in the mandibular arch) and the fact that the palatal injection might be more painful than the buccal injections. Corresponding results were observed while analysing primary second molars separately – mean heart rate value for the conventional technique was significantly higher (110,4 ± 11,5 vs 102,9 ± 10,7). This difference could be attributed to the anatomical features of the second molar that can lead to difficulty in positioning of the needle with the conventional intraligamental anaesthesia technique, whereas correct position might be easier to achieve and maintain with the CCLADs as a result of the informing sound signals (Wand Milestone Scientific, 1998). Additionally, Vitale et al. reported that significantly higher pain scores were observed in the deciduous teeth (mean VAS score for CCLAD 6,00 ± 2,00 traditional 6,29 ± 2,14), as compared to the mixed dentition (CCLAD 1,78 ± 1,28 traditional 3,00 ± 1,73). Similar results were noted while analysing age groups, where 5—10 year olds showed higher pain levels, than a 10—15 age group. Perugia et al. noticed that for all permanent teeth the estimated positive response percentages to the anaesthetics administration after 0, 10, 20 and 40 min were observed as follows: 88 %, 96 %, 96 % and 96 % in computerised system group, while the results of 56 %, 64 %, 76 % and 72 % were observed in the traditional carpule group. In the study of Dempsy-Chengappa and Prashanth a 46,09 % of change in terms of fear decrease was observed from pretest to post-test in the CCLAD group, while in the conventional group no significant difference was shown.

Table 1
Articles eligibility criteria.

Inclusion criteria	Exclusion criteria
Clinical studies comparing CCLADs and conventional anaesthesia in terms of perceived pain	Case reports
Publication between 2015 and 2022	Publication before 2015
English language	Language other than English

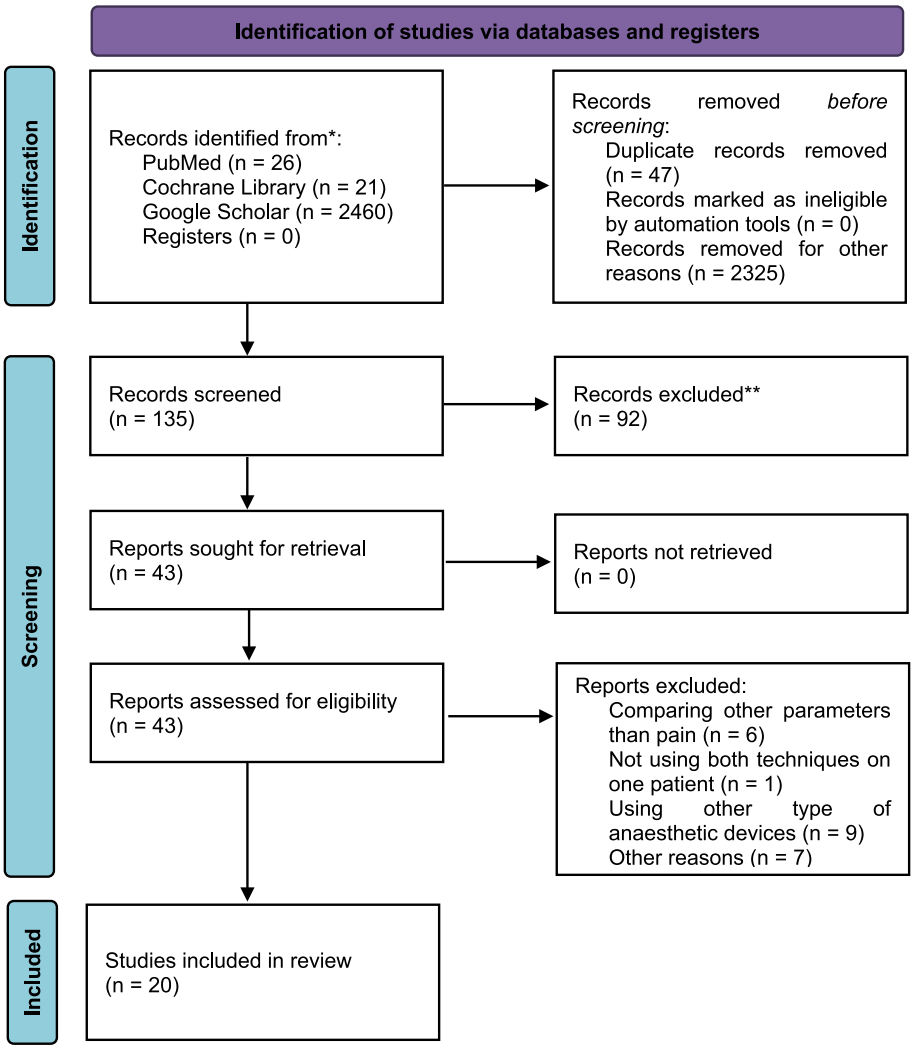

Fig. 1. Selection process flowchart.

Moreover, a significant difference in patients' fear perception was reported between CCLAD and the traditional group in the pretest (CCLAD 2,88 ± 1,01 traditional 3,65 ± 0,92), as well as the post-test CFSS-DS scores (CCLAD 1,55 ± 0,74 traditional 3,73 ± 1,03), where CCLAD turned out to be less threatening. Helmy et al. observed significantly lower scores in the heart rate in the CCLAD group during injection (104,64 ± 12,04 vs 113,48 ± 16,66), whereas no significant difference was recorded during extraction. Additionally, intergroup comparisons revealed a significant increase in mean heart rate from baseline to injection in each group.

3.2. Studies on adults

A total of 468 patients aged between 18 and 79 years old participated in 8 considered studies among adults. With respect to devices, The Wand, Morpheus, Calaject, Smartject, Dentapen and Quicksleeper were used. There was no significant difference in perceived pain in Araújo i Flisfisch's studies as well as in hemodynamic parameters' changes and patient satisfaction in Berrendero's studies between both techniques. Although Flisfisch et al. observed no significant differences in duration of anaesthesia, the researchers noted that the patients' preferences for a particular system was altered significantly with time. Immediately after treatment 45 % of the patients preferred computerised anaesthesia and 20 % chose the traditional carpule, yet after the reflection time 60 % of the patients preferred CCLAD devices, while 10 % preferred the conventional anaesthesia. Additionally, a positive correlation between pain during administration and anxiety score was noted.

Attia et al. reported no significant difference in pain perception on puncture and the score in Dental Anxiety Scale between two techniques, in contrast to the pain perception during injection, where the CCLAD performed better (1,65 ± 1,93 vs 2,49 ± 2,31).

The other part of the studies showed that mean perceived pain was significantly lower for CCLAD in comparison with the conventional technique (Aggarwal et al., 2018; Berrendero et al., 2021; Ghaderi and Ahmadbeigi, 2018; O'Neal et al., 2022). Aggarwal et al. reported corresponding results in terms of pain perceived during drug administration (mean VAS score for traditional technique 14,51 ± 15,40; CCLAD 11,24 ± 14,25), immediately after the injection (mean VAS score for traditional technique 6.23 ± 9.40; CCLAD 3.86 ± 8.86) and at the completion of periodontal procedures (mean VAS score for traditional technique 1.78 ± 4.51; CCLAD 0.96 ± 4.71). In contrast, there were no significant differences in pain during needle insertion. 64,4% of the patients preferred computerised anaesthesia, 32,5% chose the traditional carpules, while 2,9% were indifferent. Likewise, patients in the study of Pol et al. demonstrated a preference of 67 % for the CCLAD, 20 % for the conventional method and 13 % had no preferences. O'Neal et al. also reported higher patients' preference for CCLAD in the number of 75 %.

Berrendero et al. noted that the mean VAS score for the conventional method was 3,73 ± 1,55 – significantly higher than CCLAD (1,95 ±

Table 2
Data collected from studies among children. W – number of girls, M – number of boys, VAS – Visual Analogue Scale, HR – heart rate, CFSS-DS – Children's Fear Survey Schedule – Dental Subscale, SEM – Sound, Eye, Motor, NVRS – Numerical Visual Rating Scale, FLACC – Face Legs Activity Cry Consolability, mFIS – modified Facial Image Scale, IANB – inferior alveolar nerve block, FPS – Face Pain Scale, BP – blood pressure, RR – respiratory rate.

Studies among children							
Author	**Publication year**	**Age, number, gender of patients**	**Device**	**Type of anaesthesia**	**Anaesthetic solution**	**Treatment**	**Evaluated parameters**
Chavhan et al.	2019	6—12, 106 W: 46 M: 60	The Wand	Infiltration	2 % lidocaine + adrenaline 1:80 000	Dental treatment	Pain (VAS scale), HR
Dempsy Chengappa et al.	2022	6—13, 80 W: 40 M: 40	The Wand	Infiltration	Not mentioned	Minor paediatric dental procedures	Pain (Wong Baker scale), anxiety and fear (CFSS-DS)
Helmy et al.	2022	5—7, 50 W: 29 M:21	The Wand	CCLAD: intraligamental Traditional: IANB	4 % articaine + adrenaline 1:100 000	Extraction of mandibular primary molars	Pain (FPS, SEM scale), HR
El Hachem et al.	2019	6—8, 30 W: 12 M: 18	The Wand	Infiltration	2 % mepivacaine + adrenaline 1:100 000	Primary maxillary molars pulpotomy	Pain (VAS scale), child's behaviour (Frankl scale), HR
Garret-Bernardin et al.	2017	7—15, 67 W: 29 M: 38	The Wand	Infiltration	2 % mepivavaine + adrenaline 1:100 000	Conservative treatment, extraction	Pain (VAS scale), HR, level of collaboration (modified Venham scale), level of satisfaction (10-point scale)
Mittal et al.	2015	8 – 13, 100 W: 46 M: 54	The Wand	Infiltration	2 % lidocaine + adrenaline 1:80 000	Extraction of maxillary primary molars	Pain (VAS scale, SEM scale), HR
Mittal et al.	2019	6—13, 82 W: 35 M: 47	The Wand	CCLAD: infiltration Traditional: intraligamental	2 % lidocaine + adrenaline 1:80 000	Primary molar extraction	Pain (SEM scale, FPS-R scale), HR
Patini et al.	2018	5—12, 76 W: 38 M: 38	The Wand	Intraligamental	2 % mepivavaine + adrenaline 1:100 000	Extraction	Pain (NVRS scale), HR
Perugia et al.	2017	5—13, 50 W: 24 M: 26	The Wand	Infiltration, intraligamental	2 % lidocaine + adrenaline 1:100 000	Restorative treatment, primary and secondary molars extractions	Pain (2-point scale), child's behaviour (descriptive assessment)
Shetty et al.	2022	6—12, 30 W: 16 M: 14	No Pain III	IANB	2 % lidocaine + adrenaline 1:80 000	Dental treatment	Pain (Wong Baker scale), HR, BP, RR
Smaïl-Faugeron et al.	2019	7—15, 158 W: 81 M: 77	Quicksleeper	CCLAD: intraosseous Traditional: infiltration	4 % articaine + adrenaline 1:200 000	First permanent molars deep caries and MIH lesions treatment	Pain (VAS scale), duration of anaesthesia, need for additional anaesthetic
Thoppe-Dhamodhara et al.	2015	7—11, 120 W: 49 M: 71	The Wand	Infiltration	2 % lidocaine + adrenaline 1:100 000	Operative procedure	Child's behaviour (FLACC), pain (mFIS scale), HR, blood pressure
Vitale et al.	2022	5—15, 30 W: 14 M: 16	SleeperOne	Infiltration	4 % articaine + adrenaline 1:100 000	Restorative treatment of primary teeth	Pain (VAS scale, Wong Baker scale)

0,53). 92,5% of the patients preferred computerised anaesthesia, while the rest didn't have any preferences. Ghaderi et al.'s study showed similar results – mean VAS score for the conventional method was 24 ± 12,1 and for the CCLAD 14,5 ± 7,4.

It was observed by Pol et al. that although the time required to administer the conventional block (125 ± 44 s) was significantly shorter than for the alternative method (180 ± 0 s), it was the alternative technique that had a significantly shorter latency period (immediate effect vs 6 ± 4 min). Additionally, the amount of solution injected to obtain anaesthesia was significantly lower for the CCLAD (1,84 ± 0,28 vials) than for the conventional block (2,08 ± 0,24). On the other hand, a significant difference in heart rate increase during infiltration was noted, where CCLAD induced a higher increase than the conventional technique (22 ± 10 BPM vs 5 ± 13 BPM).

As regards anxiety inducement of the device's appearance, Aggarwal as well as Flisfisch noted significant differences. Mean scores in 5-point scale of fear in Aggarwal's study were 1,01 ± 1,02 for the traditional technique and 0,78 ± 0,91 for CCLAD respectively. Similar results were shown in the Flisfisch study in case of men and patients with high dental fear. Therefore, a significant positive association was detected between mean visual impression score and gender, as well as anxiety score.

4. Discussion

The purpose of this paper is to review the data on pain associated with anaesthesia with computerised systems compared to conventional injection. Seven of the considered studies showed significantly lower pain levels during drug administration (Aggarwal et al., 2018; Berrendero et al., 2021; Flisfisch et al., 2021; Garret-Bernardin et al., 2017; Ghaderi and Ahmadbeigi, 2018; Mittal et al., 2019, 2015), as well as connected with the treatment (Aggarwal et al., 2018; Mittal et al., 2019) for the computerised anaesthesia, compared with the conventional technique. Perugia et al. reported a higher percentage of complete anaesthetic effect with the computerised technique. However, two other studies (Aggarwal et al., 2018; Flisfisch et al., 2021) found no significant difference in pain during mucosal puncture. Araujo's study showed higher mean pain variables for the conventional technique compared to the computerised one, but the difference was not statistically significant. One study noted no significant difference between the techniques for all assessed parameters (C El Hachem et al., 2019). However, Chavhan et al. reported significantly lower pain levels associated with CCLAD in the 12-year-old group in contrast to the other patient groups. Similarly, Thoppe-Dhamodhara et al. observed corresponding results during the second visit, but no significant difference during the first visit.

Before drawing meaningful interpretations of the results, it is

Table 3
Data collected from studies among adults. W – number of women, M – number of men, VAS – Visual Analogue Scale, HR – heart rate, IAN – inferior alveolar nerve, IANB – inferior alveolar nerve block.

Studies among adults							
Author	**Publication year**	**Age, number, gender of patients**	**Device**	**Type of anaesthesia**	**Anaesthetic solution**	**Treatment**	**Evaluated parameters**
Aggarwal et al.	2018	18—65, 100 W: 56 M: 44	The Wand	Inferior alveolar, long buccal, mental, posterior superior alveolar, infraorbital, greater palatine and anterior middle superior alveolar nerve block	2 % lidocaine + adrenaline 1:80 000	Periodontal procedure	Anxiety (5-point scale), pain (VAS scale), further anaesthesia method preference
Araújo et al.	2015	18—40, 29 W: not mentioned M: not mentioned	Morpheus	IANB	2 % lidocaine + adrenaline 1:100 000	Impacted mandibular third molars extraction	Patient satisfaction (Linkert scale), pain (VAS scale), need for additional anaesthetic, HR, blood pressure
Attia et al.	2022	Not mentioned, 60 W: 41 M: 19	Calaject	Infilltration and IANB	4 % articaine	No treatment	Pain, excitement (Dental Anxiety Scale)
Berrendero et al.	2020	21—79, 40 W: 24 M: 16	Calaject	IANB, anterior alveolar nerve block, infiltration	4 % articaine + adrenaline 1:100 000	Restorative treatment in upper incisors (Black's class III), lower molars (Black's class I and II), scaling, root planning in lower molars, extraction of upper molars	Pain (VAS scale, 2-point scale), further anaesthesia method preference
Flisfisch et al.	2021	42—76, 20 W: 10 M: 10	The Wand	Infiltration	4 % articaine + adrenaline 1:200 000	Tooth-neck defects conservative treatment	Pain, anxiety-inducement of the devices's appearance (VAS scale), duration of anaesthesia, further anaesthesia method preference
Ghaderi et al.	2018	23—28, 50 W: 28 M: 22	Smartject	Infiltration	2 % lidocaine + adrenaline 1:80 000	Maxillary premolars dental treatment	Pain (VAS scale)
O'Neal et al.	2022	19—35, 130 W: 75 M: 55	Dentapen	Infiltration	2 % lidocaine + adrenaline 1:100 000	Maxillary lateral incisor treatment	Pain (Heft Parker VAS scale), overall anaesthesia method preference
Pol et al.	2022	13—27, 39 W: 16 M: 23	Quicksleeper	CCLAD: intraosseous Traditional: IANB	3 % mepivavaine (IAN) and 2 % mepivavaine + adrenaline 1:100 000 (lingual nerve)	Impacted mandibular third molars extraction	Pain (2-point scale), HR, duration of anaesthesia, execution time, amount of anaesthetic used, presence of Vincent's sign, anaesthesia of the lingual nerve, breakage/ obstruction of the needle, patient malaise, anaesthetic difficulty, type of anaesthetic sensation, further anaesthesia method preference

important to evaluate the strengths and weaknesses of the study. The considered studies had a few limitations, such as the use of convenient samples that may not represent the entire population, including all types of necessary dental treatment and socioeconomic conditions. Moreover, the assessment of pain is a highly subjective component that is challenging to analyse scientifically due to many factors. This results in some degree of misestimation. Additionally, dental procedures are often preceded by anxiety, which in severe cases can increase pain perception (Kuscu and Akyuz, 2008; Ram and Peretz, 2002).

Nevertheless, this study also had considerable advantages. The division into groups of paediatric and adult patients was valuable, as local anaesthesia can cause misunderstandings among children and adolescents. The management of young patients can be challenging due to fear-related behaviour, which can interfere with collaboration and limit the quality of care (Garret-Bernardin et al., 2017; Ram and Peretz, 2002). Furthermore, cognitive development differences between paediatric patients and adults may result in distinct concepts of pain applicable to these two age groups (Franck et al., 2000; Versloot et al., 2004).

The study focused on the latest literature according to evolving trends in clinical studies, excluding case reports which do not represent wide groups of patients. It is important to note that the study aimed to stay objective and does not include subject evaluations unless clearly marked as such.

The outcomes of this study provide an opportunity to expand research about the use of computer-assisted anaesthesia. Further research focusing on developing and validating a standard pain assessment algorithm that will facilitate consistent reporting in future studies for better comparability of results would be beneficial. Standardisation of methodology and subsequent interpretation of the outcomes using the Consolidated Standards of Reporting Trials (CONSORT) is essential for future studies. Inclusion of wider age groups, such as young, pre-cooperative children and elderly patients, in further studies would be helpful to evaluate the effectiveness of CCLADs in a wider range of population and to highlight the differences between the responses, cooperation and most effective treatment methods of patients at different stages of life. In addition, widening the research to include

other dental specialties could help to develop the use of CCLADs in minimally invasive approach into clinical practice, with a focus on the maximisation of the patient's comfort.

5. Conclusions

The present literature review disposed the authors to draw the conclusion that the use of CCLADs is significantly less painful than the use of traditional carpules and opens new, promising opportunities for working with patients presenting high dental fear. Further studies are crucial for the effective use of CCLAD in dental treatment, especially focusing on the precise methods of pain and fear assessment.

Ethical statement

Hereby, I Katarzyna Janik consciously assure that for the manuscript „Computer-Controlled Local Anaesthesia Delivery efficacy – a literature review" the following is fulfilled:

1) This material is the authors' own original work, which has not been previously published elsewhere.
2) The paper is not currently being considered for publication elsewhere.
3) The paper reflects the authors' own research and analysis in a truthful and complete manner.
4) The paper properly credits the meaningful contributions of co-authors and co-researchers.
5) The results are appropriately placed in the context of prior and existing research.
6) All sources used are properly disclosed (correct citation). Literally copying of text must be indicated as such by using quotation marks and giving proper reference.
7) All authors have been personally and actively involved in substantial work leading to the paper, and will take public responsibility for its content.

7. Author statement

All people who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public resposibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript. Furthermore, each author certifies that this material or similar material has not been and will not be submitted to or published in any other publication before its appearance in *The Saudi Dental Journal*.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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