REVIEW ARTICLE

Clinical Effectiveness of Precooling Agent (Ice) and Topical Anesthetic Gel in Reduction of Pain Before the Intraoral Anesthetic Injection in Children—A Systematic Review and Meta-analysis

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Abstract

Aim: Clinical effectiveness of precooling agent (ice) and topical anesthetic gel in reduction of pain before the intraoral anesthetic injection in children—a systematic review and meta-analysis.

Background: Topical anesthesia plays a crucial role in pediatric dentistry to mitigate the discomfort and anxiety associated with local anesthesia injections. Numerous strategies have been investigated to minimize pain perception during injections. In this systematic review, the focus is on comparing the efficacy of application of local anesthetic gel and cooling the injection site with ice.

Materials and methods:

Research question: Are precooling agent (ice) more effective than topical anesthetic gel (Benzocaine or lidocaine) in reduction of pain before the intraoral anesthetic injection in children?

Research protocol: This systematic review followed the recommendation of PRISMA guideline 2020.

Literature search: An electronic search of the databases was performed to find the effectiveness of precooling agent (ice) and topical anesthetic gel (benzocaine and lidocaine) in reduction of pain before the intraoral anesthetic injection in children aged between 5 and 10 years.

Data extraction: Authors independently extracted the data from the eight included studies based on the inclusion criteria.

Quality appraisal: The risk of bias was assessed using a tool developed by the Cochrane Collaboration for randomized clinical trial studies.

Results and interpretation of results: After conducting a search, 305 published studies were identified. Following the elimination of duplicate studies and a thorough analysis of full-text articles, a total of eight studies were chosen for inclusion in the systematic review.

Conclusion: Precooling the soft tissues with topical ice proved to be more effective in significantly reducing pain perception in children compared with the use of topical anesthetic gel.

Clinical significance: It is important for pediatric dentist to know appropriate use of precooling agent. This paper gives an insight into appropriate use of precooling agent ice for reduction of pain during intraoral anesthetic injection in children.

Keywords: Benzocaine gel, Ice, Lignocaine gel, Precooling, Topical anesthetic gel.

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Introduction

Administration of local anesthesia is required to reduce the pain during various dental procedures, such as extraction, pulpectomy, pulpotomy, and minor oral surgeries. However, the problem is that the injection of local anesthesia is itself a painful procedure, and this pain is further provoked by the anxiety and fear associated with the view of needle, called needle phobia.[1] Children who experience dental anxiety exhibit uncooperative behaviors, which decrease their likelihood of tolerating treatment and lengthen treatment time.[2,3] Ultimately, it will affect the quality of treatment, so it is important to effectively control the pain during intraoral anesthetic injection in children. There are several strategies available to relieve pain during the injection of local anesthetic drugs. Numerous pharmacological and non-pharmacological approaches have been explored, including the application of topical anesthetics, engaging children in diversionary activities, slowing down the rate of infiltration, introducing tissue vibration around the injection site, and applying cold before the injection.[4] The use of a topical anesthetic gel is commonly favored to mitigate the discomfort associated with local anesthesia. In dentistry, benzocaine and lidocaine are the most frequently utilized topical anesthetics due to their enduring effects and palatable flavor.

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For thousands of years, people have recognized the advantages of cold. The anti-inflammatory and analgesic properties of cold were known to the ancient Egyptians and subsequently, Hippocrates.[5] Local cooling diminishes tissue metabolism and the influx of inflammatory mediators when a needle is inserted, leading to vasoconstriction. Furthermore, it triggers inhibitory pain pathways that elevate the pain threshold, especially in response to noxious stimuli such as local anesthetic agents.[6,7]

Based on the literature search, it is noted that many different agents were used for the reduction of pain during intraoral anesthetic injection. Ice and topical anesthetic agents are the most commonly used agents for which the literature shows contradictory results. There is no strong evidence at present about which is better for reduction of pain during intraoral anesthetic injection in children. To date, no systematic review has ever compared topical anesthetic agents containing mainly benzocaine and lidocaine with precooling agents, specifically ice. So this systematic review was planned to determine the best method for reducing pain during intraoral anesthetic injection and the method that is most acceptable to the children.

Materials and Methods

The protocol for this systematic review has been officially registered on PROSPERO (International Prospective Register of Systematic Reviews, National Institute for Health Research) under the identification number CRD42022341084. Adhering to the guidelines set forth by the PRISMA statement in 2020, this review ensures a comprehensive and transparent approach to the systematic review process.

Information Sources

A comprehensive and systematic exploration of major electronic databases was conducted, encompassing publications in the English language from 1997 to 2022. The electronic searches were executed in PubMed, Central Register of Clinical Trials (CENTRAL) Cochrane, and supplemented with a search on Google Scholar. Two authors independently developed and executed the search strategy.

For each database, a combination of terms including precooling, cryotherapy, topical anesthesia, lignocaine gel, benzocaine gel, and pain was employed. Boolean operators "AND" and "OR" were skillfully utilized to interconnect these terms, thereby constructing a robust search strategy. Detailed information on the search strategies defined for each database can be found in Table 1.

Eligibility Criteria

The review incorporated studies assessing the efficacy of topical anesthetic gel and ice containing benzocaine and lidocaine for alleviating pain during intraoral anesthetic injections in children aged 5–12 years. The inclusion criteria were determined using the PICOS strategy outlined in PRISMA-P 2020, as outlined in Table 2.

Study Selection

Two independent authors conducted the study selection, with any discrepancies resolved through consultation with a third author. Initial screening of titles and abstracts involved two authors, and full texts were retrieved for abstracts meeting the inclusion criteria or in cases where abstract information was inconclusive. The second stage involved reading the full texts and determining study inclusion based on the PICOS strategy and eligibility criteria. Any disagreements regarding study inclusion were resolved through consensus with a third author. Duplicate studies identified during the database search were included only once.

Data Extraction

Two researchers independently gathered data from the selected studies. Discrepancies were resolved through consensus with a third researcher. The collected information encompassed publication details (authors, year), study type, patient age, injection technique, injection site, sample size, coolant duration, pain scale employed, and outcomes assessed based on the respective scale.

Quality Assessment

To determine the validity of the included randomized clinical trials (RCTs), a tool developed by the Cochrane Collaboration was used to assess the bias in the clinical trials. Using this tool, we evaluated the bias of the selected studies using the following parameters: random allocation concealment, sequence generation, incomplete outcome data, blinding of personnel and participants, selective reporting (selection of the reported results), analysis

Table 1: Search strategy in the database

Database	*Search strategy*	*Findings*
PubMed	#1 (((Precooling[Title/Abstract]) OR (pre-cooling[Title/Abstract])) OR (ice[Title/Abstract])) OR (cryotherapy* [Title/Abstract])	46565
	#2 (((((((Topical anesthesia[Title/Abstract]) OR (topical anesthesia[Title/Abstract])) OR (local anesthesia[Title/Abstract])) OR (lignocaine gel[Title/Abstract])) OR (lignocaine[Title/Abstract])) OR (lidocaine gel[Title/Abstract])) OR (lidocaine[Title/Abstract])) OR (benzocaine gel[Title/Abstract])) OR (benzocaine[Title/Abstract])	43857
	#3 Pain[Title/Abstract]	747634
	((#1) AND (#2)) AND (#3)	89
Cochrane	#1 (Precooling):ti,ab,kw OR (pre-cooling):ti,ab,kw OR ("ICE"):ti,ab,kw OR (cryothe*):ti,ab,kw OR (cooling):ti,ab,kw (Word variations have been searched)	9706
	#2 MeSH descriptor: [Anesthetics, Local] this term only	9273
	#3 ("local anesthesia"):ti,ab,kw OR ("topical anesthesia"):ti,ab,kw OR ("lignocaine gel"):ti,ab,kw OR ("benzocaine gel"):ti,ab,kw OR ("lidocaine gel"):ti,ab,kw (Word variations have been searched)	8358
	#4 #2 OR #3	16227
	#5 MeSH descriptor: [Pain] this term only	13011
	#6 (PAIN):ti,ab,kw (Word variations have been searched)	220766
	#7 #5 OR #6	220766
	#8 #1 AND #4 AND #7	193
Google scholar	Topical anesthesia, local anesthesia, precooling agents, cryotherapeutic agents, pain, lignocaine gel	23

Table 2: Eligibility criteria

Category	*Inclusion criteria*	*Exclusion criteria*
Participant/population/characteristics	• Clinical *in vivo* studies conducted between 1997 to 2022 on children in the age group between 5 and 12 years	• *In vitro* studies conducted before 1997 • Studies conducted on children below the age group of 5 and above the age-group of 12 years
Intervention	• Precooling the injection site with ice before intraoral anesthetic injection administration (infiltration, block, maxilla or mandible)	• Precooling the injection site with refrigerant spray
Comparison/control group	• Topical anesthetic gel containing benzocaine and lidocaine	• Topical application of clove and papaya based anesthetic gel
Outcome	• Studies in which pain scale used are: • Subjective pain—VAS, CAS scale • Objective pain- SEM, FLACC,WBFPRS scale	• Pain measured using scale mentioned in inclusion criteria
Study design	• Randomized clinical trials (RCT) • Non-randomized controlled trials	• Case reports • Case series • Review articles • Conference abstracts • Interviews • Commentaries • Replies to editor/author

intention (blinding of outcome assessment), and other types of bias not considered previously (e.g., design bias, contamination bias). The methodological quality of each study was assessed and categorized as either low, high, or unclear risk. Each included study was designated as having a "high" risk of bias for negative domain responses (indicated in red), a "low" risk of bias for positive domain responses (indicated in green), and a risk of "uncertain" bias (indicated in yellow) when the response was not clearly discernible.

Data Analysis

The meta-analysis utilized a random effects model and was conducted using RevMan 5.4 (The Nordic Cochrane Centre, Copenhagen). Heterogeneity was evaluated through the Q-test and quantified using I^2 statistics. Event frequency and total sample size data were extracted from the chosen studies. The primary outcome focused on pain reduction during intraoral anesthetic injection following the application of topical anesthetic gel and precooling agent ice. Pain reduction was assessed using both subjective and objective pain scales. In cases of substantial heterogeneity ($I^2 >$ 50%), a random effects model was employed for analysis; otherwise ($I^2 \leq 50\%$), a fixed effects model was utilized.

Results

Search Result

The search strategy flow diagram, depicted in Figure 1, outlines the systematic process employed in this study. Initially, a comprehensive electronic search across various databases yielded a total of 305 studies. Following the removal of 20 duplicate studies, 270 eligible papers were subjected to title and abstract analysis, resulting in the inclusion of 15 studies. Subsequently, all 15 articles were retrieved, and a further eligibility assessment led to the exclusion of seven studies, primarily due to non-compliance with inclusion criteria, as detailed in Table 3. After a thorough examination, eight studies were deemed suitable for inclusion in the systematic review. A subsequent hand search of the references of these selected studies did not yield additional relevant articles. Finally, six studies with homogeneous data, utilizing the visual analog scale (VAS), were chosen for meta-analysis, and four studies with homogenous data, employing the sound eye motor (SEM) scale for pain assessment during intraoral anesthetic injection, were included in a separate meta-analysis.

Study Characteristics

The data collected from the eight included studies for systematic review are summarized in Table 4.

Risk of Bias Assessment

When assessing the inner methodological risk of bias, it was observed that all incorporated studies were deemed to have a 'high' risk of bias (Figs 2 and 3). The findings revealed elevated risks of bias, particularly in terms of allocation concealment, blinding of participants and personnel, and other potential sources of bias (Figs 2 and 3).

Meta-analysis

The Meta-analyses, using random effects model, were applied with RevMan 5.4 (RevMan 5.4, The Nordic Cochrane Centre, Copenhagen). Heterogeneity was assessed by Q-test and quantified with I^2 statistics. Data on mean, standard deviation, and total sample size were obtained from selected studies. Pain score among the subjects was considered as the main outcome. Two separate comparisons for pain were performed: comparison of VAS score between precooling with ice group and local anesthetic gel group, and comparison of SEM score between precooling with ice group and local anesthetic gel group. With the meta-analysis conducted for selected studies, heterogeneity was less than 50% ($I^2 = 96\%$); hence, random effect model was applied.

Comparison of VAS Score between Precooling with Ice Group and Local Anesthetic Group

A meta-analysis was conducted on six eligible studies with sufficient outcome data for quantitative analysis. The collective comparison results are illustrated in Figure 4 as a forest plot.

Precooling with ice demonstrated a lower VAS score compared with the local anesthetic group. Nevertheless, the disparity among the two groups did not reach statistical significance ($p = 0.08$),

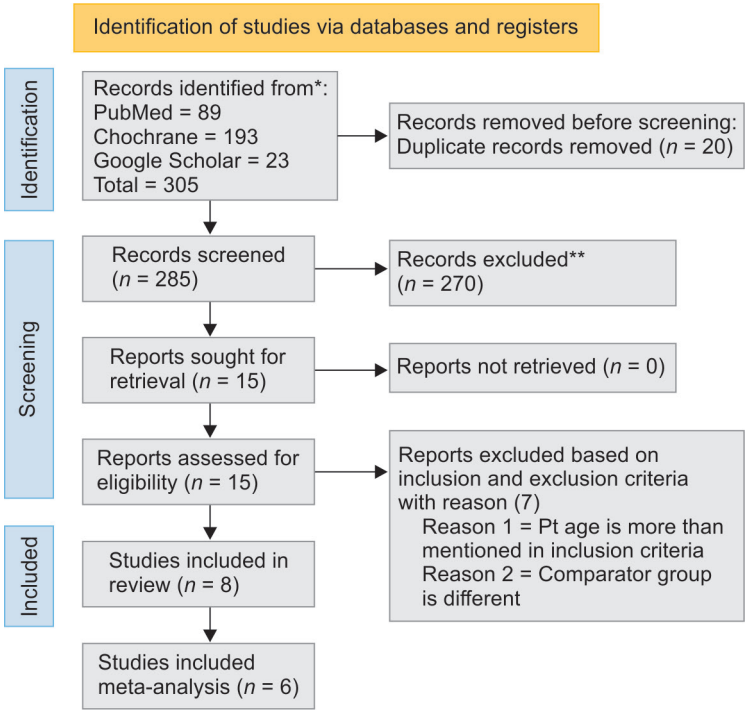

Fig. 1: PRISMA flowchart of the literature search and selection process

Table 3: Characteristics of excluded articles

Sr. No.	*Author and year*	*Reason for exclusion*
1.	Aminabadi and Farahani (2009)	Ice and topical anesthetic gel used together in comparator group
2.	Leff et al. (2007)	Age of the patient not as per inclusion criteria
3.	Kasat et al. (2014)	Review article
4.	Dhingra et al. (2020)	Lignocaine spray is used
5.	Bansal et al. (2020)	Age of patient is more
6.	Pranati et al. (2021)	Age of the patient is not mentioned
7.	Ghaderi et al. (2013)	Topical gel and ice used at the same time
8.	Hindocha et al. (2019)	Age of the patient is more

yielding a standardized mean difference of −0.95 (95% CI = −2.03 to 0.13; Z-value = 1.73).

Comparison of SEM Score between Precooling with Ice Group and Local Anesthetic Group

A meta-analysis was conducted on four eligible studies, each providing the necessary quantitative outcome data for analysis. The comprehensive comparison results are visually shown in a forest plot (Fig. 5).

The use of ice for precooling demonstrated a lower standard error of the mean SEM score compared to the local anesthetic group. Significantly, there was a notable difference ($p = 0.007$) in SEM scores between subjects in the precooling with ice group and the local anesthetic group, with a standardized mean difference of −0.34 (95% CI = −0.59 to −0.09; Z-value = 2.69).

Discussion

Local anesthesia is important in dentistry. Fear of pain and discomfort from local anesthetic injections may lead some individuals to avoid dental care. The most often used medication for pain management during local anesthetic injection is topical anesthetic gel.[8–10] Cryoanesthesia, a cooling technique, halts the transmission of painful stimuli by locally cooling a specific region, preventing neural signaling associated with pain.[11,12] Various studies have used ice as a topical anesthetic agent and demonstrated that ice is an effective anesthetic agent in reducing pain during intraoral anesthetic injection. Still, no strong evidence is present to prove it. No systematic review has ever compared topical anesthetic gel, mainly containing benzocaine and lignocaine, and the cryotherapeutic agent ice in the reduction of pain in children during intraoral anesthetic injection.

AmruthaVarshini's study, conducted,[13] found that precooling the injection site with ice is just as effective as using a topical anesthetic gel in mitigating injection pain. Additionally, four other studies[8,9,14,15] concluded that the use of a topical anesthetic gel is more effective than precooling with ice in reducing pain. Surprisingly, the remaining five trials[1,11,16–18] have consistently showed that precooling the injection site with ice before providing local anesthesia gives improved anesthetic effects when compared

Table 4: Characteristics of included article

Sr no	*Author Year*	*Study design*	*Sample characterstic*	*Type of injection*	*Intervention*	*Duration of coolant used*	*Comparator group*	*Measuring scale used*	*Scale for subjective pain*	*Scale for objective pain*	*Conclusion*
1.	Lathwal et al.[1] (2005)	Randomized controlled trial. Split mouth technique	160 children aged 5–6 years	IANB	1. Ice cone 2. Refrigerant spray cooling (1,1,1, 3,3-pentafluoropr opane/ 1,1,1,2-tet rafluoroethane)	60 seconds with ice 5 seconds for refriger-ant precool-ing group	Topical a nesthetic gel (Benzocaine gel)	1. SEM 2. VAS	VAS scales Ice cone and refrigerant $p = 0.006$	SEM scale Ice cone and benzocaine gel ($p \geq 0.001$) Comparing refrigerant with benzocaine $p > 0.05$ Ice precooling and refrigerant ($p \geq 0.003$)	Ice cone precooling better than refrigerant and benzocaine
2.	Mohiuddin et al.[16] (2015)	Randomized controlled trial	Sample size of l00 children	Infiltration anesthesia in maxillary anterior region	1. Ice cubes	60 seconds	Topical lidocaine hydrochloride gel 2% (WOCAINE 2%)	VAS	VAS ($p \geq 0.001$) Precooling injection site before infiltration anesthesia significantly reduces the pain	Not mentioned	Precooling with ice better than lidocaine hydrochloride gel
3.	Vafaei et al.[14] (2019)	Randomized trial Split mouth design	99 Children aged 6–10 years G1: 33 G2: 33 G3: 33	Buccal infiltration maxillary primary molar	1. Counter-irritation 2. Ice precooling 3. Refrigerant	1 minute 5 seconds	20% benzocaine	1. VAS 2. SEM	VAS Pain perception during injection was significantly lower in the benzocaine group compared with the other three techniques, as indicated by VAS score	SEM Benzocaine and precooling with ice p–0.004 Benzocaine and refrigerant $p \geq 0.001$ Benzocaine and counterirritation p–1.00	Pain perception associated with anesthetic injections was significantly lower using benzocaine compared with counter-irritation, ice, and spray refrigerant

(Contd...)

Table 4: *(Contd...)*

Sr no	*Author Year*	*Study design*	*Sample characterstic*	*Type of injection*	*Intervention*	*Duration of coolant used*	*Comparator group*	*Measuring scale used*	*Scale for subjective pain*	*Scale for objective pain*	*Conclusion*
4.	Chilakamuri et al.[17] (2020)	Randomized split-mouth crossover clinical trial	30 children aged 7–9 years	Greater Palatine Nerve block	1. Pencil of ice	2 minutes	5% lignocaine gel	1. CAS 2. FLACC	CAS Pain reduction in the test group was statistically significant $p \geq 0.0001$	FLACC FLACC score was found in the control group (mean-5.83, SD-1.46) than in the test group (mean-1.6, SD-0.97), which indicates that the pain reduction in the test group was statistically significant	Pain perception in children was reduced by precooling the soft tissues
5.	A Anantharaj et al.[18] (2020)	Randomized controlled trial	60 healthy children aged 9–10 years	Buccal infiltration anesthesia	1. Ice cone group 2. Clove–papaya extract group		Group II: Benzocaine group	1. SEM 2. WBFPRS	WBFPRS Benzocaine group have the highest mean then Ice cone group	SEM When comparing the SEM scores, Ice group showed least mean SEM scale score followed by the Benzocaine group	Precooling of the injection site before LA provided better anesthetic results when compared with other agents
6.	Havale et al.[15] (2020)	Randomized controlled trial	60 Children aged 6–10 years	Infiltration anesthesia	1. 4.7% clove gel (Pain Out Dental gel, Colgate Palmolive India Ltd, Solan, India) 2. 10% betel leaf extract gel 3. Ice	1 min	Topical anesthetic agents, 2% lignocaine (Lox-2% Jelly, Neon, Mumbai, India)	1. SEM 2. WBFPRS	WBFPRS Pairwise comparison of SEM scores showed that there was a statistically significant difference between topical anesthetic gel and ice group	SEM Lignocaine group with a mean value of 2.13 Betel leaf with a mean score of 4.8 Clove and ice group with the same mean value of 4.93	Lignocaine gel showed greater pain reduction than ice

(Contd...)

Table 4: *(Contd...)*

Sr no	*Author Year*	*Study design*	*Sample characterstic*	*Type of injection*	*Intervention*	*Duration of coolant used*	*Comparator group*	*Measuring scale used*	*Scale for subjective pain*	*Scale for objective pain*	*Conclusion*
7.	Lakshmanan et al.[11] (2021)	Randomized controlled trial Split mouth design	30 pediatric patients between 7 years and 10 years of age	Maxillary buccal infiltration	1. Cryotherapy (ice pack)	2 minutes	20% benzocaine topical gel	1. VAS 2. SEM	VAS Statistically significant lower score in the cryotherapy group ($p \geq 0.001$)	SEM The means of SEM values for the study and control groups were not statistically significant in total (SEM); whereas sound (S) and motor (M) parameters individually were significantly less for the cryotherapy group ($p \geq 0.05$)	Precooling with ice better than lidocaine hydrochloride gel
8.	Amrutha Varshini et al.[13] (2021)	3-arm, crossover randomized controlled trial	30 children of age 9–12 years	Maxillary posterior buccal infiltration	1. Ice application 2. Laser biostimulation		20% benzocaine gel	1. VAS 2. SEM	VAS LA gel vs Ice, $p = 0.657$ LA gel vs LBS, $p = 0.037$ Ice vs LBS, $p = 0.014$	SEM LA gel vs Ice, $p = 0.073$ LA gel vs LBS, $p = 0.04$ Ice vs LBS, $p = 0.00$	Precooling the injection site with ice is equally effective as topical anesthetic gel in alleviating the injection pain

with alternative approaches. Notably, inconsistent results were reported when comparing the anesthetic efficiency of topical anesthetic gel and ice. In the present systematic review, eight randomized clinical trial were included on the basis of inclusion and exclusion criteria. Studies varied in their type anesthetic technique used (block anesthesia, infiltration), duration of application of coolant, site of injection and the results were heterogenous.

The evaluation of all eight included studies was based on quality assessment. Random sequence generation was reported adequately in seven studies[8,9,11,13–15,18] and inadequately in one study.[17] Allocation concealment was reported adequately only in two study[9,14] assessed and was categorized as high risk. Nature of the interventions did not allow for participant blinding. Outcome assessment blinding was only reported in one study.[8] The study demonstrated adequate reporting for incomplete outcome data and selective reporting, with no subjects experiencing dropouts. However, other unspecified biases were identified, attributed to the absence of information on sample size estimation, exclusion, and inclusion criteria, and examiner calibration (Table 3, Figs 2 and 3).

Duration of precooling agent ice used is varied in different studies. It ranges from 1 to 2 minutes. In four studies,[1,14–16] ice is used for 1 minute and in two studies,[11,17] ice is used for 2 minutes Studies by Anantharaj[18] and AmruthaVarshini[13] did not mention about the duration. In two studies[1,16] where ice is used for 1 minute then also showed significant reduction in pain compared with topical anesthetic gel. So even when ice used for 1 minute shows comparable result to the studies in which it is used for 2 minutes. So the duration of ice placed used does not matter when comes to anesthetic action. Gauge of needle used is different in different studies in two studies 25 gauge,[1,14] in three studies, 27 gauge,[11,15,17] and in two studies,[11,16] gauge was not mentioned. Injection type shows difference infiltration in six studies[11,13–16,18] and block in two studies.[1,4] Variation has also been seen in place like maxillary region in five studies,[11,13,14,16,17] variation in both maxilla and mandible in one study[1] and not mentioned in three studies.[13,15,18] Various literature reveal that the gauge of needle and site of injection is not affected by anesthetic action of ice.

In all studies, both objective pain and subjective pain were assessed except the study by Mohiuddin et al.[17] in which only subjective pain was measured. In these five included studies,[1,11,13,14,16] the scale used to assess subjective pain was VAS.

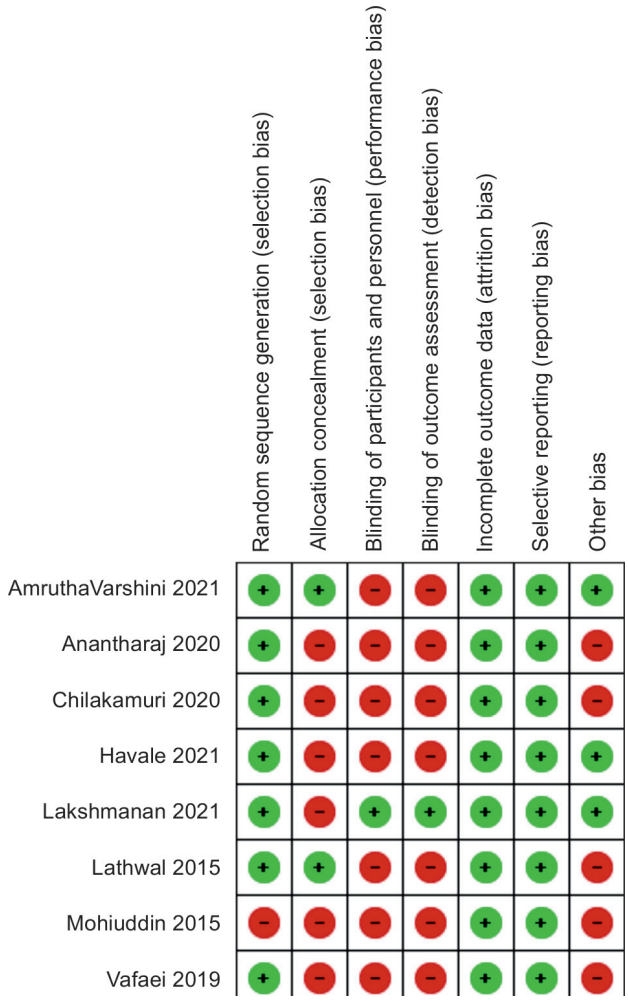

Fig 2: Risk of bias graph

Fig 3: Risk of bias summary

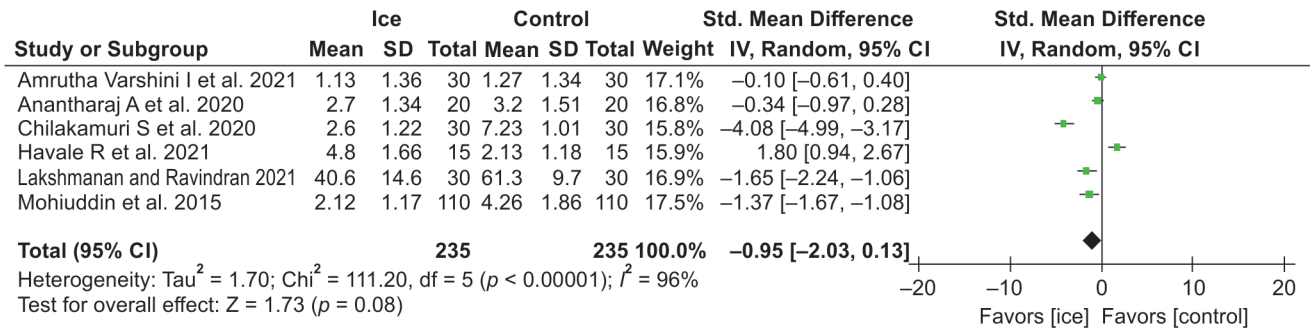

Fig 4: Comparison of VAS score between precooling with ice group and local anesthetic group

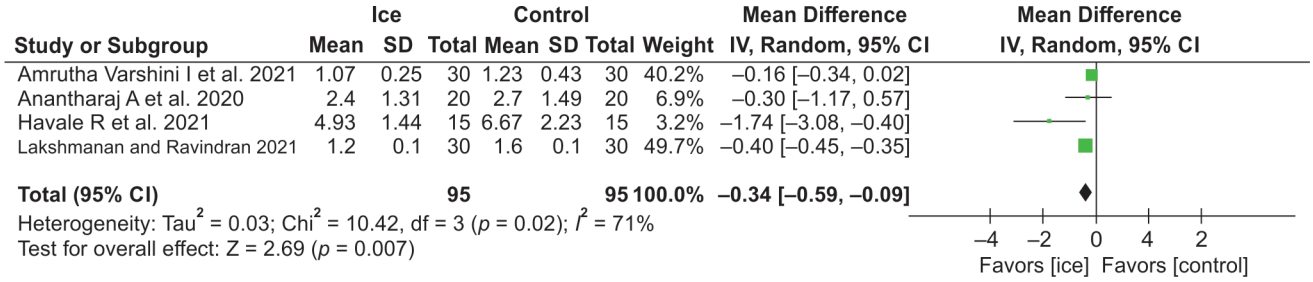

Fig 5: Comparison of SEM score between precooling with ice group and local anesthetic group

Chilakamuri et al.[17] used color analog scale (CAS) and Havale et al.[15] and Anantharaj et al.[18] used WBFPRS (Wong–Baker Faces Pain Rating Scale) for measuring subjective pain. Color Analog Scale and WBFPRS are homogenous to VAS, and 10-point Linkert scale is used to measure the pain in these scale also. So, meta-analysis of six[11,13,15–18] studies was done where for subjective assessment, similar scale was used. Works carried out by Vafaei et al.[14] and Lathwal et al.[1] were excluded from meta-analysis because they did not mentioned about the mean and SD value. As described in forest plot (Fig. 4), precooling with ice showed less VAS score as compared with local anesthetic group. However, there was no difference ($p = 0.08$) in VAS score among subjects of precooling with ice group and local anesthetic group, with a standardized mean difference of –0.95 (95% CI = –2.03 to 0.13; Z-value = 1.73).

The Meta-analysis was performed on four[11,13,15,18] studies in which SEM scale was used for objective pain assessment and that have qualified with required data outcome that could be analyzed quantitatively. In the study by Mohiuddin et al.[16] only one scale mentioned Chilakamuri et al.[17] used Face, Legs, Activity, Cry, Consolability scale (FLACC) used. Study by Vafaei et al.[14] and Lathwal et al.[1] excluded from meta-analysis because of insufficient data. As in forest plot Figure 5, precooling with ice showed less SEM score as compared with local anesthetic group and there was a significant difference ($p = 0.007$) in SEM score among subjects of precooling with ice group and Local anesthetic group, with a standardized mean difference of –0.34 (95% CI = –0.59 to –0.09; Z-value = 2.69).

Distraction of children from painful stimuli during invasive procedure helps to alleviate the child's fear and anxiety. Anantharaj et al.[18] Mohiuddin et al.[16] used euphemism like ice candy for ice cubes which help to distract the children, effectively helps the children lessen the anxiety during procedure and help to create excitement during procedure. As the pain perception directly affect the physiological parameter blood pressure, heart rate so it is important to measure these parameter along with pain to make it more reliable.[19,20] No studies has measured these parameter except study done by Chilakamuri et al.[17] in which pulse rate of the child was measured using a fingertip pulse oximeter. So in future more studies are required in which physiological parameter like blood pressure, heart rate used along with pain to make results more reliable.

Precooling the soft tissues with topical ice was found to significantly diminish pain perception in children when compared to the use of topical anesthetic gel. This suggests that precooling with ice can serve as a viable alternative to topical anesthetic gel in minimizing pain during intraoral anesthesia. Moreover, children exhibit a higher level of comfort with ice as opposed to topical anesthesia.

Strength of Systematic Review

First and foremost, strength of this review is its diligent adherence to the PRISMA guidelines. This is the only systematic review that has compared topical anesthetic gel and ice for reduction of pain in children. Studies which were included shows homogeneity so Meta-analysis was performed which increase the accuracy of result.

Conclusion

Pain perception in children was significantly reduced by precooling the soft tissues with topical ice compared to topical anesthetic gel. Precooling with ice can be used as replacement to topical anesthetic gel in reducing pain during intraoral anesthesia. Children are more comfortable with ice than topical anesthesia.

Clinical Significance

- It is the only systematic review that assessed the effectiveness and acceptance of precooling of injection site (ice) and topical anesthetic gel.

- It is important for pediatric dentist to know appropriate use of precooling agent. This paper gives an insight into appropriate use of precooling agent ice for reduction of pain during intraoral anesthetic injection in children.
- It enables the pediatric dentist to explore other methods to obtain painless anesthesia apart from the gold standard topical anesthetic agent.

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