

Effectiveness of Insulin Syringe in Reduction of Pain Perception among Children Undergoing Dental Treatment under Local Anaesthesia - A Systematic Review and Meta-Analysis

Dr. Aishwarya A. Patil¹, Dr. Vidyavathi H. Patil², Dr. Niraj S. Gokhale³, Dr. Shivayogi M. Hugar⁴, Dr. Krishna R. Kajave⁵, Dr. Snehal S. Kumthekar⁶, Dr. Shweta Kajjari⁷, Dr. Chaitanya Uppin⁸

¹Post Graduate Student, Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, Belagavi, Karnataka, India

ORCID: 0009-0000-3086-9872

²Reader, Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, Belagavi, Karnataka, India

ORCID: 0000-0002-3007-9317

E-mail: nisarga_vhp@yahoo.com

³Professor, Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, Belagavi, Karnataka, India

ORCID: 0000-0003-4975-5167

⁴Professor, Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, Belagavi, Karnataka, India

ORCID: 0000-0003-3657-6709

⁵Post Graduate Student, Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, Belagavi, Karnataka, India

ORCID: 0009-0007-2254-8236

⁶Post Graduate Student, Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, Belagavi, Karnataka, India

ORCID: 0009-0009-4797-0016

⁷Reader, Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, Belagavi, Karnataka, India

ORCID: 0000-0003-2328-1936

⁸Lecturer, Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, Belagavi, Karnataka, India

ORCID: 0000-0002-8527-5411

Corresponding Author: Dr. Vidyavathi H. Patil, Reader MDS, Ph.D, Department of Pediatric and Preventive Dentistry, KAHERs KLE VK Institute of Dental Sciences, Nehru Nagar, Belagavi-590010, Karnataka, India

E-mail: nisarga_vhp@yahoo.com

ORCID: 0000-0002-3007-9317

ABSTRACT

Aim:

To evaluate the effectiveness of insulin syringe in comparison with other modalities of local anaesthesia delivery in reduction of pain perception among pediatric patients undergoing local anaesthesia administration.

Background:

Local anaesthesia is a feared dental procedure among children and it plays a crucial role in pain management. Conventional syringes remain the standard method for delivering local anaesthesia in dentistry; however, they have several disadvantages. In contrast, insulin syringes offer notable advantages due to their smaller needle diameter and compact barrel size, which contribute to a less traumatic and more comfortable injection experience.

Review

Out of 218, seven studies that met the eligibility criteria were assessed in systematic review. Three articles that were evaluated for comparable parameters were included in the meta-analysis according to which the insulin syringes were better than conventional syringes in minimizing pain perception during local anaesthesia administration. The risk of bias for studies revealed some concerns for one study and high risk for the remaining two studies. The study showed $Q(2)=43.96$ and $p < 0.0001$ indicative of high heterogeneity with the $I^2=95.16\%$.

Conclusion:

Although, the studies showed that insulin syringes were better than other modalities of local anaesthesia delivery in reduction of pain perception but the meta-analysis shows high risk of bias and heterogeneity among included studies. Hence, there is necessity of further robust studies to be conducted.

Keywords: Children, Insulin Syringe, Local Anaesthesia, Pain Perception, Pediatric Dentistry.

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INTRODUCTION

Pain and dentistry are often synonymous in the patient's mind and effectively managing pain presents a significant challenge, particularly in pediatric dentistry, where it is crucial for successful behaviour management and nurtures a positive relationship between the dentist and child, helping to build trust, alleviate fear and anxiety, and promote positive dental attitudes for future treatments.¹⁻³

Local anaesthesia is a commonly feared dental procedure among children and it plays a crucial role in pain management. The majority of pediatric patients often feel fearful and anxious about the pain they may experience during the administration of local anaesthesia.¹ Such negative experiences may also affect the patient's future dental care.⁴ The traditional method of administering local anaesthesia with a syringe and needle often heightens patients' apprehension and anxiety even before dental procedures begin. Therefore, it is crucial for dental professionals to be aware of newer techniques for delivering local anaesthesia to address these issues.⁵ Due to extensive application of local anesthetics in pediatric dentistry, painless injection is crucial for ensuring successful dental procedures. It not only eases a child's anxiety but also fosters positive patient behaviour in future visits. To enhance comfort during local anesthetic administration, various techniques are used, such as applying topical agents, precooling the injection site, using fine needles, buffering and warming the local anaesthesia, employing distraction techniques, vibrating devices, and employing slow computer-regulated administration.⁶

One such approach is to utilize an insulin syringe. It is a hypodermic syringe designed specifically for administering insulin.⁷ Insulin syringes are particularly advantageous due to their needle diameter and barrel size.⁸ Research has been done on insulin syringe in pediatric dentistry for decreasing pain perception among children for local anaesthesia administration during dental treatment. They have a short needle of 30 gauge which can be used for infiltrations where the thickness of the tissue is less than 20mm. Also, the aspiration of the blood can be checked by insulin syringe like the one done with conventional syringes during local anaesthesia for infiltrations. There is controlled administration of drug in fractions as the insulin syringes are calibrated at 0.025mL intervals which do not require excessive force on the plunger during drug administration and it reduces the pain as there is less tissue distension.⁹ As, there is lack of sufficient evidence discussing the effectiveness of insulin syringes in reducing pain perception over other injection modalities for

administering local anaesthesia during dental procedures among children, the present systematic review was undertaken to identify and synthesize the available literature which compares the effectiveness of insulin syringe in reduction of pain perception compared to other injection modalities among pediatric patients during dental procedures with local anaesthesia administration.

Focused Question:

Are insulin syringes effective in reduction of pain perception among children undergoing dental treatment under local anaesthesia compared to other modalities for local anaesthesia?

PICO:

- Population (P): Children undergoing dental treatment under local anaesthesia
- Intervention (I): Insulin syringe for administration of local anaesthesia
- Comparison (C): Other injection modalities for administration of local anaesthesia
- Outcome (O): Evaluation of pain perception

Objectives:

To evaluate the effectiveness of insulin syringe in reduction of pain perception compared to other modalities for local anaesthesia among pediatric patients undergoing dental treatment.

MATERIALS AND METHODS

Protocol and registration:

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and was registered with PROSPERO (registration number: CRD42024530529).

Eligibility criteria

Inclusion criteria:

1. Study setting to be clinical.
2. Study design to be randomized and non-randomized control trials, quasi-randomized and control clinical trials.
3. Study population to be pediatric patients who underwent dental treatment under local anaesthesia.
4. Study evaluating the pain perception.
5. Study published from 1st January 1998 till 31st December 2024.
6. Studies written in English language and studies written in any other language but are possible to get translated into English.

Exclusion criteria:

1. Articles reported as an in vitro study or a review article.
2. Studies including children with special health care needs and children with any other medical conditions.

3. Articles not available as full text.
4. Studies conducted on animal.
5. Article reported as a review and systematic review.
6. Article reported as case report, case series.
7. Conference abstracts.

Literature Search and Search Strategy

Search Strategies:

The literature search strategy was formulated using keywords pertaining to different modalities of local anaesthesia administration in pediatric dentistry. (Table 1) In total, 13 search strategies (keyword combinations) were formulated with different local anaesthesia administration modalities. Data was searched through the following web bases: PubMed, Scopus, ProQuest, ScienceDirect and Cochrane Library published from 1st January 1998 till 31st December 2024. Cross-references were checked and hand searching of articles were done when full texts of the relevant studies were unavailable through electronic database. Two independent reviewers (AAP and VHP) did the web search utilizing the keywords strategy. The duplicates from the articles collected were filtered using Zotero software version 6.0.26.

Two reviewers (AAP and VHP) separately examined titles and abstracts identified from the search process, ensuring they met inclusion criteria. Complete texts of all shortlisted studies were then acquired and thoroughly reviewed to determine their eligibility. In cases of uncertainty about a study's inclusion, the issue was resolved through discussion with the third author (NSG). The calculated kappa score for agreement was found to be 0.79, which indicates moderate reliability. For articles considered for meta-analysis, quality assessment was conducted independently by AAP and VHP. These steps ensured the systematic integration of studies into the systematic review. Finally, the search yielded 7 studies to be included in systematic review. All the excluded studies were recorded with reason for exclusion of each study. (Figure 1)

Data Extraction (Study Characteristics):

Data extraction was performed using a standardized outline. General information such as author name, year of publication was collected from each study. Study characteristics like (1) Authors Name & Country of Origin (2) Study Design (3) Sample Size (4) Age-group (5) Intervention (6) Comparator (7) Other groups (8) Outcome Measurement Scales (Objective + Subjective) (9) Mean Scores (Objective + Subjective) were noted. (Table 2)

Risk of Bias:

The studies were categorized as having high (red), moderate (yellow), or low (green) risk of bias, in accordance with the Cochrane Handbook for Systematic Reviews. Six randomised controlled trials were assessed using RoB 2 tool.¹⁰ ROBINS-I

tool was used for one non-randomised controlled trial.¹¹

Meta-analysis:

For meta-analysis 3 articles were reviewed and were statistically evaluated using statistics and data software (STATA). Studies were selected for meta-analysis due to the similarity in intervention and outcome measurement parameters across the studies, that is the studies that compared insulin syringes and conventional syringes for subjective pain perception during local anaesthesia administration.

RESULTS

In the studies identified through databases and registers, 218 studies were selected. Out of which duplicate studies were excluded employing Zotero software version 6.0.26, resulting in 144 studies. Further exclusions at the title level resulted in the selection of 2 articles from these sources. On the other hand, 36 studies were identified through other methods such as citation and hand searching. Of these, 8 studies were excluded due to being non-retrievable, resulting in 28 studies. These were then further screened for duplicates and abstract-level exclusions yielding to 5 studies. The entire process finally resulted in 7 studies for the systematic review and 3 for the meta-analysis. All excluded studies were documented along with the reasons for their exclusion. The flowchart illustrates the selection process based on PRISMA 2020 guidelines.¹² (Figure 1)

Risk of Bias:

Risk of bias assessments for randomized controlled trials included in the present study showed that in the research done by Patel et al. (2023) had an overall moderate risk of bias due to concerns in D4, that is, Bias in the measurement of the outcome. In the research by Tirupathi et al. (2020) had an overall high risk of bias due to concerns in D4, that is, Bias in the measurement of the outcome and D5, that is, selection of the reported result. Whereas, in the research done by Dutt et al. (2022) and Vardhana et al. (2021) showed some concerns, particularly in the randomization process (D1). Kour et al. (2017) also presented concerns in D1, but overall, had a moderate risk of bias. Whereas, Kohli et al. (2022), on the other hand, had an overall low risk. Overall, most studies had a mix of low risk and some concerns, with only one study presenting a high risk in key domains.¹⁰ (Graph 1) Risk of bias assessment for the non-randomized controlled trial done by Verma R et al. (2021) showed concerns in D1 and D6, that is, Bias in confounding and bias in the measurement of the outcome. An overall moderate risk of bias was assessed.¹¹ (Graph 2)

The summary of the risk of bias for each individual study, along with domain-specific bias assessments, is presented in Graph 1, 2.

Meta-analysis:

The results obtained from the analysis showed high precision values considering 95% confidence interval. Out of 7 studies included, 3 studies were selected for meta-analysis. Meta-analysis was carried out using studies conducted by Kohli et al. (Study 1), Vardhana BS et al. (Study 2) and Kour G et al. (Study 3).

The forest plot shows an overall effect size across all three studies with a Hedges' g calculated value as 2.62, with a confidence interval from 0.76 to 4.48, indicating a statistically significant reduction in pain perception with insulin syringes compared to conventional syringes. However, with respect to heterogeneity, the I^2 value is 95.16%, indicating high heterogeneity, which suggests variability in the effect sizes across the studies. The high levels of heterogeneity could be attributed to lesser number of studies included in the meta-analysis, varying sample sizes or methodological issues. (Graph 3)

Despite the heterogeneity, the test for overall effect ($z = 2.76$, $p = 0.01$) suggests a statistically significant difference in pain perception between the two syringe types. The p -value for the heterogeneity test is 0.00, confirming this significant variation. The forest plot provides a visual summary of the standardized mean differences, measured using Hedges' g with a 95% confidence interval (CI), for each study. (Graph 3)

The funnel plot was also obtained where it showed asymmetry in the distribution of studies, with two studies falling outside the funnel suggesting a potential source of publication bias. Specifically, we see one study on the left, indicating it has a lower effect size with a larger standard error, and two studies towards the right, showing larger effect sizes with varying standard errors. (Graph 4) The asymmetry suggests that there may be some publication bias or heterogeneity affecting our results, but this should be interpreted with caution due to the small number of studies in the analysis.

In summary, while the funnel plot hints at potential bias or variability in the included studies, it's important to remember that the small sample size limits our ability to draw strong conclusions about publication bias.

GRADEpro GDT Analysis:

GRADEpro (Grading of Recommendations, Assessment, Development and Evaluation) GDT (Guideline Development Tool) was used to assess the quality of the body of retrieved evidence. It suggested a significant risk of bias, as several studies did not provide adequate justification for their randomization techniques or allocation concealment. Additionally, the outcome assessors were aware of the intervention administered, which could introduce bias into the study results. (Table 3)

DISCUSSION

Odontogenic pain, which includes pain from dental caries, pulp involvement, and dental trauma, is commonly reported in children. Effectively managing pain in pediatric dental care is vital, as pain is often linked with anxiety. This anxiety can increase pain perception, leading to more intense and prolonged pain experiences, along with an enhanced memory of that pain.¹³

Pain during an injection is typically caused by the needle's penetration of the skin and the deposition of the anesthetic solution into the target tissue. The gauge of the needle can also influence the level of discomfort experienced.² Use of insulin syringe with 30-gauge needle for the delivery of LA using infiltration technique in child patients has proven to be less painful. The accuracy helps minimize pain, reduces tissue swelling, and lowers the risk of local ischemia and tissue damage.¹

A total of 7 studies were included after screening for full texts. Subjective and objective pain parameters were used to assess pain perceived by the children. Subjective pain determination was done using various pain rating scales such as the Faces Pain Scale-Revised (FPS-R) and the WBFRS (Wong-Baker Faces Rating Scale), while objective pain was assessed using the FLACC (Face, Legs, Activity, Cry, Consolability) Scale and the SEM (Sound, Eye, Motor) Scale.

Over the past fifty years, numerous modifications have been made to modern insulin syringes and needles.⁷ In the present review, Kour G et al. support the use of insulin syringes for delivering local anaesthesia in pediatric patients, highlighting that the smaller needle gauge contributes to reduced pain.⁹ Kohli N et al. also reported significantly lower pain scores with insulin syringes compared to conventional and deception syringes ($p = 0.0030$).⁶ Similarly, Dutt M et al. and Bharath Vardhana S et al. found that insulin syringes effectively minimized pain during local anesthetic administration in pediatric dental patients compared to conventional syringes.^{1,14}

Using conventional syringes often encounter considerable resistance, which requires the operator to exert more pressure on the plunger to deliver the anesthetic. This increased pressure can lead to higher forces within less flexible tissues, resulting in pain, ischemia, and potential tissue damage.¹⁵ The traditional method of administering local anaesthesia with a syringe and needle often heightens patients' apprehension and anxiety even before dental procedures begin.⁵

Insulin syringes are particularly advantageous due to their needle diameter and barrel size.⁸ This allows precise drug delivery and reducing the risk of tissue distension, pain, and local tissue damage.^{3,6} Several studies have compared needle gauge and length to assess pain perception during local anaesthesia. Asokan A et

al. and Sneharaj N found that thinner needles (30- or 31-gauge) caused significantly less pain than thicker ones (26-gauge), with thinner gauges also helping reduce anxiety during children's first dental visits.^{16,17} Sevekar S et al. reported better patient compliance and reduced pain with 31-gauge needles in children.¹⁸ However, studies by Fuller NP et al., Brownbill et al., and Ram et al. found no significant differences in pain or efficacy between various needle sizes.^{19,20,21} Notably, Ram et al. observed more children cried during mandibular injections with 27-gauge needles compared to 30-gauge.²¹ Lehtinen found that 30-gauge needles required less insertion force (69mN) and caused less pain than 27-gauge needle (139mN).²²

Jet-injection technology operates on the principle of utilizing mechanical energy to generate enough pressure to force a dose of liquid medication through a small orifice, creating a thin fluid stream with sufficient force to penetrate soft tissue and reach the subcutaneous layer without the need for a needle. They provide several advantages like faster and easier to use, minimal or no pain, reduced tissue damage, and quicker drug absorption at the injection site.²³

In the present review, Patel M et al. found that the INJEX needleless device resulted in minimal pain perception during anaesthesia administration in children compared to insulin syringes.³ Similarly, studies by Saravia ME et al. and Angelo Z et al. reported that children preferred needleless injectors, and these devices provided effective pain control during a variety of dental procedures.^{24,25} Additionally, Lambrianidis T et al. demonstrated that effectiveness of jet injectors was potentially be achieved as it allows for easier positioning and the use of larger injection volumes which further enhances its effectiveness for maxillary extractions.²⁶ Altan H et al.'s study showed that needleless systems, including Comfort-In™, offered sufficient analgesia and lower pain perception in procedures like pulpotomy and filling, with a faster onset of action and improved patient compliance.²⁷ Mohamed LS et al. found similar results in 6-8-year-old children when 4% articaine with 1:100,000 epinephrine was administered via a jet injector for pulpotomy.²⁸ Moreover, Makade et al. demonstrated that jet anaesthesia was successful for procedures such as curettage, scaling, mental and nasopalatine blocks, cementing crowns, jackets, bands, and clamps, copper tube impressions, gingivectomies, direct pulp injections, biopsies, and abscess drainage.²⁹

Despite their advantages, needleless injectors have notable limitations. In some studies, including those by Arapostathis et al. and Geenen et al., children actually preferred traditional needles due to discomfort caused by the sudden noise, pressure, and vibration of the INJEX device during anaesthetic delivery.^{30,31} Difficulty in positioning

the device on gingival tissue and occasional reports of inadequate anaesthesia contributed to negative experiences.³⁰ Furthermore, Alameeri AA et al.'s systematic review emphasized that for complex dental procedures or extractions requiring deeper and longer-lasting anaesthesia, conventional needle-based methods remain superior.²⁹

CCLAD is an electronic, preprogrammed anaesthesia delivery system featuring a two-stage injection rate. The rate of injection adjusts depending on the chosen technique, starting with a slow flow that gradually increases to a rate specific to the selected technique.³²

CCLAD has demonstrated effectiveness in both children and adults. For children, the majority of studies have found that CCLAD provides enhanced comfort compared to traditional syringes across various injection procedures, such as suprapariosteal, palatal, and block injection.⁸ Vemula et al. and Langthasa et al. found that computer-assisted anaesthesia led to significantly lower anxiety and pain in children compared to conventional methods.^{33,34} In this present review, Verma R et al. reported that the Comfort Control Syringe (CCS) significantly reduced both anxiety and pain levels compared to the insulin syringe.² Similarly, Gibson et al. observed that children exhibited fewer disruptive behaviours with computerized delivery techniques.³⁵ Additionally, studies by Feda et al., Al Amoudi et al., and Klein et al. indicated that CCLAD systems provided greater comfort, particularly for palatal injections.³⁶⁻³⁸ These findings suggest that computer-assisted anaesthesia offers a more positive experience for children in terms of pain management, behavior, and comfort, especially in procedures involving sensitive oral tissues.

Despite the favourable results, not all studies showed significant advantages of CCLAD systems over traditional techniques. In the present review, Tirupathi SP et al. reported no significant difference in child-reported pain scores between groups, though a majority still preferred the insulin syringe.⁸ Likewise, Tahmassebi et al. found no significant difference in reported pain and anxiety levels between children treated with the Wand system and those treated using conventional methods.³⁹ In studies, by Asarch et al. and Versloot et al., no statistically significant difference in pain was observed between traditional and computerized methods across various injection techniques.^{40,41} These mixed results suggest that while CCLAD systems may offer behavioural or comfort-related benefits in some settings, their superiority in reducing pain is not consistently demonstrated across all injection types and patient groups. Additionally, factors such as higher cost, longer time to administer the drug, more space needed to store the device, and its complexity may limit their widespread clinical adoption.⁴²

Although insulin syringes showed promise in reducing pain perception, the studies analyzed in this systematic review had significant heterogeneity and bias. Only English-language studies and those translatable into English were included, which may introduce selection bias and limit comprehensiveness. The selected studies themselves stated certain limitations in their research like smaller sample size^{2,3,6,8} and techniques of use of drug delivery.²

Of the studies compared in the meta-analysis, insulin syringe showed better in reducing pain perception compared to conventional syringe however the evidence is low for their effectiveness.

CONCLUSION

Although, Insulin syringes were more effective than other modalities of local anaesthesia delivery in reducing pain perception among children for dental procedures, the meta-analysis indicated low evidence due to considerations in bias like randomization technique, allocation concealment and blinding of the outcome assessors among the included studies. Hence, high-quality, randomized controlled trials with larger sample

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sizes need to be conducted to strengthen the evidence.

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AAP and VHP; study conception and design. AAP and VHP; data collection. AAP and VHP; Methodology. AAP, VHP and NSG; statistical analysis and interpretation of results. AAP and VHP ; Writing - review & editing. SMH, KRK, SSK, SK and CU; critically revised the manuscript. All authors reviewed the results and approved the final version of the manuscript to be published.

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TABLES

Table 1: Table summarizing the search strategy, articles searched and selected from PubMed, Scopus, ProQuest, ScienceDirect and Cochrane Library

S L N o	SEARC H STRAT ERGIES	ARTICLES IN SEARCH				
		Pub Med	Sco pus	Pro Ques t	Sci enc e Dir ect	Coch rane Libr ary
	Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodont ics AND Pain Perceptio n AND Local Anaesthe sia	49	3	38	2	26
	Children OR Pediatric Patients AND Pediatric Dentistry	15	4	4	0	0

Effectiveness of Insulin Syringe in Reduction of Pain Perception among Children Undergoing Dental Treatment under Local Anaesthesia - A Systematic Review and Meta-Analysis

	OR Pedodontics AND Insulin Syringe OR Hypodermic Syringe AND Pain Perception AND Local Anaesthesia					
	Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodontics AND Insulin Syringe OR Hypodermic Syringe AND Conventional Syringe AND Pain Perception AND Local Anaesthesia	5	3	2	0	0
	Children OR Pediatric Patients AND Pediatric Dentistry	0	1	4	0	0

OR Pedodontics AND Insulin Syringe OR Hypodermic Syringe AND Auto Controlled Syringe AND Pain Perception AND Local Anaesthesia					
Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodontics AND Insulin Syringe OR Hypodermic Syringe AND Computer Controlled Local Anaesthesia AND Pain Perception AND Local Anaesthesia	7	1	6	0	0

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Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodont ics AND Insulin Syringe OR Hypoder mic Syringe AND Wand AND Pain Perceptio n AND Local Anaesthe sia	5	1	1	0	0
Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodont ics AND Insulin Syringe OR Hypoder mic Syringe AND Comfort Control Injection System AND Pain Perceptio n AND	2	2	6	0	0

Local Anaesthe sia					
Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodont ics AND Insulin Syringe OR Hypoder mic Syringe AND Electroni c Dental Anaesthe sia AND Pain Perceptio n AND Local Anaesthe sia	3	0	5	0	0
Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodont ics AND Insulin Syringe OR Hypoder mic Syringe AND Transcut aneous Electrical	0	1	8	0	0

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	Nerve Stimulati on AND Pain Perceptio n AND Local Anaesthe sia					
	Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodont ics AND Insulin Syringe OR Hypoder mic Syringe AND Jet Injectors AND Pain Perceptio n AND Local Anaesthe sia	0	1	3	0	0
	Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodont ics AND Insulin Syringe OR Hypoder mic Syringe	2	2	1	0	0

	AND Injex AND Pain Perceptio n AND Local Anaesthe sia					
	Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodont ic AND Insulin Syringe OR Hypoder mic Syringe AND Deceptio n Syringe AND Pain Perceptio n AND Local Anaesthe sia	0	0	3	0	0
	Children OR Pediatric Patients AND Pediatric Dentistry OR Pedodont ics AND Insulin Syringe OR Hypoder	0	1	1	0	0

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	mic Syringe AND Camoufl age Syringe AND Pain Perceptio n AND Local Anaesthe sia					
	TOTAL	88	20	82	2	26

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Table 2: Table showing qualitative analysis of the studies selected for the systematic review

S l. N o	Authors Name & Country of Origin	S t u d y d e s i g n	T o t a l s a m p l e s i z e	A g e g r o u p	Int er ven tion g r o u p	Co m p a r a t o r g r o u p	Ot h e r g r o u p s	Outcome Measure ment S c a l e s		Mean Scores				
								Ob j e c t i v e	Su b j e c t i v e	Objectiv e		Subjective		
1	Patel M et al. - 2023 (India)	R C T	4 6	4- 9 ye ar s o l d	IN J E X	IS	-	FL A C C	FP S- R	IN J E X: Du rin g LA =3. 02 =1. 28 ±0. 65 Du rin g Ext =	IS: Du rin g LA =0. 88 ±0. 65 Du rin g Ext =	IN J E X: Du rin g LA =0. 43 ±0. 83 Du rin g Ext =	IS: Du rin g LA =0. 78 ±1. 07 Du rin g Ext =	-
2	Verma R et al. - 2021	N - R C	3 0	5- 9 ye ar	CCI S	IS	-	FL A C C	-	CC S: Pre =	IS: Pre =	-	-	-

	(India)	T		s o l d						0.4 2 Du rin g= 3.4 7 Po st= 2.0 7	7 Du rin g= 5.4 7 Po st= 4.9 3			
3	Tirupath i SP et al. -2020 (India)	R C T	8 0	8- 12 ye ar s o l d	ACS	IS	-	FL A C C	W B F R S	AC Spr ick = 3.0 8 ± 0.4 9 AC Sa dm in= 2.9 1 ± 0.5 9	ISp ric k= 2.9 0 ± 0.5 8 ISa dm in= 2.9 1 ± 0.5 9	AC Spr ick = 4.4 25 ± 1.1 7 AC Sa dm in= 4.3 75 ± 1.0 5	ISp ric k= 3.7 25 ± 1.0 4 ISa dm in= 3.9 5 ± 1	-
4	Dutt M et al.- 2022 (India)	R C T	5 0	6- 10 ye ar s o l d	Con ven tion al dis pos ab le syr inge	IS	-	SE M	-	Co nv ent ion al= 3.6 9 ± 0.7 6	IS = 1.5 4 ± 0.6 8	-	-	-

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5	Vardhan a BS et al. -2021 (India)	R C T	4 0	6- 10 ye ar s ol d	Con vent iona l syr inge	IS	-	-	W B F R S	-	-	Co nv ent ion al= 4.1 8 ± 0.2 5	IS = 3.0 1 ± 0.2 8	-
6	Kohli N et al.- 2022 (India)	R C T	4 5	6- 12 ye ar s ol d	Con vent iona l syr inge	IS	De ce pti on syr inge	-	W B F R S	-	-	Co nv ent ion al= 6.1 3 ± 3.2 5	IS = 2.6 7 ± 2.8 9	D ec ep tio n= 2. 80 ± 1. 82
7	Kour G et al.- 2017 (India)	R C T	2 0	6- 12 ye ar s ol d	Con vent iona l syr inge	IS	-	SE M	W B F R S	Co nv ent ion al= 2.4 7 ± 0.5 8	IS = 1.4 8 ± 0.3 4	Co nv ent ion al= 3.2 5 ± 0.9 7	IS = 1.3 5 ± 0.4 9	-

RCT=Randomised Control Trial; **N-RCT**= Non- Randomised Control Trial; **IS**= Insulin Syringe; **FLACC**= Face, Legs, Activity, Cry, and Consolability; **SEM**= Sound, Eyes and Motor; **FPS-R**= Faces Pain Scale–Revised; **WBFRS**= Wong Baker Faces Pain Rating Scale; **LA**= Local Anaesthesia; **Ext**= Extraction; **admin**= Administration; **CCS**= Comfort Control Syringe; **ACS**= Auto-Control Syringe

Table 3: Table summarizing GRADEpro GDT Analysis Comparing Conventional syringe and Insulin Syringe for Reduction in Pain Perception during Local Anaesthesia Administration

Question: Conventional syringe compared to insulin syringe for reduction in pain perception during local anaesthesia administration

Setting: Clinical

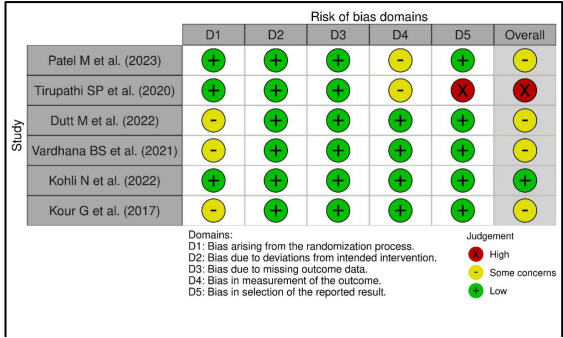
Certainty assessment												No. of Patients		Effect		Cer tai nty	Imp orta nce
N o. of st ud ies	Stu dy desi gn	Ri sk of bi as	Inco nsist ency	Indi rect ness	Imp reci sion	Othe r consi derat ions	Con venti onal syrin ge	Ins uli n syr inge	Rel ati ve eff ect (95 % CI)	Ab sol ute eff ect (95 % CI)		Con v ent ion al syr inge	Ins uli n syr inge	Rel ati ve eff ect (95 % CI)	Ab sol ute eff ect (95 % CI)		
3	Ran dom ised trial s	Se rio us ^a	Not serio us	Not serio us	Not serio us	—	45/45 (100. 0%)	45/ 45 (10 0.0 %)	Not esti ma ble		— ^a						Imp orta nt

CI: Confidence interval

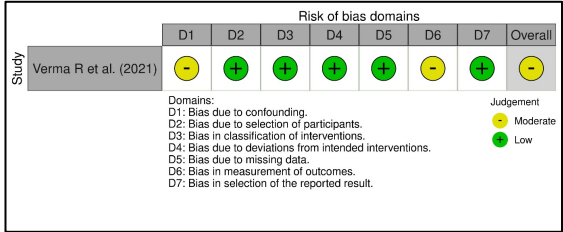
Explanation (*):

Randomization technique and allocation concealment were not justified in some studies, and outcome assessors were aware of the intervention, which may introduce bias.

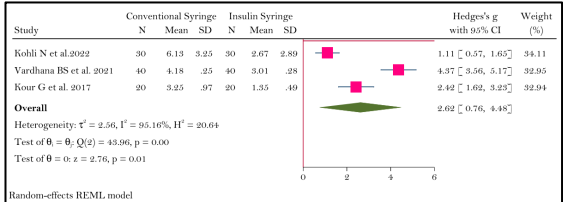
GRAPHS



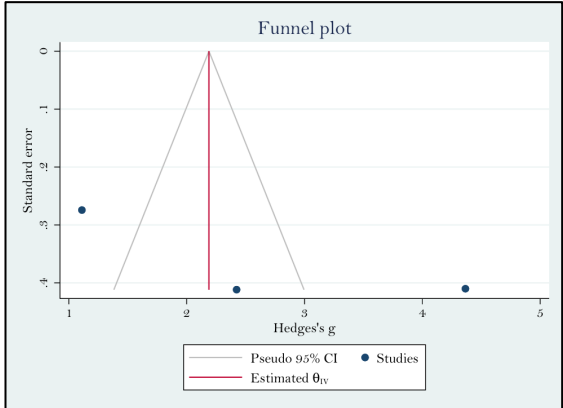
Graph 1: Traffic Plot for Revised Cochrane Risk-Of-Bias Tool For Randomized Trials (RoB 2)



Graph 2: Traffic Plot for Risk of Bias In Non-randomized Studies of Interventions (ROBINS-I)



Graph 3: Forest Plot showing pooled data obtained from Meta Analysis of Conventional Syringe and Insulin Syringe



Graph 4: Funnel Plot showing pooled data obtained from Meta Analysis of Conventional Syringe and Insulin Syringe

FIGURES

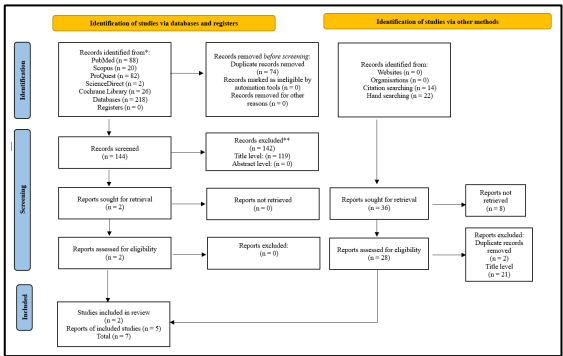


Figure 1: PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources