



Evaluating anxiety levels and pain perception while administering local anesthesia using conventional, insulin, and deception syringes in 6-12-year-olds

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Background: Injections are one of the most fear-provoking stimuli in dentistry. Painless administration of an injection is a vital step in alleviating anxiety, which in turn leads to good behavior in children. The aim is to evaluate and compare anxiety levels and pain perception using conventional, insulin, and deception syringes during the administration of local anesthesia in children.

Methods: Forty-five children aged 6-12 were selected using a standard sample size formula and equally divided into three groups. Local anesthesia was administered using a conventional syringe to Group A participants and an insulin syringe for Group B participants. Group C participants were administered local anesthesia using a deception syringe by showing the patient disposable obturation tips, and eventually a conventional syringe was used for administration of local anesthesia after hiding them from the patient. Anxiety levels were assessed using Venham's Picture Scale and pulse rate at baseline and after administration of local anesthesia. The Wong-Baker Faces Pain Rating Scale was used to assess pain perception after the administration of local anesthesia.

Results: Insulin and deception syringes showed better reduction in anxiety levels and pain perception than conventional syringes, demonstrating a high statistically significant difference.

Conclusion: The use of insulin and deception syringes for administration of anesthesia was demonstrated to be effective in alleviating anxiety in children and is therefore recommended as an alternative to conventional syringes.

Keywords: Dental Anxiety; Dental Fear; Local Anesthesia; Pain; Pediatric Dentistry; Syringes.



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INTRODUCTION

The emotional and behavioral responses of a child to dental treatment have been a matter of interest for pediatric dentists for decades. A child's uncooperative or unmanageable behavior can impede the efficient delivery of dental care and compromise the quality of treatment being rendered. If not adequately resolved, a persistent negative behavioral pattern can hamper the future dental

health of a child. A vicious cycle can be observed in relation to dental fear and anxiety, wherein fear directly leads to avoidance of dental visits, which results in the deterioration of oral health, further leading to a more problem-oriented dental visit and exacerbation of the level of dental fear. Therefore, dental fear and anxiety can be a major obstacle in the delivery of quality dental services [1].

Various studies have concluded that injections are among the most fear-provoking stimuli in dentistry,

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making the administration of local anesthesia one of the most challenging tasks [2,3]. However, profound local anesthesia ensures the successful treatment of pediatric patients by alleviating their anxiety and discomfort during restorative and surgical procedures. Owing to its ample use in the field of pediatric dentistry, painless injection plays a key role in successful dental treatment. It helps alleviate the child's anxiety, which in turn leads to good patient behavior in the future. In an attempt to improve patient comfort during local anesthetic administration, the use of topical agents, precooling the injection site, using fine needles, buffering and warming the local anesthesia, distraction techniques, vibrating devices, and slow computer-regulated administration are some of the widely used techniques.

One of the most convenient practices is to use an insulin syringe that is smaller, colorful, and less frightening than conventional syringes. Another alternative is to mask the conventional syringe by showing children disposable plastic obturation tips before administration and eventually using the conventional syringe by concealing them.

A literature search revealed that limited studies have compared conventional with insulin syringes. However, no study has been conducted on the use of disposable obturation tips for deception during the administration of local anesthesia. Accordingly, this study aimed to evaluate anxiety levels and pain perception in children during local anesthesia administration by comparing conventional, insulin, and deception syringes.

METHODS

This is a randomized, concurrent parallel, three-arm study conducted on patients reporting to the outpatient department of the Department of Pediatric and Preventive Dentistry. The study was registered in the Clinical Trial Registration of India (registration number: CTRI/2022/01/039554). Children aged 6–12 who had never received dental injections and required infiltration anesthesia in the

maxillary arch for restorative, pulp therapy, or extraction work were included in the study. Children requiring emergency treatment, allergic to the contents of local anesthesia, those with systemic diseases and special health care needs, and those who were not willing to participate were excluded from the study. The study protocol underwent a full committee review, and ethical clearance was obtained from the Institutional Review Board (Sl. No. 1501). Informed consent was obtained from all the parents/guardians of the children participating in the study.

Sample Distribution: A sample size of 45 was calculated according to the standard sample size formula and previous studies by maintaining a confidence level of 85% and a probability of 0.05 [4]. All samples were allocated randomly into three equal groups of 15 each by simple random sampling using a lottery method to ensure standardization: Group A (Conventional Syringe Group [UNOLOCK single-use syringe, Hindustan Syringes and Medical Devices Ltd., India; 26 Gauge]), Group B (Insulin Syringe Group [BD Ultra-fine Needle Insulin Syringes; 31 Gauge]), and Group C (Deception Syringe Group [Meta Biomed]).

Methodology: After comfortably seating the patient on a dental chair, the procedure was explained to the parents as well as the children. A case history was recorded for a systematic and methodological recording of all the observations and information, followed by clinical and radiographic examinations.

Baseline pulse rate was monitored using a pulse oximeter prior to treatment. The patients selected for the study were administered Venham's Picture Scale to assess their anxiety levels prior to the procedure. It consists of eight pairs of pictures. Each set contained two cartoon figures of a child, one in which the child appeared happy and the other in which the child looked distressed. The child was asked to select the pictures that they could correlate with the most on the picture scale. The anxiety score was calculated as the sum of the anxious pictures pointed at by the child. Scoring was done from 0–8 [5].

In Group A (conventional syringe group, 26 gauge) and



Fig. 1. Figure showing administration of local anesthesia using conventional syringe

Group B (insulin syringe group, 31 gauge), the respective syringes were preloaded with local anesthetic solution. A topical anesthetic was applied at the site of delivery. The child was told that the tooth will be “going to sleep” after administration of magic water. A preloaded syringe was used to deliver the local anesthetic at the site of delivery (Fig. 1 and 2).

In Group C (deception syringe group), a conventional syringe was preloaded with a local anesthetic solution and kept out of sight of the patient. The patient was shown a disposable obturation tip on a conventional syringe and allowed to feel the tip. Topical anesthetic was applied at the site of delivery. The child was told that the tooth will be “going to sleep” after administration of magic water using the same disposable tip as shown before. A preloaded conventional syringe with 31 gauge needle was then used to deliver the local anesthetic at the site of delivery after ensuring that it was not visible to the patient (Fig. 3).

Anxiety levels were recorded after the procedure using a pulse oximeter and Venham’s Picture Scale. The patient was then asked to record pain perception using the Wong Baker Faces Pain Rating Scale, in which the faces ranged from a smiling to a sad, crying face. A numerical rating was assigned to each face (from 0, “no hurt” to 10, “hurts worst”) of the Wong Baker Faces Pain Rating Scale [6].



Fig. 2. Figure showing administration of local anesthesia using insulin syringe

Further treatment of the tooth was continued.

The results were tabulated and entered into an Excel spreadsheet. The results were subjected to statistical analysis, which was performed using the SPSS statistical software package version 22.0.

RESULTS

The demographic profiles of the participants are shown in Table 1. All the groups showed an equitable distribution of participants according to age and gender, which maintained the standardization of selection criteria in our study.

When a comparison of baseline and postoperative Venham's picture scale scores was carried out in the three groups using the dependent t-test and one-way repeated measures of ANOVA, a highly statistically significant difference was found in the insulin syringe group, indicating that it was the most efficient in reducing anxiety. This was closely followed by the deception



Fig. 3. Figure showing administration of local anesthesia using deception syringe

Table 1. Table showing demographic profile of patients in three groups (A, B, C)

	Group A (%)	Group B (%)	Group C (%)	Total (%)	χ^2	P-value
Age groups						
6-7 yrs	6 (40.00)	3 (20.00)	3 (20.00)	12 (26.67)	2.5	0.6450
8-9 yrs	4 (26.67)	7 (46.67)	7 (46.67)	18 (40.00)		
≥ 10 yrs	5 (33.33)	5 (33.33)	5 (33.33)	15 (33.33)		
Mean age	7.53	8.27	8.07	7.96		
SD age	1.85	1.83	1.75	1.80		
Gender						
Male	10 (66.67)	10 (66.67)	7 (46.67)	27 (60.00)	1.667	0.4350
Female	5 (33.33)	5 (33.33)	8 (53.33)	18 (40.00)		
Total	15 (100.0)	15 (100.0)	15 (100.0)	45 (100.0)		

Group A, conventional syringe group, 26 gauge; Group B, insulin syringe group, 31 gauge; Group C, deception syringe group.

syringe group, which also showed a statistically significant difference between baseline and postoperative Venham picture scores. In contrast, an increase in anxiety levels was observed in the conventional syringe group.

When pair wise comparison was done between the conventional and insulin syringe groups, a highly statistically significant difference was observed as indicated by a P value of 0.0001. The difference between the conventional and deception syringe groups also had a very high statistically significant P value of 0.0080. However, when comparing the insulin syringe group with the deception syringe group, a non-statistically significant difference was observed, indicating the efficacy of both modalities in reducing anxiety among children during local anesthesia administration (Table 2).

When comparing the baseline and post-operative pulse rates among the three groups using one-way ANOVA,

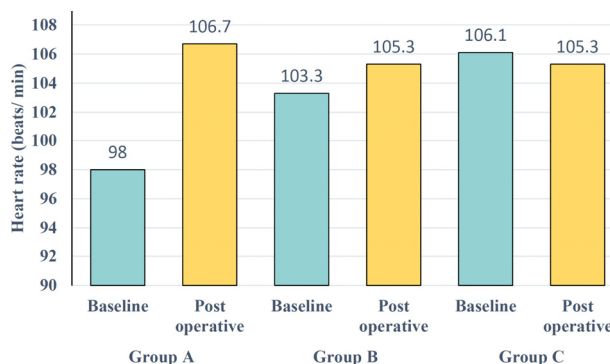


Fig. 4. Graph showing comparison of baseline and post-operative pulse rate scores in three groups. Group A, conventional syringe group, 26 gauge; Group B, insulin syringe group, 31 gauge; Group C, deception syringe group.

the maximum increase was observed in the conventional syringe group as the difference between the baseline and postoperative scores was the highest. The insulin and deception syringe groups also showed a marginal increase

Table 2. Table showing pair wise comparison of three groups (A, B, C) with baseline and post operative Venham's picture scale scores by Tukeys multiple posthoc procedures

Times	Groups	Group A	Group B	Group C
Baseline	Mean	2.47	4.27	3.47
	SD	2.13	2.12	2.85
	Group A	-		
	Group B	P = 0.1110	-	
	Group C	P = 0.4920	P = 0.6330	-
Post operative	Mean	3.80	1.33	1.73
	SD	3.00	1.72	1.28
	Group A	-		
	Group B	P = 0.0080*	-	
	Group C	P = 0.0290*	P = 0.8650	-
Difference	Mean	-1.33	2.93	1.73
	SD	2.85	2.46	2.63
	Group A	-		
	Group B	P = 0.0001*	-	
	Group C	P = 0.0080*	P = 0.4370	-

Group A, conventional syringe group, 26 gauge; Group B, insulin syringe group, 31 gauge; Group C, deception syringe group; SD, standard deviation.

Table 3. Table showing pair wise comparison of three groups (A, B, C) with Wong Baker FPRS scores by Tukeys multiple posthoc procedures

Groups	Group A	Group B	Group C
Mean	6.13	2.67	2.80
SD	3.25	2.89	1.82
Group A	-		
Group B	P = 0.0030*	-	
Group C	P = 0.0050*	P = 0.9900	-

Group A, conventional syringe group, 26 gauge; Group B, insulin syringe group, 31 gauge; Group C, deception syringe group. FPRS, Faces Pain Rating Scale; SD, standard deviation.

in the pulse rate, but the difference was not statistically significant (Fig. 4).

When comparing the three study groups according to Wong Baker's Faces Pain Rating Scale (FPRS) scores using one-way ANOVA, the maximum pain perception score was observed among the conventional syringe group with a mean score of 6.13. Least pain perception scores were observed in the insulin syringe group, followed by the deception syringe group, with mean pain perception scores of 2.67 and 2.80, respectively.

In accordance with these findings, when intergroup comparison was carried out using Tukey's multiple posthoc procedures, a highly statistically significant difference in mean pain perception scores was observed between the conventional and insulin syringe groups with a P value of 0.0030. Similar findings were observed while

comparing the conventional and deception syringe groups with a P value of 0.0050. However, no statistically significant difference was observed between the insulin and deception syringe groups, implying that both were equally effective in minimizing the pain perception of children during local anesthesia administration (Table 3).

DISCUSSION

The administration of local anesthesia in pediatric patients has always been challenging because children perceive injections to be threatening both visually and psychologically. This also pertains to the fact that children are exposed to injections multiple times since they undergo vaccination from infancy to childhood. The

physiology of fear due to threatening visual stimuli begins when the child enters a dental clinic. In view of such threatening stimuli, an electrical stimulus is sent to the brain to activate the sympathetic response and increase heart rate [7]. It is also believed that an anxious or fearful patient might perceive more severe pain of longer duration than would a less anxious patient [8]. Therefore, procedures aimed at reducing anxiety during the administration of injections may result in decreased pain perception. Therefore, the present study was undertaken to evaluate anxiety levels and pain perception using conventional, insulin, and deception syringes.

Our study included children aged 6–12 as they are competent to understand the concepts of pain and anxiety, making the self-reporting scales more reliable. This was also in accordance with the Piagetian theory of cognitive development, as children below six years of age may have difficulty understanding logical and abstract concepts, which would ultimately be unreliable for research purposes.

Various parameters were used to determine the effectiveness of the study groups in alleviating anxiety. Objective assessment of anxiety was carried out by measuring the pulse rate using a pulse oximeter, as an increase in heart rate due to anxiety is a direct result of sympathetic stimulation [7]. Subjective evaluation was carried out using the Venham Picture test, which is a projective, psychometric, and self-measure test whose reliability has been tested previously [5,9]. Pain perception was evaluated using the Wong Baker FACES Pain Rating Scale, which is one of the most preferred scales by children, according to a systematic review conducted by Tomilson et al. [6].

Our study compared conventional syringes with insulin syringes and the newly devised deception syringes. Owing to the available literature, various studies have been conducted in the past depicting the efficacy of insulin syringes in the painless administration of local anesthesia. Studies conducted by Kour et al. [10], Tirupathi et al. [11], Prabhu et al. [12], Vardhana et al. [13], and Nabi et al. [14] advocated the use of insulin syringes, as they resulted in lower pain perception. The

results of these studies were in accordance with those of our study, wherein an insulin syringe resulted in lower pain perception scores and helped reduce anxiety.

The results of our study revealed a statistically non-significant difference between the insulin and the deception syringe groups, as they were equally effective owing to the lower pain perception scores and self-reported anxiety levels. The above-cited studies state that a lesser gauge in the insulin syringe is responsible for the lower pain experience. The efficacy of the deception syringe used in our study contradicts this fact, as the administration of anesthesia was eventually performed using a conventional syringe with a larger gauge. The results of our study support the hypothesis that pain is not essentially related to the amount of tissue injury experienced, but by the attention paid to the stimulus at the time of injury. Pain intensifies if more attention is paid to the injury [15]. Studies conducted by Fuller et al. [16], Lehtinen [17], and Brownbill et al. [18] also reported no significant difference in pain perception when using needles with lesser gauge.

The findings of our study support the fact that it is indeed logical clinical practice to hide or camouflage threatening stimuli. Both the insulin and deception syringes had a less threatening appearance than the conventional syringe. The insulin syringe has a smaller size and brighter color, which makes it appear like a toy. Plastic obturation tips used in the form of a deception syringe also removed fear-provoking stimuli. It was interesting to note that no child reacted negatively or gave any signs of fear regarding the obturation tips or actually held the syringe with the tips. This also explains why less time was required to convince patients to receive the injection in both the insulin and deception syringe groups.

However, insulin syringes cannot be used for nerve blocks because of the shorter length of the needle. In contrast, a deception syringe can be easily used before administering any form of injection. Moreover, obturation tips are readily available in any dental setting, making them convenient and cost-effective. This makes them a superior choice to insulin syringes for the administration

of local anesthesia in children.

Our study emphasizes the use of plastic obturation tips in the form of deception syringes to reduce anxiety prior to the administration of local anesthesia in children. The results of our study highlight its efficacy over the direct use of conventional syringes due to the highly statistically significant differences in pain perception and anxiety scores. It is an economic alternative to other modalities used in the past, such as camouflage syringes, vibration devices, jet injectors, and computer-controlled delivery systems. In the future, we can carry out the study using a larger sample size and expand the age group so that the results can be generalized to the entire population.

In conclusion, the use of insulin and deception syringes for administration of anesthesia was demonstrated to be effective in alleviating the anxiety of children and is therefore recommended as an alternative to the use of conventional syringes for administration of local anesthesia.

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