

Comparative Evaluation of Reduction in Pain Perception Using 5% Topical LA vs Freezed Cone as a Preparatory Agent for Intraoral Injection in Children and Effect of VRD as Distraction Technique

Rashi Singh¹, Nidhi Gupta², Natasha Gambhir³

ABSTRACT

Aim: To compare freezed cone and 5% lignocaine as a numbing agent before intraoral injection and evaluate the effect of virtual reality distraction (VRD) as a distraction technique in reducing pain perception in children.

Study design: Around 60 children of 6–11 years old undergoing treatment for the extraction or any pulp therapy of primary tooth were selected. Freezed cone and 5% lidocaine were used to decrease the pain during local anesthesia (LA). VRD was used as a distraction method and to analyze the pain perception, Wong–Baker Faces Pain Rating Scale was used.

Materials and methods: Each child was randomly assigned to receive ice as a topical anesthetic or lignocaine 5% as a topical anesthetic agent. The pain perception was evaluated after the injection of 2% lignocaine hydrochloride (HCL). The primary researcher evaluated the pain during injection using the sound, eye, motor (SEM) scale. The pain experienced during injection was evaluated using Wong–Baker Faces Pain Rating Scale.

Results: In the freezed cone group with the VRD technique, maximum responded to the less pain score. On the contrary, many responded to higher pain scores in the freezed cone group without the VRD technique.

Conclusion: It was concluded that the VRD technique can be used for distraction and the frozen ice cone can be an alternative method to reduce the pain perception during LA.

Keywords: 5% lidogaine gel, Distraction technique, Freezed cone, Intraoral injection, Pain Perception, Wong–Baker Faces Pain Rating Scale.

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INTRODUCTION

Fear of dental treatment is one of the major reasons that keep children from receiving better dental care. Many procedures in the process of dental care require the administration of LA which is considered the most traumatic experience by the child. Even though this perceived pain is the reason that keeps children away from the dentist's office, the administration of anesthetics is what helps in managing the pain during the procedure.

Local anesthetic (LA) injection is the common reason for the development of avoidance behavior in children. However, LA is essential in pediatric dentistry as they help the child overcome the discomfort and pain experienced during the procedure.¹ Various methods have been used over time to reduce this initial pain and discomfort felt during the initial injection at the site such as the application of topical anesthetics, warming the anesthetic solution, buffering the anesthetic solution, counterirritation, adjusting infiltration rate by controlling the speed of injecting the anesthetic agent, using mechanical delivery systems to pressure applications on site of injection, the vibration of the adjacent mucosa as well as distraction techniques which help in reducing the initial pain felt during the administration of LA intraorally.^{2–8}

The most noninvasive and commonly used tool that the pediatric dentist has is the use of behavior management techniques especially distraction to help the child develop a positive mental attitude towards dental procedures and prevent any mishaps in the clinical settings, which may lead to dental emergencies. This technique of distraction helps the child to get focused on

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something other than what's going to be done, thus reducing anxiety. There are various methods of distraction such as the use of audio, audio-visual aids, and others.³ An ideal distraction is one involving multiple sensory modalities and optimal attention. Its use is based on the concept that pain perception is largely dependent on psychological components, thus withdrawal from the noxious stimuli may directly impact the pain perception.

Virtual reality (VR) (Fig. 1) refers to a human-computer interface that allows direct interaction of the user with the virtual world.

The virtual world is essentially a computer-generated environment that ensures the complete involvement of the user. The application of VR as a distraction technique may provide a higher success rate in comparison to other traditional distraction techniques as it offers a more immersive environmental and sensory distraction, however, it still needs to be proven scientifically.

Precooling the anesthetic site is another recommended way to reduce the sensation of pain perception in patients. This technique has been applied successfully in sprains, burns, insect bites, sports injuries, etc. It is a method that is an economic and efficient method of reduction of preoperative pain prior to injection of LA. Herbert was the first to document the use of a cooling solution and found that cooling the palatal area before injection relieves the perception of pain.⁹ However, the literature on the efficiency of precooling of the injection site in children is sparse and insufficient to draw a conclusion on the effectiveness of its use.

Similarly, the use of topical anesthetics plays an important part in reducing the initial prick sensation and pain associated with intraoral injections. It has proven to be an intrinsic part of dental procedures, especially in children. Although it is rare in children to show any toxicity towards topical LA agents, the clinician should be well acquainted with the type, frequency, and volume of the LA to be administered.

Hence the present study was designed to compare the frozen cone (Fig. 2) technique and 5% lignocaine as numbing agents before intraoral injection and evaluate the effect of VRD as a distraction technique in reducing pain perception in children.

Aim

To compare frozen cone and 5% lignocaine as a numbing agent before intraoral injection and evaluate the effect of VRD as a distraction technique in reducing pain perception in children.

MATERIALS AND METHODS

The sample size determined for this randomized control trial study was 60. Children ages ranging from 6 to 11 years coming to the outpatient department of the Department of Pediatric and Preventive Dentistry, Santosh Medical/Dental Colleges and Hospital, Ghaziabad, were randomly selected based on the inclusion criteria.

Inclusion Criteria

- Requirement of extraction or any pulp therapy of primary tooth.
- Frankl's behavior rating of III or IV (positive or definitely positive).
- Absence of inflammation or infection in the periodontal ligament of the tooth to be extracted and no history of allergy to LA solutions.

Method

- The required armamentarium (Fig. 3) was prepared.
- Informed consent from parents was obtained prior to starting treatment.
- A randomized control trial design was used wherein each child was randomly assigned by envelope method to receive either ice as a topical anesthetic or lignocaine 5% as a topical anesthetic agent.
- Tissues were dried with cotton gauze before the application of any agent.

Children were Divided into Two Groups

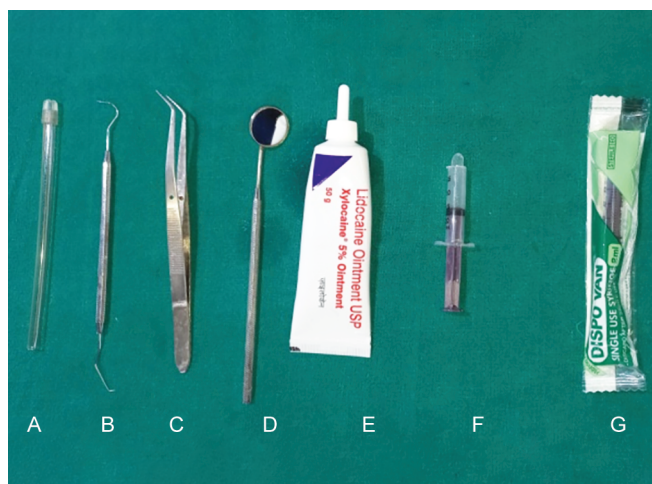
- Group I received topical anesthesia with 5% lignocaine for 60 seconds.
- Group II received frozen cone application for 60 seconds as a surface anesthetic.



Fig. 1: VR



Fig. 2: Application of frozen cone



Figs 3A to G: List of armamentariums used; (A) Suction tip; (B) Explorer; (C) Tweezer; (D) Mouth mirror; (E) 5% LA gel; (F) Frozen cone; (G) 2 mL 30-gauge syringe

Both Group A and B were Further Sub-divided Into

- Group IA: Control with VRD technique.
- Group IB: Control without VRD technique.
- Group IIA: 5% lignocaine with VRD technique.
- Group IIB: 5% lignocaine without VRD technique.
- Group IIIA: Freezed cone with VRD.
- Group IIIB: Freezed cone without VRD.

This was followed by an injection of 2% lignocaine HCl (Fig. 4) at the same site using a standard cartridge (Septodont, France) and a 30-gauge ½ needle.

Two researchers conducted the study, of which the primary researcher evaluated the pain during injection using the SEM scale. At the end of the injection, each patient was asked by the second researcher about the pain experienced during injection using Wong–Bakers Faces Pain scale (Fig. 5).

RESULT

Table 1 depicts the distribution of each sample in each category with respect to their mean and standard deviation of the pain score



Fig. 4: Administration of LA

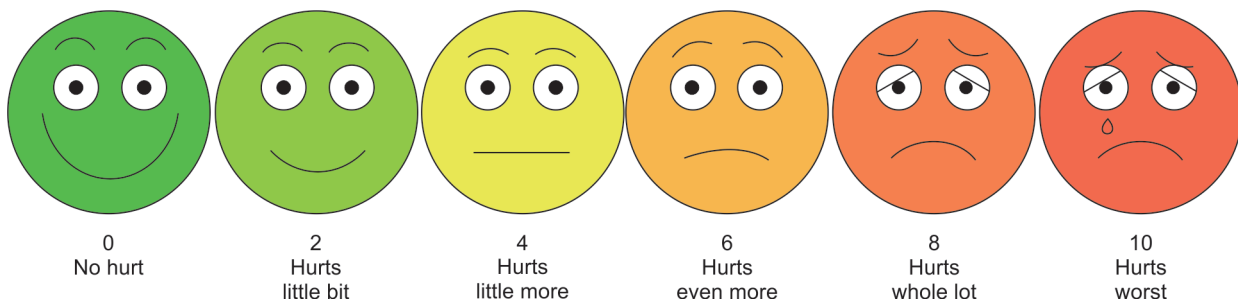


Fig. 5: Wong–Baker Scale

Table 1: Distribution of samples with respect to pain scores in descriptive statistics

| Group | Samples | Sample size (N) | Mean pain score | Standard deviation |
|---------------------|-----------------------|-----------------|-----------------|--------------------|
| I control | With VRD technique | 10 | 3.6 | 2.459 |
| | Without VRD technique | 10 | 4.8 | 1.932 |
| II 5% lignocaine | With VRD technique | 10 | 2.4 | 1.838 |
| | Without VRD technique | 10 | 3.4 | 2.319 |
| III freezed cone | With VRD technique | 10 | 3 | 1.944 |
| | Without VRD technique | 10 | 5.2 | 1.932 |

respectively. A total of 60 subjects was divided into six groups. In each group, there were 10 subjects. The freezed cone without the VRD technique has the highest mean ± standard deviation pain score of 5.2 ± 1.932, whereas the 5% lidocaine with the VRD technique has the lowest mean ± standard deviation pain score of 2.4 ± 1.838.

Figure 6 graphically represents the frequency of pain scores for each category. Categories of groups were drawn along the X-axis and the frequency of pain score was drawn along the Y-axis. It is clearly observed that the group which was administered 5% lignocaine responded to the lowest pain scores more frequently.

Table 2 shows Pearson’s correlation among each category. The Pearson correlation test was conducted to determine the correlation among the VRD technique categories and also for the without VRD technique categories. The agreement among the 5% control with VRD technique with 5% lignocaine with VRD ($r = 0.925, p > 0.001$) and freezed cone ($r = 0.930, p > 0.001$) were more or less equal. Significant associations between 5% control without VRD technique and 5% lignocaine without VRD technique ($r = 0.913, p > 0.001$) and between 5% control without VRD technique and freezed cone without VRD technique test ($r = 0.905, p > 0.001$), suggesting that pain score was equally measured between the scales.

Table 3 represents the independent t-test among each group and p-value < 0.001 for each category suggestive of statistically significant data series.

Table 4 indicates the in-between group comparison for different pain scores using the Chi-squared test and the p-value for each category. The lowest p-value is observed for the group administered with 5% lignocaine both with and without the VRD technique.

DISCUSSION

According to the International Association for the Study of Pain (1979) pain is defined as “the unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.”¹⁰ Pain is a subjective symptom experienced by the child, which depends on various factors like physiological, psychological, social, and cultural. The pain threshold



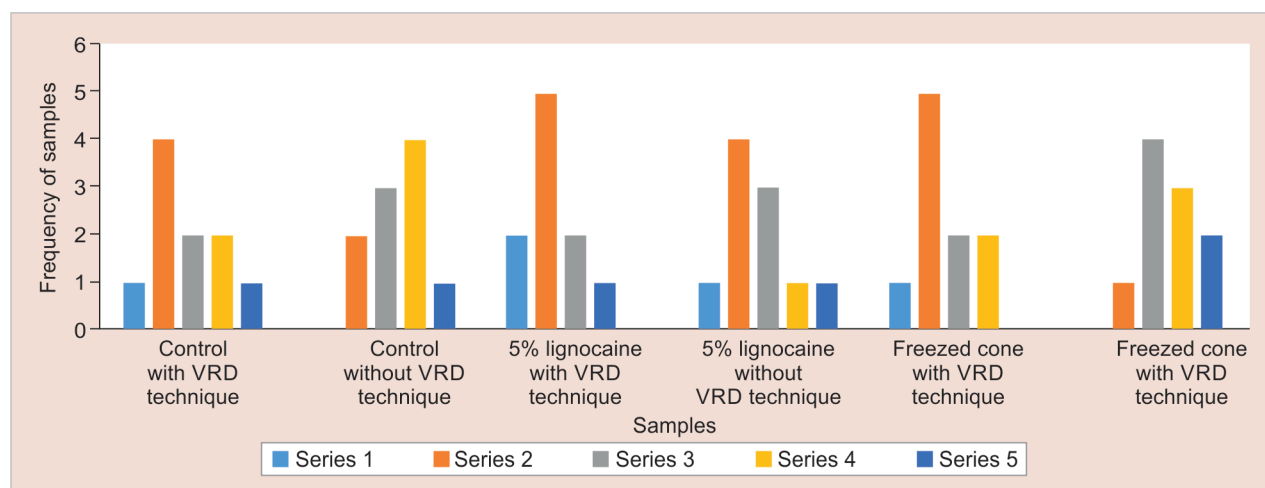


Fig. 6: Frequency distribution of samples with respect to the pain score. *Series 1: pain score 0, series 2: pain score 2, series 3: pain score 4, series 4: pain score 6, series 5: pain score 8

Table 2: Reliability statistics of the samples using Pearson correlation test

| Variables | N | r | p-value |
|---|----|-------|---------|
| Control with VRD technique ~ 5% lignocaine with VRD technique | 10 | 0.925 | 0.001* |
| Control with VRD technique ~ freezed cone with VRD technique | 10 | 0.930 | 0.001* |
| Control without VRD technique ~ 5% lignocaine without VRD technique | 10 | 0.913 | 0.001* |
| Control without VRD technique ~ freezed cone without VRD technique | 10 | 0.905 | 0.001* |

*statistically significant

Table 3: Distribution of control group using independent t-test

| Samples | N | t-test value | p-value |
|---------------|-----------------------|--------------|---------|
| Control | With VRD technique | 4.63 | 0.001 |
| | Without VRD technique | 7.85 | 0.003 |
| 5% lignocaine | With VRD technique | 4.129 | 0.003 |
| | Without VRD technique | 4.636 | 0.001 |
| Freezed cone | With VRD technique | 4.881 | 0.001 |
| | Without VRD technique | 8.510 | 0.002 |

Table 4: In-between group comparison for different pain scores using the Chi-squared test

| Variable | Category | Mean | Standard deviation | χ ² | p-value |
|------------|---------------|------|--------------------|----------------|---------|
| With VR | Control | 3.6 | 2.459 | 3.000 | 0.558 |
| | 5% lignocaine | 4.8 | 1.932 | 3.600 | 0.308 |
| | Freezed cone | 2.4 | 1.838 | 3.600 | 0.308 |
| Without VR | Control | 3.4 | 2.319 | 2.000 | 0.572 |
| | 5% lignocaine | 3 | 1.944 | 4.000 | 0.406 |
| | Freezed cone | 5.2 | 1.932 | 2.000 | 0.572 |

of each child varies.¹⁻¹⁵ Fear of pain is one of the reasons the child fears visiting a dentist.¹⁶

Various pain evaluation approaches, including inventories and sales, have been reported. The visual analog scale, numeric scale, and verbal rating scale for evaluating pain intensity are the most often employed in clinical and pain surveys. The most commonly used pain scales are the Numerical Rating Pain Scale; Wong-Baker Faces Pain Rating Scale; Face, Legs, Activity, Cry, Consolability Scale; Crying, Requires increased oxygen administration, Increased vital signs, Expression, Sleeplessness Scale; COMFORT Scale; Color Analog Scale, etc.

State anxiety and trait anxiety are the two types of anxiety seen in children. The transitory emotional state of the children is characterized by feelings of tension and apprehension perceived consciously while the trait anxiety refers to the stable characteristics of the child with the tendency to respond to a threat or stimulus with anxiety from the environment.¹⁶

Virtual reality (VR) is a human-computer interface, a computer-generated environment, which allows a dynamic interaction of the user with the virtual world.¹⁵ VR is a non-pharmacological distraction technique, which is commonly used by pedodontists to manage a child with fear and anxiety.¹⁷

The main purpose of our study was to compare the effects of topical anesthetics on reducing pain during injection techniques. 5% lignocaine gel which is an amino amide-type LA is used to relieve pain during needle insertion.¹⁸⁻²³ Cryotherapy or the application of ice is an effective and inexpensive way of management of pain, the mechanism mainly involved is the inhibition of nerve conduction velocity and nociceptors.²⁴ Hindocha et al. conducted a randomized crossover study to determine the efficacy of ice and lidocaine 5% gel after topical application on the oral mucosa. The study concluded that the readily available ice could be used as an alternative topical anesthetic for 5% lignocaine gel, during injection of buccal anesthesia.¹⁰ Wolf and Otto conducted a double-blinded comparative study to determine the efficacy and safety of lignocaine gel in patients aged 6 months to 8 years and found that 2% lignocaine gel could be effective in reducing pain on the oral mucosa or gingiva.¹¹ Bhushan and Nayak conducted a study to determine the effect of 5% lignocaine and 5% bupivacaine as a topical anesthetic during the extraction of teeth and found that 5% lignocaine was better than 5% bupivacaine in reducing pain.²⁵

In our study, to evaluate the pain during injection SEM scale was used. The SEM scale is used to evaluate the relationship between the pain and the feeling of the pain produced by the movement of the eyes of the patient, it is vocal and uncomfortable expressions and also capable of noting the severity of the pain feeling.²⁶ After the administration of the injection, each patient was asked by the second researcher about the pain experienced during injection using Wong–Baker Faces Pain Rating Scale. The use of a self-reported pain intensity scale also helps children, as this scale includes facial expressions to assist them and convey their feelings. Wong–Bakers Faces Pain scale has been used under guidance from the American Academy of Pediatric Dentistry (2014–15), which, because of its well-proven reliability and validity advises its usage for children over 3 years of age.²⁷ Our study had the main limitation as it was unblinded, thereby increasing the possibility of bias constantly. Neither patients nor clinicians could have been blindfolded, as it became clear which approach was employed in the case of the 5% temperature differential between lidocaine gel and ice with the various techniques of administration.

In our study maximum of around 40% of patients gave a response of a pain score of 2 in the control group using the VRD approach. In the control group without the VRD approach, 40% of the pain score 6 was reacted. The pain score of 2 in both the 5% lignocaine group with and without VRD was met by a maximum of 50 and 40% of patients, respectively. Around 50% of patients replied to a pain score of 2 in the frozen cone group with the VRD method. In the frozen cone group without VRD technology, however, 40% of patients reacted to a pain score of 4. This implied that most of the children gave the response of high pain perception during injection, the pain perception was significantly reduced in group IIA where 5% lidocaine topical gel was used along with the VRD technique as a distraction method, and also in group IIIA where the freeze-dried cone was used along with VRD technique as a distraction method. This result was in accordance with Sweta et al.¹⁸ where the author showed that VR is an excellent distraction technique for patients during the administration of LA. Our result was also in accordance with Aminabadi et al.²¹ where it was seen that cooling the injection site for a nerve block at 0°C for 2 minutes prior to injecting a LA agent substantially reduced discomfort experienced during LA administration for routine dental procedures. The child has been transmitted into another environment by using VRD which does not deal with the operator's field and noises as both the pain perception and the anxiety increase when the child focuses on the

process or the viewing of dental tools.¹⁴ A study by Hoffman compared VRD to opioids and showed that there were similar outcomes of VR and opioid analgesics in terms of pain reduction, and the combination of opioids and VR shows a considerable reduction in pain signals. Consequently, VRD can diminish the sense of pain.²⁸ However our study result was not in accordance with the study conducted by Sullivan et al.²⁹ where the author had shown that VRD had no significance in reducing pain during dental anesthesia and that few patients were more comfortable without VRD.

Ice or coolant spray precooling is another way to reduce pain sensation, which has been shown to be more effective compared to topical benzocaine anesthesia and refrigerants when managing injection-related pain. Lathwal et al. had shown that when compared to benzocaine and refrigerant, the ice cone demonstrated much superior efficiency in pain reduction.²⁶ In our study a frozen-water plastic syringe was used for the direct administration of ice on the oral mucosa, this method was presented in a study conducted by Hindocha et al.¹⁰ The approach presented in our study makes it feasible for ice and oral mucosa to connect directly during the application period. A custom-manufactured ice cone for the topical anesthetic of the injection site was utilized in a study by Lathwal et al. However, the size and form of the icing Cone were not defined, nor how the ice cone was maintained.²⁶ Jayasuriya et al. said that ice slips from the operators' hands owing to dampness and cools operators' fingers when the technique is placed directly on the oral mucosa. These issues are however not present while using our described approach, as the operator's fingers are not touching the ice itself but simply the plastic syringe.³⁰

The application of ice as a precooling agent might therefore be a useful alternative to 5% lidocaine gel, provided there are no other methods of topical anesthesia or if some pharmacological components are avoided as a result of the danger of allergic reactions or intoxication.¹⁰

CONCLUSION

The approach for the application of ice as topical anesthesia before injection on oral mucosa has a comparable impact as 5% lidocaine gel on pain reduction at needle insertion. VRD technique using the latest VR may be seen as an effective method of behavioral counseling that minimizes the experience of fear and discomfort in children during an invasive dental procedure. Thus, it can be concluded that including the VRD technique as a distraction aid, the use of the freezing cone, and 5% topical anesthetics at the injection site also reduce pain perception during anesthesia.

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