Comparison of Topical Anesthetic Gel, Pre-Cooling, Vibration and Buffered Local Anesthesia on the Pain Perception of Pediatric Patients during the Administration of Local Anesthesia in Routine Dental Procedures

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ABSTRACT

Introduction: As a dentist, administering anesthesia to patients, especially children proves to be one of the most difficult parts of a procedure. Also, poor pain control adds on to the fear and anxiety of the needle that might interfere with appropriate dental management. So, several desensitization methods were aimed to reduce are being tried out recently.

Material and methods: 40 children aged between 7 to 13 years were included. On a random basis, the subjects were allocated into four groups. Application of topical anesthesia at the site of administration of local anesthesia, pre-cooling the anesthetic site prior to the administration of local anesthesia, vibratory stimulus at the site of administration of local anesthesia, buffering the local anesthetic agent were the groups from 1 to 4 respectively. During the administration of infiltration anesthesia, the pain perception was assessed using Wong-Baker Faces Pain Rating Scale. The statistical analysis was performed using SPSS software.

Results: Greatest pain reduction was observed in the pre-cooling group with mean pain score 2.4 followed by vibration group with mean pain score 2.6 then buffered local anesthesia with mean score of 5.6 and lastly topical anesthesia with 6.2 mean score. Mann-Whitney test showed that pre-cooling was statistical significance compared with topical anesthesia and buffered local anesthesia (P<0.001).

Conclusions: Pre-cooling of the injection site before infiltration anesthesia is an easy, reliable and effective technique with no additional cost and was found to reduce discomfort and facilitate clinical management.

Keywords: Infiltration Anesthesia, Topical Anesthetic Gel, Cubed Ice, Vibratory Massager, Sodium Bicarbonate, Wong-Baker Faces Pain Rating Scale, Pain Perception

INTRODUCTION

There has been a steady rise over the last decade in the number of procedures being performed under local anesthesia that had conventionally been performed under general anesthesia.[1] As a dentist, administering anesthesia to patients, especially children proves to be one of the most difficult parts of a procedure and most commonly fear, anxiety and development of avoidance behavior in children is also due to injection. The feeling of needle and syringe carries a negative impact on child's psychology. Poor pain control adds on to the fear and anxiety of the needle and might interfere with appropriate dental management. Researches have shown that most of the pediatric patients postpone their dental visits primarily due to the fear of needles, pain and biting injury from injection.[2,3] Local anesthesia needs to be deposited as close to the nerve as possible so that optimal diffusion of the drug may occur, providing profound anesthesia and a pain-free dental experience for the kids. The importance of this is demonstrated by the fact that when pediatric patients' parents were asked to list the most important factors used when selecting an exodontist, the two most important are: a pedodontist who does not hurt and a painless injection.

Since achieving an appropriate anesthesia is critical in modern dentistry and the needle phobia has become an obstacle for pediatric patients, administrating various possible pharmacological and non-pharmacological desensitization techniques such as warming, buffering the local anesthesia, pre-cooling the site of injection, vibration or pressure, acupuncture, adjusting the rate of infiltration, hypnosis, applying topical anesthetics, computerized anesthesia delivery system (e.g., WAND), using modern devices like vibra ject, dental vibe, or accupal or jet injectors have been tried out recently.

Ice is believed to help control pain by inducing anesthetic effect around the treatment area. Investigators have also shown that it reduces edema, nerve conduction velocities, cellular metabolism, and local blood flow.[4] There have been numerous studies in medicine where pre-cooling has been used to relieve pain from a local anesthetic injection, and prevent edema. Ghaderi et al found in their study that cooling the injection site before infiltration of local anesthetics for 1 min, significantly reduces the pain perceived by pediatric patients.[5]

The gate control theory of pain is the basis behind analgesic effect of vibration. Vibration and touch receptors stimulate inhibitory interneurons in the spinal cord and results in elimination of pain transmit information by A-δ and C fibers to the second-order neurons of the spinal cord.[6]

If the pH of the anesthetic solution is raised, a higher percentage of the local anesthetic molecules is in the uncharged state, and therefore more molecules are available to cross into the nerve cells and bring about anesthesia.[7,8] Stanley F. Malamed stated that (1) buffering local anesthesia greatest patient comfort during injection; (2) more rapid onset of anesthesia; and (3) decreased post-injection tissue injury in ADSA.[9] Also Davies

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reviewed the literature on buffering local anesthetics to decrease the pain of injection and found that buffering local anesthetics with sodium bicarbonate significantly reduced injection pain.[10] Hence this study was aimed to compare the effect of various desensitizing techniques such as application of topical anesthetic gel, pre-cooling the site before administration of local anesthesia, vibration and buffering the anesthetic agent in reducing pain among pediatric patients undergoing first dental visit requiring infiltration anesthesia during routine dental procedures.

MATERIAL AND METHODS

The study was conducted on a sample size of 40 children (both male and female) outpatients aged between 7-13 years attending the Department of Pedodontics and Preventive Dentistry, Krishnadevaraya College of Dental Sciences. Ethical clearance was obtained and a prior written informed consent was taken from the parents before the start of the study.

Subjects were in good health and were not taking any medications that would alter their perception of pain. Subjects were asked for previous dental visit, post-traumatic stress disorder or specific phobia related to a dental setup and only those who can follow the instructions and be able to interpret the pain perception appropriately requiring infiltration anesthesia for routine dental procedures like extractions, crown preparation, vital pulpotomy, single visit pulpectomy and exposure of unerupted teeth were included in the study. And those with significant medical conditions, any active pathology at the site of injection were excluded from the study.

Subjects were randomly allocated in to four groups by fish bowl draw method depending on the colour of the chit that they chose. The procedure was explained both to the parents and the child. If the subject chose blue chit they were allotted into the group 1 were topical anesthetic gel (precaine gel) was applied at the site of administration of local anesthesia for 60 seconds using cotton applicator in each patient and they were made to look at a blue sand coloured 60 seconds hour glass for distraction. If the subject chose red chit from the fish bowl they were allotted into group 2 in which ice cubes made by filling water in the small finger of latex gloves were placed for 60 second and for distraction each individual were made to watch at a red sand coloured hour glass. Subjects who had chosen green chit were allotted to group 3 wherein a power driven mini vibratory massager with three heads was applied such that one vibrating sphere is located against the zygomatic arch and two spheres are located on the mandibular body and mandibular angle for mandibular infiltration anesthesia and for maxillary division injections, the vibrating spheres were relocated to provide more vibration. The vibration was applied for 60 seconds calculated using green sand coloured hour glass. And the subjects who chose purple chits were allocated into group 4 in which (LIGNOX* 2% A) with 1:1,00,000 adrenaline buffered with 8.4% NaHCO3 solution at the ratio of 1.1 mL:10 mL having pH of 7.38 ± 0.47 was administered at the site of infiltration anesthesia with puple sand coloured hour glass for distraction. Test doses for the buffered local anesthetic agent were given before the study.

Also for each of the group certain euphemistic phrases were used to relieve apprehension among pediatric patients.

STATISTICAL ANALYSIS

After infiltration anesthesia each patient was asked to individually rate their pain experience using Wong-baker Faces Pain rating scale (Figure 1). The scores were tabulated and analyzed using SPSS version 10.5. Statistical analysis was done using Chi square test, Kruskal Wallis test to find out mean scores of Wong-baker faces pain rating scale and Mann-Whitney test for pair wise comparison of pain score between the groups.

RESULTS

Greatest pain reduction was observed in the pre-cooling group with Wong-Baker FACES mean pain score 2.4 followed by vibration group with mean pain score 2.6 then buffered local anesthesia with mean score of 5.6 and lastly topical anesthesia with 6.2 mean score (Figure-2). Mann-Whitney test showed that pre-cooling was statistical significance compared with topical anesthesia and buffered local anesthesia with $P<0.001$ (table 2).

DISCUSSION

Dental anxiety and fear of needle is one of the most common problem encountered by pedodontists. Several methods are suggested to lower the discomfort of local anesthesia injection for dental procedures among which desensitizing the injection site is a recommended strategy.

Effect of topical anesthetic gel was found to be uncertain in the present study. Mixed results were observed, moreover its displeasing taste made some patients anxious. This is in accordance with the study conducted by Adriani et al[11] and Iqra

Group	N	Mean	SD	Median	Min.	Max.	Chi-square*	P value
Group 1	10	6.20	1.751	6.00	4	10	27.770	<0.001
Group 2	10	2.40	0.843	2.00	2	4		
Group 3	10	2.60	0.966	2.00	2	4		
Group 4	10	5.60	1.578	6.00	4	8		

Table-1: Pain Score of all groups under study tested by chi-square and Kruskal Wallis test

Groups under study					
Topical anesthetic gel Vs Pre-cooling	Topical anesthetic gel Vs Vibration	Topical anesthetic gel Vs Buffered anesthetic agent	Pre-cooling Vs Vibration	Pre-cooling Vs Buffered anesthetic agent	Vibration Vs Buffered anesthetic agent
P value	*P* value	*P* value	*P* value	*P* value	*P* value
<0.001	<0.001	0.529	0.739	<0.001	<0.001

Table-2: Pair wise comparison of Pain Score between the groups using Mann-Whitney test

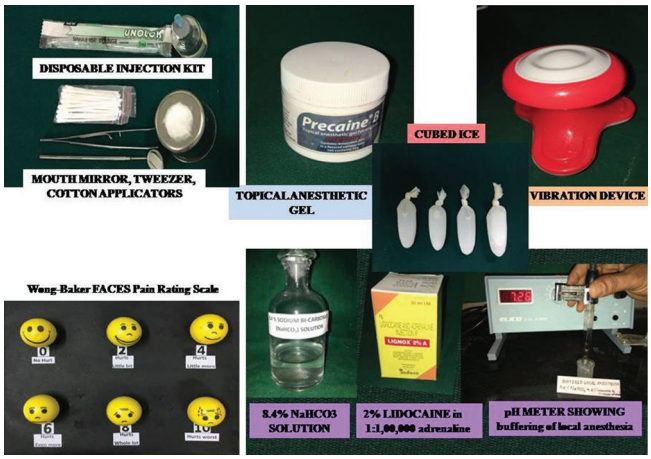

Figure-1: Showing the armamentarium for the 4 groups under study with color coding and the Wong-Baker FACES Pain Rating scale

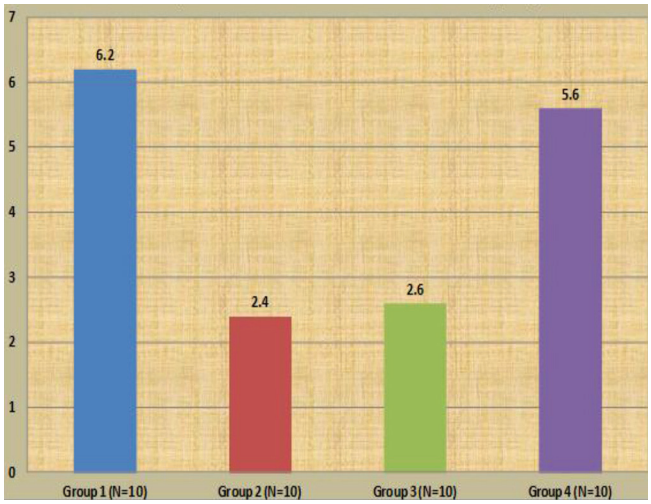

Figure-2: Comparison of mean scores of Wong-baker faces pain rating scale by Kruskal Wallis test

Mohiuddin et al.[12]

Topical cold application is believed to stimulate myelinated A fibers, activating inhibitory pain pathways, which in turn raises the pain threshold. It slows the nerve conduction, causing temporary vasoconstriction. The results of the present study showed that pre cooling of the injection site significantly reduced the anxiety and pain perceived by the pediatric patients. The present study results are supported by Harbert et al[13], Aminabadi et al[14], Kuwahara and Skinner[15], Kosaraju et al[16], who also found similar results from their studies.

Gate control theory of pain is the base of analgesic effect of vibration and it was prescribed to minimize concurrent pain. Similar findings were observed by Blair[17] using of VibraJect in children. However extra-oral vibration using massager is first of its kind used in the present study for children alleviating pain during injection.

None of our patients showed any adverse reactions with the exception of one isolated case among buffered local anesthetic group, wherein mild swelling was observed at the site of injection which gradually subsided which might be probably due to rapid injection. A study by Bowles et al found that patients experienced less pain when buffered lidocaine was used with maxillary infiltrations.[18] Kashyap et al found that buffered lidocaine decreased pain on mandibular block injections.[19] In agreement with the present study, Whitcomb et al concluded that 2% lidocaine buffered with sodium bicarbonate did not result in less pain than unbuffered anesthetic during IA injections.[20]

Also supported by skin infiltration anesthesia in children evidenced by Richtsmeier et al. and Fatovich et al.[21,22]

We had considered raising the pH of the anesthetic formulation to 7.9, which is the acid dissociation constant (pKa) of lidocaine, thereby producing equal amounts of the cation and the base form.

Several faces rating scales exist and were developed primarily for use with young children. The Wong-Baker Faces Pain Rating Scale is repeatable, easy to use and has proven to have significant positive correlation. It has been used for pain assessment in children and adults in various studies.[23] Hence in the present study Wong-Baker Faces Pain Rating Scale was used.

Another important finding of this study was that the use of euphemism like strawberry jelly for topical anesthetic gel, ice candy for ice cubes, motor bike for vibration effect and sleepy juice for buffered local anesthesia which made the patients less anxious. The patients especially presumed the ice cubes to be some form of new ice candy which made them excited and to some extent reduced the anxiety levels.

A few limitations of this study were that blinding of the patients and the examiner was not possible due to the sensation felt in each groups under the study. Negative controls such as placebo gel and sprays could not be used, since a bilateral cross-over design was used. Also, the buffering of local anesthetic agent in contrast to theoretical concept was not found to be statistically significant which might be due to manual mixing. Hence, further researches have to be carried out with sophisticated buffering devices and on a larger sum of sample for better conclusion.

CONCLUSION

Pre-cooling the injection site significantly reduced the pain perception in pediatric patients when compared to topical anesthetic gel application and buffered local anesthesia application. With little difference compared with pre-cooling even vibration stimulus was found to be effective when applied extra-orally while administering local anesthesia. Also various distraction techniques and using euphemistic phrases were found to help in reducing anxiety among pediatric subject population.

Pre-cooling of the injection site before infiltration anesthesia is an easy, reliable, and an effective technique with no additional cost and was found to be beneficial to be applied to all pediatric patients which reduces discomfort and facilitates clinical management.

Buffered 2% lidocaine with 1:100,000 adrenaline did not significantly reduce the pain clinically on injection during infiltration anesthesia in children.

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