ORIGINAL RESEARCH

A Clinical Comparison of Pain Perception and Behavior in Children Using Conventional and Vibraject Injection Techniques

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Abstract

Aim: The study was aimed at evaluating the efficacy of vibraject in reducing pain and related disruptive behavior in children who underwent routine local anesthesia procedures in the dental setting.

Materials and methods: A total of 60 healthy children who needed dental procedures on both sides of the oral cavity, which necessitates the administration of local anesthesia who visited the department, were selected for the study. The children were assigned into three groups based on their age. A split-mouth technique was used in the study. The children were given appointments for two consecutive days. In the first appointment, dental procedures were carried out with local anesthesia using a conventional injection technique, and on the next appointment, with the vibraject attachment. After the administration of local anesthesia, the evaluation of pain perception was recorded with the aid of Wong–Baker Faces Pain Rating Scale (WBFPS), followed by the assessment of the child's behavioral pattern based on Frankl Behaviour Rating Scale (FBRS).

Results: The mean WBFPS score was higher with the conventional technique in comparison to the vibraject injection technique in all three age-groups of children. The overall standard deviation (SD) value was similar with both techniques, but the overall mean value was higher for the conventional technique compared to the vibraject injection technique, which was statistically significant. The mean value for FBRS scores was higher for the vibraject injection technique in children in the 6–9-year age-group, which was not statistically significant, but the mean value was higher for the conventional technique in children in the 9–12-year age-group which was also not statistically significant. However, statistical significance was observed in the 12–15 year age-group children who had a higher mean value with the vibraject technique in comparison to the conventional technique.

Conclusion: The study gave promising results regarding the efficacy of vibraject in reducing pain and related disruptive behavior in children.

Clinical significance: Vibraject can be used as the most cost-effective and easy painless technique to administer local anesthesia in pediatric clinical settings.

Keywords: Conventional injection, Pain, Vibraject .

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Introduction

Effective local anesthesia has an important role in modern dentistry. Most pediatric patients experience fear and anxiety while given an injection of local anesthetics.[1,2] Of even greater concern, children who experience discomfort may avoid necessary dental care and may be more likely to avoid future care as adults.[3] In the field of dentistry, local anesthesia is considered as the principal means of pain control, but research has been going on to find out innovative and better means of managing the pain. To address the discomfort associated with dental injections, a number of pharmacological and alternative delivery methods have been developed. Pharmacological methods involve the use of topical anesthetics and anxiolytic drugs such as nitrous oxide and oxygen (N_2O-O_2). Unfortunately, topical anesthetics may result in allergic reactions and can combine with injected anesthetic and increase the risk of overdose.[4] Anxiolytic drugs can add to the appointment time, have side effects, and come with increased legal risks.

Alternative delivery methods for the administration of local anesthesia have included computerized delivery systems such as "The Wand" compudent system. While "The Wand" has been shown to reduce the pain associated with the delivery of the anesthetic solution, the time involved in the procedure appears to negate the device's effectiveness and generally is more expensive than conventional methods.[5] Some studies proved that vibration stimuli applied in the orofacial areas in order to raise the pain threshold could reduce pain,[6] and also another study reported that injections with vibration resulted in less pain and lower pain rating.[7] One inexpensive and potentially promising alternative to address discomfort associated with dental injections is the vibraject which was first introduced in 1995 in the USA.

The vibraject is a small device that temporarily attaches to a traditional syringe and transfers a vibrating stimulus to the needle.

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The vibration is proposed to stimulate large-diameter nerve fibers, thus inhibiting pain signals. The device is also attractive because it requires no modification to the traditional anesthetic protocol, including injection technique, patient positioning, and the time involved.[4]The vibraject works on gate control theory. The "gate control" theory was proposed by Ronald Melzack and Patrick D Wall in 1965. The theory states that pain and noxious sensations like touch, pressure, and vibrations are carried to the brain *via* thin and large-diameter nerve fibers through the dorsal horn of the spinal cord. This dorsal horn of the spinal cord acts as a "gate," which allows large fiber activity to reach the brain if its intensity is relatively higher than thin fiber activity. So, as a result, if the intensity of vibration or other noxious stimulus is more than pain intensity, the perception of pain is blocked by the dorsal grey horn of the spinal cord.[7] Since this device sounds more convincing and as there are not many studies reported to prove its efficiency, especially in children, the present study was conducted to evaluate the efficacy of the vibraject in reducing perceived pain and pain-related disruptive behavior in children undergoing routine anesthetic injections in the pediatric dental clinic setting. This study aims to provide an economical and less complicated painless alternative to conventional local anesthetic injection in pediatric patients.

Materials and Methods

The study consisted of 60 children of both sexes in the age-group of 6–15 years visiting the Department of Pedodontics and Preventive Dentistry, Sri Siddhartha Dental College and Hospital, Tumakuru, were selected for the study [Research Ethics Committee Sri Siddhartha Dental College (IEC NO: 2014-2015/11)] approval no: 2014–2015/11].

Sample Selection

To determine the sample size for this study we use the formula of "sample size calculation for the difference between means."

$$\text{Formula is: } n = 2\frac{\left(Z_{1-\alpha/2} - Z_{\beta}\right)^2 \sigma}{\left(\mu_1 - \mu_2\right)^2}$$

Where,

- n = Sample size
- α: Level of significance for a two-tailed test.
- $1-\beta$: The power of the test.
- $Z_{1-\alpha/2}$ and Z_{β} are table values from the standard normal distribution corresponding to areas $1-\alpha/2$ (area to the left of $Z_{1-\alpha/2}$) and β (area to the left of Z_{β}), respectively = 1.96 and 1.28, respectively
- σ: SD of a response variable
- $\sigma_1 = 0.3$
- $\sigma_2 = 0.38$
- $\mu_1 - \mu_2$: The expected difference between population means = (1.5–1.8)

Substituting these values obtained from published articles[1–4] in the above formula, we get $n = 20$. Hence, the study was undertaken with 20 samples in each group.

Inclusion Criteria

- Healthy cooperative children.
- Children between 6 and 15 years of age.
- Children requiring dental procedures on both sides of the dental arch where local anesthesia was mandatory.

Exclusion Criteria

- Children have significant behavior management problems.
- Children with systemic illness.
- Children with mental and physical illness.
- Children who were not willing to take part in the study.

Procedure

Before starting the clinical procedure, parental consent and ethical clearance were taken from the IEC. All the procedures were done by a single operator. The children were assigned into three groups based on their age.

- Group 1: Children in the age-group of 6–9 years.
- Group 2: Children in the age-group of 9–12 years
- Group 3: Children in the age-group of 12–15 years.

A split-mouth technique was used. Appointments were given to the children for two consecutive days. In the first appointment, dental procedures were carried out with local anesthesia using a conventional injection technique, and on the next appointment with the vibraject attachment (Fig. 1). After the administration of local anesthesia, the evaluation of pain perception was recorded with the aid of WBFPS. This rating scale is recommended for children aged 3 years and older. After the administration of local anesthesia, a brief word instruction will be given to the child to point to each face using the words to describe the pain intensity. The child was asked to choose the face that best describes his or her own pain and report it to the operator. The child was explained that each face is for a child who has no pain (hurt), or some pain or a lot of pain and it corresponds to a particular score in the range of 0–10, in multiples of 2. Based on these facts, the child was made to understand that face 0 does not hurt at all, face 2 hurts just a little bit, face 4 hurts a little more, face 6 hurts even more, face 8 hurts a whole lot, and face 10 hurts as much as you can imagine, although the child may not be crying to have this worst pain. After this, the child was asked to choose the face that best describes how much pain he or she has felt during the administration of local anesthesia. This was followed by the assessment of the child's behavioral pattern based on FBRS, which classifies the behavior of a child as definitely negative in case when there is refusal of treatment, forceful cry, fear, or any other evidence of extreme negativism.[8] The second category according to the Frankl rating scale classifies a child as negative when he or she is reluctant to accept treatment, is uncooperative and has

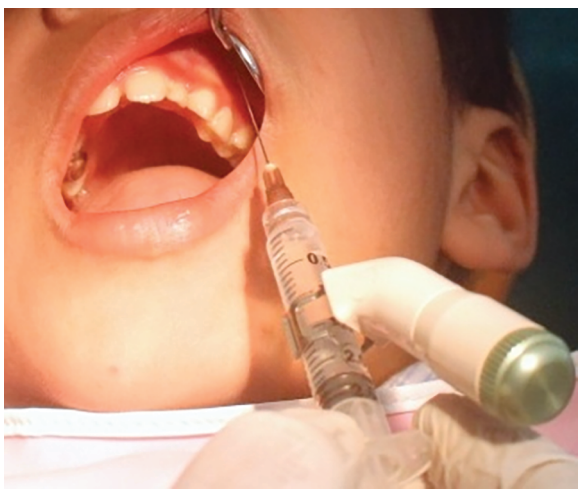

Fig. 1: Patient receiving vibraject injection

some evidence of negative attitude, which is not pronounced for example a sudden withdrawal. The Frankl rating scale classifies a child as positive if he or she accepts treatment with caution, there is a willingness in the child to comply with the dentist but with reservation, and the child follows the dentist's directions cooperatively. According to the rating scale, a child is definitely positive if he or she has a good rapport with the dentist, is interested in the dental procedures, laughs, and enjoys both the situation and the treatment.

Clinical Evaluation

After the administration of local anesthesia, the child was asked to select a face from the WBFPS, and the scores were given accordingly. This is followed by behavior evaluation based on the FBRS wherein a score of 1 was given to a definitely negative child, a score of 2 to a negative child, a score of 3 to a positive child, and a score of 4 to a definitely positive child.

Statistical Analysis

Data was collected in Microsoft excel 2007 and analyzed using Epi Info. Version 3.4.3. An unpaired *t*-test is used as the statistical method for the statistical analysis of the present study.

Results

A total of 60 healthy children who required dental procedures to be carried out on both sides of the oral cavity, which necessitates the administration of local anesthesia, who visited the department, were selected for the study. The children were assigned into three groups based on their age. Table 1 shows the distribution of cases with corresponding WBFPS scores obtained. Score 0 was recorded for 10 children with the conventional technique and 25 children with the vibraject technique. Score 2 was recorded for 42 children with the conventional technique and 34 children with the vibraject technique. Score 4 was recorded for seven children with the conventional technique, and no children had this score with the vibraject technique. Score 6 was recorded for one child with the conventional technique and one child with the vibraject technique (Table 1). The comparison of WBFPS scores between conventional and vibraject injection techniques in children of the three age groups was compared and analyzed. Unpaired *t*-test is used as the statistical method for the analysis of the present study. The children in the 6–9-year age-group showed higher mean and SD values for WBFPS scores with the conventional technique in comparison to the vibraject technique, which was not statistically significant. The children in the 9–12-year age-group showed higher values for mean and SD with respect to the WBFPS scores with the conventional technique, which was statistically significant. The children in the 12–15-year age-group showed a higher mean value for WBFPS scores with the conventional technique, but the SD value was lower compared to the vibraject technique (Table 2). Table 3 and Figure 2 show a comparison of mean WBFPS scores obtained from conventional and vibraject injection techniques in the three age groups of children. The mean WBFPS score was higher with the conventional technique in comparison to the vibraject injection technique in all three age groups of children. The overall SD value was similar with both the techniques, but the overall mean value was higher for the conventional technique compared to the vibraject injection technique, which was statistically significant (Table 3 and Fig. 3). Thus vibraject appears to give better results in all the age groups with regard to WBFPS scores.

Table 4 shows the distribution of cases with corresponding FBRS scores. Score 2 was recorded for three children with the conventional technique, but no children had this score with the vibraject injection technique. Score 3 was recorded for 45 children

Table 1: Distribution of cases with corresponding WBFPS scores

	Conventional		*Vibraject*	
WBFPS score	*No.*	*%*	*No.*	*%*
0	10	16.7	25	41.7
2	42	70.0	34	56.7
4	7	11.7	0	0.0
6	1	1.7	1	1.7
Total	60	100.0	60	100.0

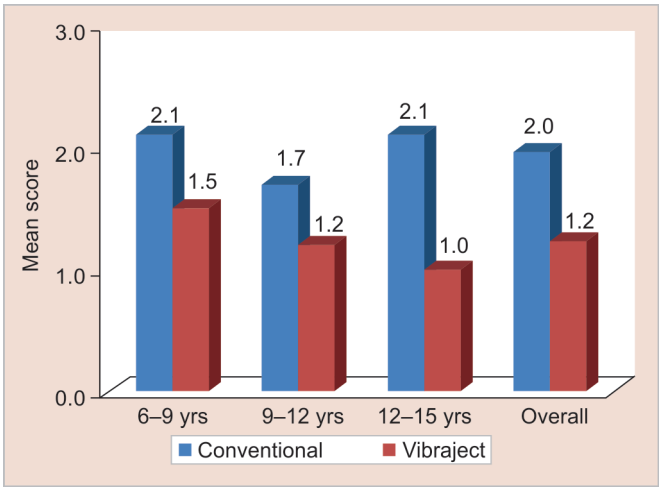

Fig. 2: Mean WBFPS scores in two techniques

Table 2: Comparison of WBFPS scores between conventional and vibraject techniques

	WBFPS Score						
	Conventional		*Vibraject*		*Conventional vs vibraject*		
Age-group (Yrs)	*Mean*	*SD*	*Mean*	*SD*	*Mean Diff*	*t value*	*p-value*
6–9	2.1	1.4	1.5	1.4	0.6	1.35	0.18, ns
9–12	1.7	1.3	1.2	1.0	0.5	1.33	0.19
12–15	2.1	0.8	1.0	1.0	1.1	3.80	0.002*
Overall	2.0	1.2	1.2	1.2	0.7	3.40	0.003*

Unpaired *t*-test; * $p < 0.05$, Sig.; $p > 0.05$, Not sig.(ns)

with the conventional technique and 42 children with the vibraject injection technique. Score 4 was recorded for 12 children with the conventional technique and 18 children with the vibraject injection technique (Table 4). Table 5 shows the comparison of FBRS scores in children of the three age groups. The mean value obtained for FBRS scores for children in the 6–9-year age-group was higher with the vibraject injection technique in comparison with the conventional technique, which was not statistically significant. The mean value for FBRS scores was higher with the conventional technique in the 9–12-year age-group children, which was also not statistically significant. Higher mean value for FBRS scores was observed with the vibraject injection technique in children in the 12–15-year age-group, which was statistically significant (Table 5). Table 6 and Figure 2 show the comparison of mean FBRS scores of conventional and vibraject injection techniques in children of the three age-groups. The mean value for FBRS scores was higher for the vibraject injection technique in children in the 6–9-year age-group, which was not statistically significant, but the mean value was higher for the conventional technique in children in the 9–12 year-age-group, which was also not statistically significant. However, statistical significance was observed in the 12–15 year age-group children who had a higher mean value with the vibraject technique in comparison to the conventional technique (Table 6 and Fig. 2). Thus the present study indicates mixed results with respect to vibraject and FBRS. Also, none of the patients from all the age groups reported any adverse reactions following vibraject injection.

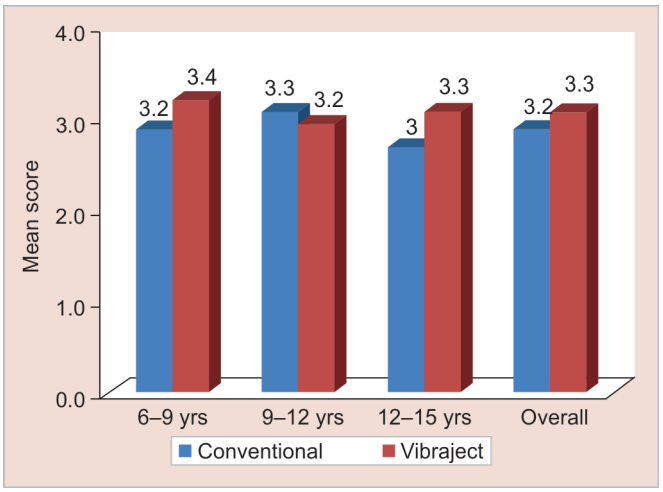

Fig. 3: Mean Frankl behavioral scores in two groups

Table 3: Comparison of WBFPS scores between conventional and vibraject techniques

6–9 yrs	*9–12 yrs*	*12–15 yrs*	*Overall*
2.1	1.7	2.1	2.0
1.5	1.2	1.0	1.2

Table 4: Distribution of cases with corresponding Frankl behavioral rating scale scores

Frankl behavior score	*Conventional*		*Vibraject*	
	No.	*%*	*No.*	*%*
2	3	5.0	0	0.0
3	45	75.0	42	70.0
4	12	20.0	18	30.0
Total	60	100.0	60	100.0

Discussion

In dentistry, pain is like a double-edged sword to the dentist. Injections play a vital role in medical and dental care. The report by the secretariat for the World Health Organization injection safety at its 107th executive board session in Geneva stated that about 12 billion injections and 100 million childhood vaccinations were given worldwide annually. Milgrom et al., in their studies, proved that injections of local anesthesia are effective methods to reduce pain, but the injection of local anesthetic itself is a great source of patient fear.[1]

Since injections are indispensable in dentistry, many advances have been made in the drug delivery system and injection techniques. An example of this would be transcutaneous electric nerve stimulation which was first used by Shane and Kessler for sedation during dental procedures in 1967.[5] To address the discomfort associated with dental injections, a number of pharmacological and alternative delivery methods have been developed. The pharmacological methods involve the use of topical anesthetics and anxiolytic drugs such as N_2O-O_2. The study conducted by Rosivack et al. showed that topical anesthesia, typically with lidocaine or benzocaine, is effective on surface tissues 2–3 mm in depth to reduce painful needle penetration of the oral mucosa.[8] Unfortunately, topical anesthetics may result in allergic reactions and can combine with injected anesthetic and increase the risk of overdose.

Alternative delivery methods for administration of local anesthesia included computerized delivery systems like the

Table 6: Mean values of Frankl behavioral rating scores in conventional and vibraject groups

	6–9 yrs	*9–12 yrs*	*12–15 yrs*	*Overall*
Conventional	3.2	3.3	3.0	3.2
Vibraject	3.4	3.2	3.3	3.3

Table 5: Comparison of Frankl behavioral rating scale scores between conventional and vibraject techniques

	Frankl behavior score						
	Conventional		*Vibraject*		*Conventional vs vibraject*		
Age group (Yrs)	*Mean*	*SD*	*Mean*	*SD*	*Mean diff*	*t value*	*p-value*
6–9	3.2	0.6	3.4	0.5	–0.3	1.45	0.16, ns
9–12	3.3	0.6	3.2	0.4	0.1	0.64	0.53, ns
12–15	3.0	0.0	3.3	0.5	–0.3	2.85	0.007*
Overall	3.2	0.5	3.3	0.5	–0.2	1.74	0.08, ns

Unpaired *t*-test; * $p < 0.05$, Sig.; $p > 0.05$, Not sig.(ns)

computer-controlled local anesthesia delivery device, compudent (WAND), and comfort control syringe, which was based on the computer program that controls the anesthetic flow and was effective in providing low-pressure injections which resulted in pain-free and precise anesthetic delivery. But the computer-aided anesthesia devices had adverse side effects, and they were much more expensive and time-consuming compared to the conventional methods. So to overcome the difficulties of conventional local anesthesia and limitations and pitfalls in advanced and alternative methods of anesthesia, one inexpensive and potentially convincing novel method called vibraject injection technique was developed, which was first introduced in 1995 in the USA. Since this device sounds promising and limited studies are available currently to prove its efficacy, the present study was to evaluate the efficacy of vibraject in reducing pain and related disruptive behavior in children who underwent routine local anesthesia procedures in the dental setting.

The vibraject is a small vibrating dental-injection attachment device. The device has a clip bracket that gets easily attached to most kinds of dental injection needles. The device has a small motor that is powered by conventional 1.5-volt batteries, and it adapts to the clip bracket. The whole assembly attaches to the needle, which causes vibrations in the range of 180 hertz. The vibraject works on gate control theory. The "gate control" theory was proposed by Ronald Melzack and Patrick D Wall in 1965.[9] This theory suggested that the pain sensation can be reduced by the activation of nerve fibers that conduct non-noxious stimuli. This theory provides an excellent basis for explaining pain mechanisms and everyday pain-reducing strategies such as rubbing the head after painfully bumping it. To simplify, the theory states that pain and noxious sensations like touch, pressure, and vibrations were carried to the brain *via* thin and large-diameter nerve fibers through the dorsal horn of spinal cord. This dorsal horn of spinal cord acts as a "gate" which allows larger fiber activity to reach the brain if its intensity is relatively higher than thin fiber activity. So, as a result, if the intensity of vibration or other noxious stimulus is more than pain intensity, the perception of pain is blocked by the dorsal grey horn of spinal cord. This is in accordance with the study done by Kakigi and Watanabe in 1996.[10] Blair J, also recommended vibraject for painless injection.[11] In addition there are many studies that confirm the efficacy of vibration tools for pain control in local anesthetic injections.[12–14]

The study included 60 healthy, cooperative children who required dental procedures to be done on both sides of the oral cavity. Children in the age-group of 6–15 years were selected for the study because children have good cognitive skills in this age-group. Children who had any significant behavior management problem, systemic, mental, or physical illness, and those children who were not willing to take part were excluded from the study. Before starting the clinical procedure, parental consent and ethical clearance were taken from the IEC. All the procedures were done by a single operator. The children were assigned into three groups based on their age. A split-mouth technique was used. The children were given appointments for two consecutive days. In the first appointment, dental procedures were carried out following local anesthesia using conventional injection technique, and on the next appointment with the vibraject attachment. After the administration of local anesthesia, the evaluation of pain perception was recorded with the aid of WBFPS. This rating scale is recommended for children aged 3 years and older. The main advantage of this rating scale is that it is relatively simple to use, reproducible, and is proven to have a remarkable positive correlation. After the administration of local anesthesia, a brief word instruction will be given to the child to point to each face using the words to describe the pain intensity. The child was asked to choose the face that best describes his or her own pain and report it to the operator. The child was explained that each face is for a child who has no pain (hurt), some pain, or a lot of pain, and it corresponds to a particular score in the range of 0–10, in multiples of 2. Based on these facts, the child was made to understand that face 0 does not hurt at all, face 2 hurts just a little bit, face 4 hurts a little more, face 6 hurts, even more, face 8 hurts a whole lot, and face 10 hurts as much as you can imagine, although the child may not be crying to have this worst pain. After this, the child was asked to choose the face that best describes how much pain he or she has felt during the administration of local anesthesia. This was followed by the assessment of the child's behavioral pattern during the dental procedure based on FBRS, which is a reliable method to assess the level of cooperativeness of pediatric patients during dental visits. This behavior rating scale classifies the behavior of a child as definitely negative in the case when there is the refusal of treatment, forceful cry, fear, or any other evidence of extreme negativism. The second category, according to the Frankl rating scale, classifies a child as negative when he or she is reluctant to accept treatment, is uncooperative, and has some evidence of a negative attitude, which is not pronounced, for example, a sudden withdrawal. The Frankl rating scale classifies a child as positive if he or she accepts treatment with caution, there is a willingness in the child to comply with the dentist but with reservation and the child follows the dentist's directions cooperatively. According to the rating scale, a child is definitely positive if he or she has a good rapport with the dentist, is interested in the dental procedures, laughs, and enjoys both the situation and the treatment. After the administration of local anesthesia, the child was asked to select a face from the WBFPS and the scores were given accordingly. This is followed by a behavior evaluation of the child during the dental procedure based on the FBRS wherein a score of 1 was given to a definitely negative child, a score of 2 to a negative child, a score of 3 to a positive child, and a score of 4 to a definitely positive child. The results of the study showed that more number of children reported no pain with the vibraject attachment device which was substantiated by the score of 0 given by them in comparison to the children in the conventional group. A little pain during the anesthesia procedure which was indicated by a score of 2 was recorded with more children in the conventional technique compared to the vibraject device and pain of increased severity during the procedure which was indicated by scores 4 and 6 were recorded by some children for the conventional technique and only one child with the vibraject attachment. The statistical analysis of this study showed an increased mean value for the conventional technique in all three age groups and an overall increased mean which was not significant. When behavior evaluation was considered, more definitely positive children were observed in the vibraject group in comparison to positive children who were higher in the conventional group. The most interesting finding of this study was that the statistical analysis gave a higher mean value for FBRS scores with the vibraject in the 12–15-year age-group which was significant. The results of the present study are in accordance with many previous studies,[6,15–19] which shows vibraject injection technique as one of the potentially promising novel method for painless local anesthetic administration in pediatric clinical scenario. This can be explained on the basis of gate control theory which suggests that pain can be reduced by

simultaneous activation of nerve fibers that conduct non-noxious stimuli.[9] When vibration is applied as a counter-stimulation to an anesthetic injection, it will first reach the brain before the sensation of pain. As the brain can perceive only one sensation at a time, the sensation that arrives at the brain first is the one that will be felt. So as counter-stimulation vibration reduces pain perception.

There have been studies on the effectiveness of the vibraject with adult patients, which have given varied results. Marie et al., investigated the effectiveness of vibratory stimulation as a means of managing orthodontic pain and found a significant difference in overall pain scores at various intervals.[15] Nanitsos et al., performed a study to investigate the effects of extraoral vibration stimuli on pain experienced during inferior alveolar nerve block and buccal infiltration injections and came to the conclusion that vibration can be used to decrease the pain during the administration of local anesthetic injections.[6] In their study patients reported lower levels of pain during anesthetic injections in the vibration group than those in the control group. Pain levels were evaluated using a visual analog scale (VAS) and the McGill pain questionnaire. They additionally performed extra-oral vibrations, which could have decreased the effects of vibration exerted through the gate control mechanism of pain control due to the presence of a distance between the injection site and the device. Chandrasekaran et al., in their study, showed that vibraject has significantly reduced pain during insertion of the needle as well as during deposition of the solution during the administration of local anesthesia in comparison with the conventional technique in adults. However, the efficacy of the device has not been effectively evaluated in children.[16] The study conducted by Chaudhry et al., was a positive attempt in this aspect, and the study gave promising results regarding the pain reduction efficacy of vibraject in children when compared with the conventional technique. If effective, the device may represent a time-efficient, nonpharmacological technique to improve the experience of children receiving local anesthesia during dental procedures. Since this device sounds more convincing and as there are not many studies reported to prove its efficiency, the present study was conducted to evaluate the efficacy of the vibraject in reducing perceived pain and pain-related disruptive behavior in children undergoing routine anesthetic injections in the pediatric dental clinic setting.[17] Recently, Vishu Midha investigated an array of techniques for administering the LA and reported that minimum pain was felt during vibraject than conventional local anesthesia techniques.[18] Fred Quarnstrom in his study where the overall evaluation of unpleasantness was less for the vibraject.[19] Another study by Roeber et al., which gave less convincing results and proved that vibraject did not provide many benefits over a conventional anesthesia injection.[20] But that may be attributed to the reason that the study lacked a crossover design which can lead to bias resulting in fewer differences between the two groups. Another pilot study was done by Saijo et al., to compare the effectiveness of vibraject with an electrical injection device reported that no benefits were observed by vibraject injection.[21] Yoshikawa et al.[22] also got neutral results in their study and reported that vibraject use found no significant difference in pain scores. One possible explanation may be that the vibrations created by the device were not that strong or effective enough to trigger the nerve ends at the injection site in most patients.[6] The sample size of the study by Saijo et al.[21] was too small, and the penetration depth and the amount of anesthetic agent injected in their study were also lower than the standard level.[20] All these elements could have contributed to their findings.

In spite of the efficacy of vibration for pain reduction during anesthetic injections, there are certain factors involved in this process that need to be explored. As these devices are battery-operated, the frequency and intensity of vibrations may change over time and may also be variable for different patients. Furthermore, different operators may perform injections in contrasting manners, and the level of pressure applied by operators to the vibration device may differ.[23] All these factors must be taken into account and thoroughly investigated in future research.

The statistical significance which was obtained in the present study regarding the positive behavioral aspects of the vibraject serves to place the study as an attempt to provide a basis for further studies in the future. The present study is carried out in a smaller sample size; hence, sound conclusions regarding the efficacy of the device in relation to pain reduction and behavior in children can only arrive at on the basis of further research, which is substantiated by larger sample sizes and better evaluation.

Conclusion

Vibraject appears to be promising in reducing the pain during local anesthesia administration and also in regulating the pain-related disruptive behavior following anesthesia in comparison to the conventional technique, so the device can definitely be considered a cost-effective and easy solution for painless and pleasant local anesthetic procedures in children.

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