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An alternative local anaesthesia technique to reduce pain in paediatric patients during needle insertion

ABSTRACT

Aim *Pain control, which is necessary during most dental procedures, is administered by injecting a local anaesthetic. Because the injection itself can be painful, the procedure via which pain is reduced warrants continued investigation. Only a few studies regarding the reaction of children to dental needle insertion without the use of topical anaesthetics have been reported. This study was conducted to evaluate the efficacy of the local anaesthetic procedure without topical application as compared to the conventional insertion technique for alleviating pain in children receiving local anaesthesia injections.*

Materials and methods *For the alternative injection procedure, the dentist quickly and gently pulled or pushed the clean and dried loose tissue at the injection site over the tip of the needle to a depth of 1 to 1.5 mm. When the end of the bevel of the needle tip entered the tissue, a few drops of solution were released, after which the needle was advanced to its proper and intended depth to continue anaesthetic release.*

Results *There was a significant difference regarding the pain response between the alternative insertion technique (less painful) and the conventional one according to Sound, Eye, and Motor (SEM) scale ratings ($P < 0.000$). No significant difference was observed in the response between the maxilla and mandible, nor between boys and girls, between the conventional and alternative techniques.*

Conclusion *This alternative technique can reduce discomfort in paediatric dental patients and allow the clinician to administer a superficial local anaesthesia injection before the needle is advanced into deeper tissue. This technique is simple, quick, devoid of additional costs, and potentially more effective than the conventional needle insertion method.*

Keywords *Local anaesthesia; needle, injection; children.*

Introduction

Administering a local anaesthetic injection to children is among the most anxiety-provoking tasks for dentists. It is universally agreed that adults should act to prevent or alleviate pain to children wherever possible. Dentists are trained in techniques that can minimise pain and discomfort, especially during the administration of local anaesthetics to children. In paediatric dentistry, the use of a topical anaesthetic agent is commonplace prior to the administration of local anaesthesia.

Even after topical anaesthesia application, however, not all patients are free from injection pain, as some experience moderate to severe discomfort. A number of studies have examined the effectiveness of topical anaesthesia in dentistry [Fukayama et al., 2002]. Some topical anaesthetics work well, whereas others are ineffective, without consistent results reported in the literature regarding their efficacy. The reasons for these discrepancies include individual differences, variations in the topical anaesthesia application procedures, and various concentrations of topical anaesthetics [Karhryn et al., 2001].

A recent survey in the United States demonstrated that most children (89%) disliked the taste, consistency, and warm/burning sensation of topical anaesthetics [Kohli et al., 2001].

Furthermore, the additional time required to apply topical anaesthetics may allow the child to become apprehensive concerning the approaching procedure, similar to the problem associated with a lidocaine patch [Karhryn et al., 2001]. In addition, some oral topical anaesthetics can produce systemic toxicity or localised allergic reactions from prolonged or repeated use [McDonald and Avery, 2000]. Therefore, the need exists to develop newer and/or better topical anaesthetic delivery systems or insertion techniques to minimise the abovementioned problems in the paediatric dental population.

Only a few studies have been reported regarding the reactions of children to dental needle insertion without using topical anaesthetics. Therefore, the purpose of this investigation was to evaluate the efficacy of a local anaesthetic procedure without topical application as compared to the conventional insertion technique for alleviating pain in children receiving local anaesthesia injections.

Materials and methods

One hundred thirty-four children between the ages of 3 to 12 who visited the department of Paediatric Dentistry, Chosun University Dental Hospital, for dental treatment requiring local anaesthesia were selected for this study, regardless of previous dental experience, and randomly divided into the following 2 groups: alternative and conventional. Gender, race, and ethnic restrictions were not applied, and emergency cases were not selected for this study. Patients who needed a mandibular block were included in both groups. Patients were excluded from the study if they had behavioural management problems.

This study protocol was approved by the Institutional Review Board (IRB) of Chosun University Dental Hospital, Gwangju, Korea. The written informed consents were obtained from all patients prior to study and they were informed about the aim of the study. All parents were informed about the treatment and associated procedures.

Reframing techniques, i.e., those using euphemistic phrases, e.g., "injecting the cotton roll only, not on your teeth", were used to describe the injection to all the children. No sedative or other pharmacological supports, such as nitrous oxide, were used in this study. Positive reinforcements and reassurance were given to the subjects throughout the insertion process.

All children in both groups were administered local anaesthesia by the same dentist who is experienced in paediatric dentistry. Short needles (21 mm, 30-gauge, SHINjetTM, Shinhung Co, Seoul, Korea) and 2% lidocaine (Lidocaine HCLTM, Yuhan Co. Seoul, Korea) with 1:100,000 epinephrine were used in both techniques.

The conventional injection technique was performed via buccal infiltration, whereby the mucosa at the injection site was dried with gauze. Topical anaesthetic gel (5% EMLA cream, AstraZeneca, Sweden) was applied to the injection site approximately 30 seconds prior to insertion [McDonald and Avery, 2000]. The loose tissue was stretched and the needle tip was gently advanced to the injection site to slowly release the drug.

For the alternative procedure, the dentist quickly and gently pulled or pushed the clean and dried loose tissue at the injection site over the tip of the needle to a depth of 1 to 1.5 mm. When the end of the needle tip bevel entered the tissue, a few drops of solution were released, after which the needle was advanced to its proper depth to continue anaesthetic release.

Topical anaesthetic gel was not used before the insertion. For the mandibular nerve block (alternative group), the same insertion procedure was performed.

All needle insertion parameters were recorded by video camera. Children were excluded if technical problems occurred during the videotaping procedures. Data recorded in the videotape were rated using the Sounds, Eyes, and Motor (SEM) scale [Wright et al., 1991] (Table 1) by 2 independent evaluators (trained dental students). Intra- and inter-rater reliabilities were established at 90%. The rating scale was divided into 2 categories of discomfort and comfort. The discomfort response was divided into the following three subscales: mild pain, moderate pain and severe pain.

Pain-behavioural parameters were evaluated using Chi-square analysis.

Results

The alternative group consisted of 80 patients between the ages of 3 to 12 (mean age 6.4 ± 2.2 years) while the conventional group consisted of 54 children aged 4 to 12 years (mean age 6.9 ± 2.2 years).

Table 2 shows the distribution of the variables for both groups. A significant difference existed regarding pain response between the alternative and conventional groups based on SEM ratings ($P < 0.000$).

Table 3 presents some of the paediatric patient responses in more detail. Children in the conventional injection group exhibited a greater range of mild to severe pain as evaluated using the SEM scale.

Table 4 compares the responses between boys and girls within the alternative group. There were no statistically significant differences among the variables. Moreover, no

OBSERVATIONS	COMFORT	DISCOMFORT MILD PAIN	MODERATE PAIN	SEVERE PAIN
Sounds	No sounds indicating pain	Nonspecific sounds; possible pain indication	Specific verbal complaints, e.g., "OW", raises voice	Verbal complaint indicates intense pain, e.g., scream, sobbing
Eyes	No eye signs indicating discomfort	Eyes wide, show of concern, no tears	Watery eyes, eyes flinching	Crying, tears running down face
Motor	Hands relaxed; no apparent body tension	Hands show some distress or tension, grasps chair due to discomfort, muscular tension	Random movement of arms or body without aggressive intention of physical contact, grimace, twitch	Movement of hands to make aggressive physical contact, e.g., punching, pulling head away

TABLE 1 The Sounds, Eyes, and Motor (SEM) scale for measuring the comfort or pain.

	ALTERNATIVE (N=80)	CONVENTIONAL (N=54)	P VALUE
Gender			
Boys	42 (52.5%)	35 (64.8%)	NS
Girls	38 (47.5%)	19 (35.2%)	
Jaw			
Maxilla	42 (52.5%)	28 (51.9%)	NS
Mandible	38 (47.5%)	26 (48.1%)	
Pain response			
Comfort	76 (95%)	32 (59.3%)	0.000 *
Discomfort	4 (5%)	22 (40.7%)	
* statistically significant difference NS not significant			

TABLE 2 Distribution of responses in the alternative and conventional groups

	COMFORT	DISCOMFORT MILD PAIN	MODERATE PAIN	SEVERE PAIN
Technique				
Alternative	76	3	1	0
Conventional	32	12	1	9

TABLE 3 Distribution of the Sounds, Eyes, and Motor (SEM) scale by technique.

	BOYS	GIRLS	P VALUE
Jaw			
Maxilla	23 (54.8%)	19 (50%)	NS
Mandible	19 (45.2%)	19 (50%)	
Pain response			
Comfort	38 (90.5%)	38 (100%)	NS
Discomfort	4 (9.5%)	0 (0%)	
Mandibular block			
Comfort	5 (83.3%)	5 (100%)	0.000 *
Discomfort	1 (16.7%)	0 (0%)	
* statistically significant difference NS not significant			

TABLE 4 Distribution of responses between boys and girls in the alternative group.

ALTERNATIVE	MAXILLA	MANDIBLE	P VALUE
Pain response			
Comfort	40 (95.2%)	36 (94.7%)	NS
Discomfort	2 (4.8%)	2 (5.3%)	
NS not significant			

TABLE 5 Distribution of responses between the maxilla and mandible

significant difference was found in the response between the maxilla and mandible, as shown in Table 5.

Discussion

The results indicated that children who received needle insertion using the alternative technique demonstrated less statistically significant levels of discomfort than those in the conventional group (Table 2). This may have resulted from differences in oral mucosa perforation, which involved 'quickly pulling' or 'pushing' the oral tissue onto the needle in the alternative group versus 'slowly advancing' in the conventional group.

In the suggested procedure, the mucosa at the injection site was stretched before it was quickly and gently pushed or pulled onto the tip of the needle located close to the mucosal surface. The depth of insertion was equivalent to that of the bevel of a 30-gauge needle (approximately 1-1.5 mm) and some droplets of local anaesthetic were released. These actions did not impair the visibility of the injection site.

The tissue was pulled down and perforated using the needle tip rather than by advancing it upward.

If the patient or the tissue at the site of needle penetration was inadvertently moved during insertion, discomfort did

occur (4/80 cases).

The responses between boys and girls in the alternative group did not exhibit significant differences (Table 4). These findings were unexpected because previous studies [Peretz and Efrat, 2000] have shown gender differences with respect to dental anxiety in general, as well as fear of the needle in particular. It has been reported that girls demonstrated significantly higher levels of fear over the needle than boys. The reason for the difference may be that previous studies involved self-reported data on previous dental experiences, especially in the waiting room before dental treatment. In the current study, evaluations of children's reactions were conducted immediately after needle insertion. Although the children saw the needle and only conventional, non-pharmacological behavioural management techniques were used, their responses were mostly favourable.

The results showed that pain-free reaction was obtained with the great majority of mandibular blocks (10/11 cases) in the alternative group (Table 4). This finding may be useful because other studies have shown that topical anaesthesia did not affect the pain experience for the inferior alveolar injection [Meechan, 2002; Nakanishi et al., 1996]. This alternative technique may be effective in reducing pain from needle insertion not only in the buccal site but also in the pterygotemporal depression. In contrast, no significant difference was observed between maxillary and mandibular insertions (Table 5).

In this study, the tissue was pierced and some droplets of solution were slowly injected. The results suggested that discomfort during transmucosal injection may not be a function of the local anaesthetic, which is not in accordance with a previous study [Kramp et al., 1999]. Further research is needed to confirm this finding.

This study assessed pain upon insertion and its results do not suggest discontinuing the use of topical anaesthetics. Nevertheless, the findings suggest that discomfort may be reduced if certain factors are well controlled during needle insertion. Topical anaesthetics, in addition to their effectiveness, may serve to reduce the anticipatory anxiety associated with an impending dental injection, thus making the injection experience less aversive.

There were some limitations to this study that may require the results to be interpreted with caution. First, this study employed 30-gauge needles and a SEM scale. The assessment of the multidimensional nature of pain with the SEM scale has been shown to be problematic and may not have accurately reflected the complexity of the pain experience. Second, this study design was not double blind, i.e., the dentist was aware of the procedure. In addition, he also served as the investigator, making the results subject to experimental bias. Nevertheless, it seems unlikely that bias would have played a factor, given that the results were consistent with what had been anticipated. Indeed, one might argue that this fact lends even more credence to the results. Finally, the operative technique and management skills also influenced the results. Because the alternative technique was performed by only one operator, the results may be specific for this one individual. In the future, it would be beneficial to compare the suggested procedure among multiple operators.

This was the first investigation assessing the efficacy of the suggested technique. However, other techniques also have advantages, and further research is required to assist clinicians in determining effective techniques in a variety of clinical conditions, as well as variables that influence technique reliability.

This technique may not be the best procedure for every child, although it may be useful in children with difficulty tolerating topical anaesthetics. However, despite its simplicity, the technique requires time and effort by the operator. As such, a 'modified' pain-free needle has been designed based on the results of this pain-free insertion technique study for easier application by beginner dental students and less-skilled practitioners.

Conclusion

This alternative technique can reduce discomfort in paediatric dental patients and enable superficial injections of local anaesthesia before the needle is advanced into deeper tissue. This technique is simple, quick, devoid of costs, and potentially quite effective, the children were not sleeping.

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