DOI: 10.1111/j.1365-263X.2009.01023.x

INTERNATIONAL JOURNAL OF PAEDIATRIC DENTISTRY

Evaluation of mandibular infiltration versus mandibular block anaesthesia in treating primary canines in children

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International Journal of Paediatric Dentistry 2010; 20: 43–49

Objective. The objectives of this study were to determine the effectiveness of mandibular infiltration compared with mandibular block in treating primary canines in children and to relate the effectiveness to the type of treatment performed.

Methods. A total of 89 children, 6–9 years old, requiring identical treatment on contralateral mandibular canines were selected. The split mouth study design was used. The anaesthetic used in both techniques was 2% lidocaine solution with 1 : 80,000 epinephrine. Dental procedures included class III, IV, and V restorations, formocresol pulpotomies, and extractions. Child's pain reaction and behaviour for each anaesthesia technique and the type of treatment were rated at certain intervals of treatment using sounds, motor, and ocular changes indicating pain and the Frankl Behaviour Rating Scale. Evaluations were made upon injection, probing, rubber dam placement, and during tooth preparation and extraction.

Results. No statistically significant difference was found between the two anaesthetic techniques for either pain or behaviour at all evaluation intervals ($P > 0.05$), during the performance of restorations, pulpotomies, or during extractions.

Conclusions. Mandibular infiltration anaesthesia is as effective as mandibular block for restoration, pulpotomy, and extraction in primary canines. The mandibular infiltration anaesthesia was not significantly less painful than the mandibular block.

Introduction

Pain control is an important part of dentistry and particularly of paediatric dentistry; the technique of local anaesthetic administration is an important consideration in the behaviour guidance of a paediatric patient[1].The mandibular nerve block is the most frequently used injection technique for achieving local anaesthesia for mandibular restorative and surgical procedures. Mandibular block has some disadvantages for children. Specifically, the lengthy duration of the anaesthesia allows for greater possibility of postoperative trauma such as lip or tongue biting. Furthermore, a successful mandibular block involves a degree of difficulty that makes the injection stressful for both the clinician and the patient[2].

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Investigations have looked at alternative techniques to mandibular block. Periodontal ligament injection delivered via a high-pressure syringe has been suggested as an alternative[3]. Branstorm *et al.*[4] reported the development of enamel hypoplasia or hypomineralization in 15 permanent teeth after periodontal ligament injections adjacent to primary dentition. Although the use of intraosseous injection has been demonstrated by Sixou and Barbosa-Rogier[5] as a primary technique in children and adolescent, the intraosseous technique may be contraindicated with primary teeth due to potential for damage to the developing permanent tooth[1].Other alternative techniques suggested include: computerized anaesthesia delivery system[6–11], the needle-free jet anaesthesia[12], and electronic dental anaesthesia[13,14]. Yet, most of the alternative local anaesthetic delivery systems represent additional costs when compared with those of conventional applications, and cost-effectiveness is an important factor to be con-

sidered when implementing these systems in dental practice[15]. Furthermore, these systems require specialized equipment that may not be readily available.

Few studies have evaluated the effectiveness of mandibular infiltration as a possible alternative to mandibular block in children[16,17]. Two comparative studies found no significant differences between mandibular infiltration and block overall[18,19]. In addition, the quality of anaesthesia was not significantly related to tooth location, age, or type of anaesthetic agent. Oulis *et al.*[20] and Sharaf[21] suggested that mandibular infiltration was less effective than block for pulpotomy procedure.

The mandibular block is usually used when treating permanent mandibular canines. Haas *et al.*[22] demonstrated that mandibular infiltration of the local anaesthesia in the mandibular permanent canine area resulted in pulpal anaesthesia in 65% of the subjects studied. Although many paediatric dentists advocate the use of mandibular infiltration for treating primary mandibular canines in their routine practice, to the best of our knowledge, no previous study focused on the effectiveness of infiltration anaesthesia in the primary mandibular canines. The aims of this study were to determine the effectiveness of mandibular infiltration compared with mandibular block in treating primary canines in children, and relate the effectiveness to the type of treatment performed.

Materials and methods

This study was performed from January 2006 to November 2008. The actual experimental group was selected from the children who were treated at the Paediatric Department Clinic at the College of Dentistry, Mosul University. The study was approved by the research ethics committee of the College of Dentistry, Mosul University. A signed informed consent was obtained from each child's parents or guardian. All children were screened at the first visit for admission to the study. To be included, children had to have essential negative medical histories with no known allergies to medications or local anaesthesia, have primary canines on both sides of the mandible requires the same type of treatment; furthermore, the mandibular canines involved in the study should not have more than half root resorption.

Children received an infiltration on one side of the mandible and a block on the other. Treatment in the mandible was completed in two visits, spaced at least 1 week apart, one visit for each side. Selection of the side to receive an infiltration or a block and the order of injection were made randomly. The site of the injection was dried with a cotton tip applicator, and topical anaesthetic (Hurricaine®; Beutlich L.P. Pharmaceuticals, Waukegan, IL, USA, 20% benzocaine gel) was applied for 60 s. For the infiltration visit, the procedure was as follows; 1.2 mL of lidocaine hydrochloride 2% containing epinephrine 1 : 80,000 (Lignospan® Septodont; Mazamet Cedex, France) was used. After initial needle penetration, a small amount of solution was injected in the superficial mucosa. After a few seconds, the needle was slowly advanced in the mucobuccal fold towards the apex of the mandibular primary canine and the remaining anaesthetic was given. No intrapapillary or lingual injection was given. A 27-gauge needle, 11 mm long (Septodent, France), was used for all infiltration injections. A 5-min waiting period elapsed before the tooth to be treated was probed labially and lingually to determine anaesthesia. A rubber dam was then applied and treatment followed. Treatment was discontinued if the child expressed signs of pain and was resumed after additional anaesthetic was given. In each case, once the rater evaluated presence of pain during a dental procedure, he/she immediately announced it and the child was crossed over to a mandibular block. For the inferior alveolar block, a 27-gauge needle, 25 mm long (Septodent), was placed medial to the internal oblique ridge with the barrel angled over the primary molars on the opposite side of the arch and advanced approximately 15 mm. Approximately 1.6 mL of 2% lidocaine, 1 : 80,000 epinephrine (Lignospan) was administered. The same syringe was used for each of the bilateral injections on the same subject. Dental procedures included class III, IV, and V restorations, formocresol pulpotomies, and extractions. All children involved in

the study were treated by the same operator (the author).

The effectiveness of each anaesthesia technique was assessed by evaluating the presence or absence of pain; during the injection, labial and lingual probing for anaesthesia, placing the rubber dam, during the use of high- and low-speed hand piece and during extraction. A separate evaluation was made during the removal of the coronal pulp during a pulpotomy procedure. No evaluation was made for the restoration following a pulpotomy. Following the injection, any sign of discomfort indicating pain upon assessment of other evaluation intervals was recorded as a presence of pain, the procedure was discontinued, and the anaesthesia technique was evaluated as inadequate. Signs of discomfort included hand and body tension, eye movement indicating pain, verbal complaints, tears, and hand and body movement. No observational scale to quantitate discomfort was used. Either there was discomfort or not and that was translated to presence or absence of pain. The child's behaviour at the stages described above was also assessed by using the Frankl behaviour rating scale (Table 1)[23]. Assessments of both pain and behaviour were made separately for each tooth treated. Children whose behaviour interfered with an assessment of discomfort or pain were removed from the study and were excluded from the data analysis. This was usually discovered at the time of injection or shortly thereafter.

Table 1. Frankl Behaviour Scale, used to measure cooperative behaviour[23].

Rating 1	*Definitely negative* Refusal of treatment, crying forcefully, fearful, or any other overt evidence of extreme negativism
Rating 2	*Negative* Reluctant to accept treatment, uncooperative, some evidence of negative attitude but not pronounced (i.e., sullen, withdrawn)
Rating 3	*Positive* Acceptance of treatment; at times cautious; willingness to comply with the dentist, at times with reservation, but patient follows the dentist's directions cooperatively
Rating 4	*Definitely positive* Good rapport with the dentists interested in the dental procedures, laughing, and enjoying

During the study, both anaesthesia techniques were evaluated blindly by a single rater (dental specialist) who was not the operator. The operator was entirely guided by the rater during all the evaluation intervals. A pilot study was conducted on a group of 12 children to refine the methodology and familiarize the rater with methodology. The treatment in both sides of the mandible was videotaped to establish rater reliability. During the pilot study, evaluations on pain and behaviour were made by the rater and an experienced paediatric dentist to establish inter-rater reliability. The *z*-test was used for statistical analysis of pain evaluation, whereas the chi-square test of independence was used to analyse behaviour. The 0.05 level of significance was used. The data were analysed using SPSS 10.0 (SPSS Inc. Chicago, IL, USA) for Windows.

Results

The initial study population consisted of 98 children; however, the results of the investigation were derived from 89 children, aged 6–9 years, 38 males and 51 females. Seven children were eliminated from the study because their behaviours did not allow reasonable pain evaluation, and two children were excluded because they failed to come to the second visit at the Paediatric Department Clinic. During the pilot study, the kappa values for intra- and inter-rater consistency ranged from 0.8 to 1.00 and 0.67 to 0.84, respectively.

The data were analysed and are presented separately for pain and behaviour assessment, relative to each type of dental procedure performed. A total of 46 restorations (28 class III, 8 class IV, and 10 class V) were completed in mandibular primary canines. Twenty-six formocresol pulpotomies were performed, and 106 primary mandibular canines were extracted. The extraction group was further subdivided into two subgroups, 72 extractions due to orthodontic considerations and 34 extractions due to other reasons – unrestorable, necrotic, or inflamed primary canines.

The success rate for mandibular infiltration and mandibular block was 85% and 95%, respectively. The number of children who

expressed signs of discomfort indicating pain during various treatments after mandibular infiltration and mandibular block was 13 and 4, respectively. The results of pain control effectiveness of the two anaesthesia techniques at each evaluation interval are presented in Table 2. No significant difference in the subjects' comfort between the two techniques was found at all evaluation intervals ($P > 0.05$), during the performance of restorations, pulpotomies, or during extractions. The mandibular infiltration anaesthesia was not significantly less painful at the injection time than the mandibular block.

Table 3 demonstrates the assessment of the subjects' behaviour for both of the anaesthesia techniques. The results indicated no difference in behaviour evaluation during restoration, pulpotomy, or extraction at all evaluation intervals ($P > 0.05$).

Discussion

This study evaluated the effectiveness of mandibular infiltration compared to mandibular block in completing various dental procedures in primary canines. The results showed that mandibular infiltration is an effective technique when performing restorations or pulpotomy or extraction in primary canines. This is consistent with the findings of Dudkiewicz *et al.*[16], Donohue *et al.*[18], and Naidu *et al.*[19], but disagrees with the results of Oulis *et al.*[20] and Sharaf[21] who found that mandibular infiltration cannot be reliable in the case of pulpotomy in the primary molars. Establishment of anaesthesia after a mandibular infiltration has been attributed to dissemination of the local anaesthetic through the mandibular bone[16]. The mandibular bone of a child is usually less dense than that of an adult, permitting more rapid and complete diffusion of the anaesthetic[24]. Furthermore, the relatively less buccal bone thickness over the primary mandibular canine compared to primary mandibular molar may help improve the success rate of mandibular infiltration of the primary canines. The diffusion of local anaesthetic through the mental foramen after mandibular infiltration may be considered as an additional explanation for the effective infiltration anaesthesia.

Although children tolerated the infiltration technique at the injection time better than the block during various dental treatments, the mandibular infiltration was not significantly less painful than the mandibular block ($P > 0.05$). This agrees with Corbett *et al.*[25], but contrasts with other studies[21,26,27] that demonstrated that mandibular block was more painful than buccal infiltration. The use of topical anaesthesia prior to injection in this study may have some effect in reducing the discomfort associated with needle penetration.

Six of the 13 children who expressed signs of pain during various dental procedures after

Table 2. Pain assessment for mandibular infiltration and block anaesthesia in children.

	Injection	*P*-value	Probing	*P*-value	Rubber dam	*P*-value	Preparation	*P*-value
Restoration								
Infiltration	10/23	0.37*	1/23	0.30*	1/23	0.54*	1/23	1*
Block	13/23		0/23		0/23		1/23	
Pulpotomy								
Infiltration	4/13	0.41*	1/13	0.29*	0/13	1*	2/13	0.27*
Block	6/13		0/13		0/13		1/13	
Extraction, orthodontic consideration	Injection		Probing				Extraction	
Infiltration	10/36	0.21*	3/36	0.30*			2/36	0.55*
Block	15/36		1/36				1/36	
Extraction, other reasons								
Infiltration	3/17	0.67*	1/17	0.30*			1/17	0.30*
Block	4/17		0/17				0/17	

Results are expressed in number of teeth with pain compliant out of the total number treated.
*No significant difference ($P > 0.05$).

Table 3. Behaviour assessment for mandibular infiltration and block anaesthesia in children.

	Injection				Probing				Rubber dam				Preparation			
Frankle Scale	**2**	**3**	**4**	***P*-value**	**2**	**3**	**4**	***P*-value**	**2**	**3**	**4**	***P*-value**	**2**	**3**	**4**	***P*-value**
Restoration																
Infiltration	11	10	2	0.82*	4	17	2	0.45*	4	17	2	0.45*	4	16	3	0.72*
Block	13	8	2		3	15	5		3	15	5		4	14	5	
Pulpotomy																
Infiltration	3	10	_	0.39*	2	9	2	0.82*	2	9	2	0.82*	3	8	2	0.53*
Block	5	8	_		1	10	2		1	10	2		1	10	2	
Extraction, orthodontic consideration	Injection				Probing								Extraction			
Infiltration	10	21	5	0.32*	5	26	5	0.9*					5	26	5	0.73*
Block	15	18	3		4	26	6						3	27	6	
Extraction, other reasons																
Infiltration	3	13	1	0.8*	2	14	1	0.82*					2	14	1	0.83*
Block	4	12	1		1	15	1						1	15	1	

Results are expressed in absolute numbers for each Frankle Scale rating within each group.
*No significant difference ($P > 0.05$).

mandibular infiltration were at lingual probing to ascertain the quality of anaesthesia. For these patients, 0.3 mL of intrapapillary anaesthesia was given and the treatment continued without obvious discomfort. The mandibular infiltration was, however, considered to be inappropriate in these children. The discomfort during lingual probing could be due to the only 5-min waiting period after infiltration in this study. In previous studies, the waiting period was 10 min and sometimes 15 min[16,17]. Five-minute waiting period was selected in this study in order to decrease the length of time the dental visit required for treating the children, and it is usually a long enough period to start any routine dental treatment[20].

No intrapapillary injection was tried in this study after mandibular infiltration; Oulis *et al.*[20] and Naidu *et al.*[19] used intrapaplliary injection in addition to mandibular infiltration. Single-needle penetration for mandibular infiltration was intended in this study in an attempt to decrease any child discomfort that may appear after subsequent needle penetrations. Although no lingual or intrapapillary injection was given after mandibular infiltration, most of children had adequate lingual anaesthesia to allow pain-free dental treatment. This may be due to the diffusion of the local anaesthetic.

In this study, the extraction group was subdivided into two subgroups: extraction for orthodontic reasons, intact primary canines, and extraction for other reasons, such as unrestorable, necrotic, or inflamed primary canines. This was done to further consider other factors that might affect the mandibular infiltration effectiveness and reliability. Inadequate anaesthesia may result when local anaesthetics are injected into inflamed or infected areas. No significant difference between the two anaesthetic techniques was observed in each of the extraction subgroups ($P > 0.05$).

To avoid difference in anaesthesia quality during the use of different local anaesthetics and to make results more comparable, lidocaine 2% 1 : 80,000 epinephrine, a local anaesthetic that is widely accepted and used in dentistry was used in this study. Wright *et al.*[17] used various local anaesthetics but failed to show any significant difference in the anaesthesia effectiveness, although the potency of anaesthesia differed markedly. Recently, Kanaa *et al.*[28] and Robertson *et al.*[29] found that 4% articaine with 1 : 100,000 epinephrine was more effective than 2% lidocaine with 1 : 100,000 epinephrine in producing pulpal anaesthesia in permanent mandibular molars after buccal infiltration in adults. Furthermore, Jung *et al.*[30] concluded that buccal infiltration with 4% articaine for permanent mandibular

first molars in adults can be a useful alternative for clinicians because compared with mandibular block it has a faster onset of action. Future studies are needed to compare the efficacy of articaine mandibular infiltration to mandibular block in children during various dental procedures.

In this study, the volume of anaesthetic used in mandibular infiltration (1.2 mL) was less than that used in previous studies[19,20]. This was considered to minimize the dose of anaesthetic used, as specific teeth may be anaesthetized with less residual anaesthesia. It was our impression during the study that the duration of lip numbness in children was shorter after mandibular infiltration than mandibular block. The above parameter, however, needs to be investigated in a future study.

Although the wide range of scales in literature that are used to measure dental pain of children, we believed that an independent trained rater (dental specialist) – who was present during the dental treatment – can adequately assess child's comfort. No continuous scale was used to measure pain. Even a single, mild sign of discomfort was perceived by the rater as the presence of pain. Sounds as well as ocular and motor changes were all taken into consideration to determine comfort. Comfort was thus translated to presence or absence of pain. Comfort and behaviour evaluations are usually adequate indicators of how well a child can tolerate a dental procedure, which is one of the goals in paediatric dentistry[20]. The small numbers of children in some groups of this study may have had some influence on the final results. Yet, it is uncommon to obtain a study population with bilateral identical treatment needs for mandibular primary canines. The Paediatric Department Clinic at the College of Dentistry/Mosul University is the only professional centre available in Nineveh Province/Iraq, which is inhabited by more than 3 million residents.

Conclusions

The results of this study indicated that mandibular infiltration anaesthesia is as effective as mandibular block for restorations, pulpotomies, and extractions in primary canines. The mandibular infiltration anaesthesia was not significantly less painful than the mandibular block.

What this paper adds

- This study has provided an insight into the reliability of mandibular infiltration anaesthesia during various treatments of primary canines.

Why this paper is important to paediatric dentists

- Paediatric dentists should be aware of the effective anaesthetic techniques during the treatment of primary mandibular canines, in order to choose the most appropriate anaesthetic approach.

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