The effectiveness of mandibular infiltration compared to mandibular block anesthesia in treating primary molars in children

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Abstract

Mandibular infiltration has been routinely avoided in treating mandibular molars because of its questionable adequacy. The purpose of our investigation was to determine the effectiveness of mandibular infiltration compared with mandibular block in treating primary molars in children, and to relate the effectiveness to age and type of treatment performed. The study population consisted of 89 cooperative children, 3 to 9 years old, requiring the same type of treatment on contralateral mandibular molars. The half-mouth study design was used. Dental procedures included class I and II amalgam restorations, stainless steel crowns, formocresol pulpotomies, and extractions. Evaluations of pain and behavior for each anesthesia technique and type of treatment were made using sounds, motor, and ocular changes indicating pain and the Frankl Behavior Rating Scale. Evaluations were made upon probing, rubber dam placement, and during tooth preparation and extraction. No statistically significant difference was found between the two anesthetic techniques for either behavior or pain when performing amalgam or stainless steel crown restorations ($P = 0.05$). Mandibular infiltration was less effective than mandibular block for pulpotomy and extraction ($P = 0.05$). No significant relationship to age as determined by primary or mixed dentition, for effectiveness was noticed. (Pediatr Dent 18:301–5, 1996)

The mandibular block is the local anesthesia technique of choice when treating mandibular primary or permanent molars. Simultaneous lingual and occasional long buccal nerve block when a mandibular block is administered, result in anesthetizing the respective half of the tongue and lower lip. Profundity of anesthesia has been the primary advantage of this technique, while anesthesia of all the molars, premolars, and canines on the side injected allows for treatment of multiple teeth of the same quadrant at one appointment. A number of disadvantages also have been associated with this technique. The duration of anesthesia makes the uncomfortable numb feeling last long after the end of dental treatment, often resulting in lip or tongue biting. Furthermore, a successful mandibular block involves a degree of difficulty[1] that makes the injection stressful for both the clinician and the patient.

Investigators have looked at alternative techniques. Periodontal ligament injection has been suggested as an alternative to mandibular block.[2] This technique is simple and seems to provide the patient with adequate pain control, without the extended period of postoperative anesthesia.[3] However, the potentially damaging effect of an anesthetic solution expressed under high pressure on the amelogenesis of the permanent tooth is a concern in treating primary teeth.[4] This side effect and the need for a special syringe makes it less attractive to the pediatric dentist.

Infiltration anesthesia has been used successfully to restore maxillary teeth but has been avoided in the mandibular molar regions because of denser bone that does not allow adequate dissemination of the anesthetic. Recently, two studies investigated the effectiveness of mandibular infiltration in restoring primary molars in children. Dudkiewicz et al.[5] restored 84 mandibular primary molars under infiltration anesthesia in 50 children ranging in age from 4 to 10 years. Articaine hydrochloride 4% was used as the anesthetic solution, and each injection was followed by a 10-min waiting period before undertaking operative dentistry. The authors, using clinical assessment criteria, concluded that infiltration anesthesia was successful in all cases. Wright et al.[6] also studied the effectiveness of infiltration anesthesia in 66 children, 42–78 months old, who required conventional operative dentistry in the first or second mandibular primary molars. Three types of local anesthetics were used, mepivacaine hydrochloride 2%, prilocaine hydrochloride 4%, and articaine hydrochloride 4%. Operative procedures were videotaped, and assessment of comfort and behavior was made using the SEM scale and the Frankl behavioral scale. Sixty-five percent of the subjects experienced

little or no pain during cavity preparation. Profundity of anesthesia was not significantly related to the three variables examined: tooth location, chronologic age, or anesthetic agent. However, neither study investigated the effectiveness of mandibular infiltration in comparison to an established anesthesia technique such as the mandibular block in treating primary molars.

The purpose of our investigation was to determine the effectiveness of mandibular infiltration compared with mandibular block in treating primary molars in children and relate it to the type of treatment performed. An attempt was made to relate the effectiveness of anesthesia established to patients' ages.

Methods and materials

The study sample consisted of 89 children, age 3–9 years, who came to a private practice seeking dental treatment. All children were screened at the first visit for admission to the study, and informed consent was obtained from each child's parent or guardian. To be included in the study the children had to meet the following criteria:

1. Were healthy, with no known allergies to medications or local anesthetic
2. Were cooperative at the initial visit
3. Had carious lesions in primary molars on both sides of the mandible requiring the same type of treatment on contralateral mandibular molars
4. Required treatment of at least one maxillary tooth.

All children had maxillary teeth treated prior to mandibular teeth to allow for adjustment to dental environment and to confirm their cooperative behavior. Treatment in the maxilla included dental procedures such as amalgam restorations, stainless steel crowns, pulpotomies, and extractions.

Subjects received an infiltration on one side of the mandible and a block on the other. Treatment in the mandible was completed in two visits — one side at each visit. Selection of the side to receive an infiltration or a block and the visit was made randomly. For the infiltration visit, the procedure was as follows. Following a 1-min application of topical anesthetic (Benzocaine 10%, Sultan Dental Products, Englewood, NJ) on dry mucosa, 1.7 ml of lidocaine hydrochloride 2% containing epinephrine 1:100,000 (Xylestesin — Forte, Espe Seefeld/Oberbay, Germany) was infiltrated in the mucobuccal fold between the roots of the first and second primary molars and in the mesial and distal papillae of the teeth to be treated. The total amount of anesthetic administered was consistent for all patients. A #30 gauge needle, 11 mm long, (Adaptic, x-short, Johnson & Johnson, Skillman, NJ), was used for all infiltration injections. A 5-min waiting period elapsed before the teeth to be treated were probed buccally and lingually to determine anesthesia. A rubber dam was then applied placing an Ivory 8A clamp on the second primary molar and treatment followed.

Treatment was discontinued if the child expressed signs of pain and was resumed after a mandibular block was given. In each case, once the rater evaluated presence of pain during a dental procedure, he immediately announced it and the child was crossed over to a mandibular block. Mandibular block was performed using the conventional technique and 1.7 ml of anesthetic. A long buccal nerve injection also was administered in all subjects as an adjunct to mandibular block to guarantee anesthesia of the buccal mucosa. A #30 gauge needle, 25 mm long (Hypo*, short, Smith & Nephew Inc, Franklin Park, IL) was used for the block injections.

Dental procedures included class I and II amalgam restorations, stainless steel crowns (SSC), formocresol pulpotomies, and extractions. Pulpotomies and extractions always followed preparation of proximal teeth for an amalgam or SSC restoration. All subjects participating in the study were treated by the same operator.

Effectiveness of each anesthesia technique was assessed by evaluating the presence or absence of pain while probing the gingivae, during placement of the rubber dam, during use of high- and slow-speed handpiece, and during extraction. A separate evaluation was made during removal of the coronal pulp during a pulpotomy procedure. No evaluations were made for the restoration following a pulpotomy. Any sign of discomfort indicating pain upon assessment of each evaluation interval was recorded as presence of pain, the procedure was discontinued, and the anesthesia technique evaluated as inadequate. Signs of discomfort included hand and body tension, eye movements indicating pain, verbal complaints, tears, and hand and body movements. 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 behavior at the stages described above also was assessed by using the Frankl behavior rating scale.[7] Assessment of both pain and behavior were made separately for each tooth treated.

During the study, both anesthesia techniques were evaluated blindly by a single rater who was not the operator. A pilot study was conducted in a group of 10 children to familiarize the rater with the methodology, and treatment in both sides of the mandible was videotaped to establish intrarater reliability. During the pilot study, evaluations on pain and behavior were made by the rater and an experienced pediatric dentist to establish inter-rater reliability.

The z test was used for statistical analysis of pain evaluation while the chi-square test of independence was used to analyze behavior. Fisher's exact test was used to determine the association between pain and behavior. Chi-square was performed with two degrees of freedom, and the level of significance was set at 95% for all tests.

Results

A total of 89 children (42 males and 47 females) par-

ticipated in the study. During the pilot study, inter- and intrarater reliability were established and found to be 90 and 92%, respectively. No subjects dropped out of the study.

Subjects were placed into two groups according to their dentition stage — primary or mixed dentition. The primary dentition group consisted of 51 children (22 males and 29 females) with an age range of 3–7 years and a mean age of 5 years. The mixed dentition group included 38 children (20 males and 18 females) with an age range of 5–9 years and a mean age of 7 years. Data were analyzed and are presented separately for pain and behavior assessment for the two dentition groups, relative to each type of dental procedure performed. A total of 102 amalgam restorations were completed in first and second mandibular primary molars — 61 in primary and 41 in mixed dentition — while 27 SSCs were placed — 16 in primary and 11 in mixed dentition. Twenty-three formocresol pulpotomies were completed in primary molars (13 in primary and 10 in mixed dentition) while 17 teeth were extracted (4 in primary and 13 in mixed dentition).

Findings from pain control effectiveness of the two anesthesia techniques at each evaluation interval in

TABLE 1. PAIN ASSESSMENT FOR MANDIBULAR INFILTRATION AND BLOCK ANESTHESIA IN PRIMARY AND MIXED DENTITION*

	Primary Dentition			*Mixed Dentition*		
	Probe	*Rubber Dam*	*Preparation*	*Probe*	*Rubber Dam*	*Preparation*
Amalgam						
Infiltration	0/61	0/61	2/61	0/41	0/41	0/41
Block	0/61	0/61	0/61	0/41	0/41	0/41
SSC						
Infiltration	0/16	0/16	2/16	0/11	0/11	0/11
Block	0/16	0/16	0/16	0/11	0/11	0/11
Pulpotomy						
Infiltration	0/13	0/13	5/13†	0/10	0/10	4/10
Block	0/13	0/13	0/13	0/10	0/10	0/10
	Probe	*Extraction*		*Probe*	*Extraction*	
Extraction						
Infiltration	0/4	1/4		0/13	2/13	
Block	0/4	0/4		0/13	1/13	

* Results are expressed in number of teeth with pain complaint out of the total number of teeth treated.

† Statistically significant at the 95% level of significance.

TABLE 2. BEHAVIOR ASSESSMENT FOR MANDIBULAR INFILTRATION AND BLOCK ANESTHESIA IN PRIMARY AND MIXED DENTITION*

	Primary									*Mixed*								
	Probe			*Rubber Dam*			*Preparation*			*Probe*			*Rubber Dam*			*Preparation*		
Amalgam																		
Frankl Scale	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
Infiltration	3	49	9	3	49	9	3	49	9	–	24	17	22	2	17	2	22	17
Block	1	47	13	1	47	13	1	47	13	–	24	17	–	24	17	2	22	17
Pulpotomy																		
Infiltration	–	11	2	–	11	2	6	5	2†	2	5	3	2	5	3	6	2	2†
Block	–	11	2	–	11	2	–	11	2	2	5	3	2	5	3	2	5	3
SSC																		
Infiltration	–	16	–	–	16	–	11	5	–	–	10	1	–	10	1	–	10	1
Block	1	15	–	1	15	–	1	15	–	–	10	1	–	10	1	–	10	1
	Probe			*Extraction*						*Probe*			*Extraction*					
Extraction																		
Extraction infiltration	1	2	1	4	–	–				–	9	4	1	8	4			
Block	1	2	1	2	2	–				–	9	4	1	8	4			

* Results are expressed in absolute numbers for each Frankl Scale rating within each group.

† Statistically significant at 95% level of significance.

primary and mixed dentition are presented in Table 1. There were 16 children who expressed signs of discomfort indicating pain during treatment after a mandibular infiltration was given — two children during an amalgam restoration, two during a SSC restoration, nine during a pulpotomy, and three during an extraction. For these patients, treatment was discontinued and then resumed after a block was administered. In primary dentition, when a class I or II amalgam restoration on a first or second primary molar was performed, no difference in subjects' comfort between the two techniques was found upon probing, rubber dam placement, or during preparation ($z = 1.426$, $P = 0.0769$ for preparation). The same was true when a SSC restoration was placed ($z = 1.461$, $P = 0.0721$ for preparation). On the contrary, mandibular infiltration did not provide adequate anesthesia when a pulpotomy was attempted, since children showed definite signs of pain during removal of the coronal pulp after an infiltration compared to a block ($z = 2.488$, $P = 0.0064$). Only four teeth were evaluated for extraction and in one case the child complained about pain following an infiltration.

Similar results were found when the two anesthesia techniques were compared in mixed dentition. No difference was found in pain assessment at all evaluation intervals, during performance of an amalgam or SSC restoration, or during an extraction. However, removal of the coronal pulp resulted in significant discomfort after a mandibular infiltration ($z = 2.236$, $P = 0.0127$).

Table 2 demonstrates assessment of the subjects' behavior for each anesthesia technique in primary and mixed dentition. Results indicated no difference in behavior evaluation during an amalgam restoration, SSC, or an extraction at all evaluation intervals in both dentitions. On the contrary, subjects showed a poorer behavior during removal of the coronal pulp after infiltration anesthesia compared with a block in primary dentition ($z = 8.250$, $P = 0.0162$), while there was no difference in mixed dentition ($x^2 = 3.486$, $P = 0.1750$).

Analysis of the results showed evidence of association between pain and behavior evaluation for all procedures and intervals examined, except during removal of the coronal pulp after an infiltration, in the mixed dentition ($P = 0.0047$ and $P = 0.0714$ for removal of coronal pulp after infiltration in primary and mixed dentition, respectively).

Discussion

Mandibular block guarantees profundity of anesthesia when it is successful, however, its success rate has been estimated to be around 85%[8] because of anatomical differences in the area of injection.[9,10] Furthermore, more discomfort is caused as a result of deeper penetration of the needle. The above, along with the difficult access in the injection area, presupposes a cooperative patient.

Mandibular infiltration has been questioned as an adequate anesthesia technique in treating primary molars.[3,11] In our study, we evaluated the effectiveness of this technique compared with mandibular block in completing various dental procedures in primary molars. Results indicated that mandibular infiltration is an effective technique when performing a class I or II amalgam or an SSC restoration in a primary molar, both in primary and mixed dentition. Behavior assessment showed that only in two of 102 teeth restored with an amalgam and two of 27 restored with a SSC, was profundity of infiltration during preparation inadequate. When a pulpotomy was attempted, infiltration was effective in only 61% of the teeth evaluated as anesthetized upon probing, rubber dam placement, and preparation. Therefore, the technique cannot be considered to be reliable in the case of a pulpotomy.

Regarding extractions, there was no difference in either pain or behavior assessment between the two techniques in the mixed dentition. In the primary dentition, however, the sample size was too small (only four teeth) to conclude definitely whether infiltration was adequate or not. The presence of a periapical abscess that makes dissemination of the anesthetic difficult and absorption slow, the degree of root resorption, and the degree of tooth destruction are all factors that can influence the duration and profundity of anesthesia. In this study, we did not perform any extractions on teeth with more than half of their roots resorbed. In addition, all teeth were sectioned prior to extraction, a technique that minimizes the amount of pressure necessary during extraction. Nonetheless, another study with a larger sample size needs to be undertaken that will consider the above factors to determine the effectiveness and reliability of mandibular infiltration in extracting primary molars.

In this study, mandibular block was found to be inadequate in only one case (extraction category in the mixed dentition). The long buccal nerve injection administered as an adjunct to block anesthesia helped result in successful anesthesia. The mandibular block as a technique in the hands of a pediatric dentist can be very effective in terms of adequacy, however, the child's comfort and the ease of administration should not be overlooked.

This was the first study performed on a primary molar to assess the effectiveness of mandibular infiltration relative to the type of dental procedure by comparing it to mandibular block using a half-mouth design. In this way, mandibular infiltration can be evaluated as an alternative to mandibular block anesthesia, and the indications of the technique can be investigated. Dudkiewicz et al.[5] found mandibular infiltration to be 100% successful in completing amalgam restorations, SSCs, and pulpotomies in primary molars. They used a different local anesthetic, infiltration at each root of the molar to be restored, a 10-min and sometimes 15-min waiting period before undertaking the procedure, as well as a smaller sample size without a comparison block. These differences can account for the disagreement with our results. Wright et al.,[6]

using objective evaluation criteria, concluded that mandibular infiltration is effective in restoring primary molars but is not reliable. These authors did not specify the type of dental procedure performed and used different local anesthetics in smaller doses. No comparison with a block was attempted.

An attempt was made in this project to study the relationship of the anesthesia established to the age of the patient. Both the primary and mixed dentition groups gave similar results regarding the children's comfort and behavior for any type of dental procedure studied. One would expect younger patients to develop a more profound type of anesthesia after an infiltration due to a less dense bone. However, findings suggest that anesthesia profundity is not as dependent upon bone density in the ages studied. Our results agree with Wright et al.,[6] who also did not find any relationship to age.

To avoid differences in anesthesia quality from using different local anesthetics and to make results more comparable, we selected lidocaine 2% 1:100,00 epinephrine — a local anesthetic that is widely accepted and used in dentistry. Wright et al.,[6] using various local anesthetics, failed to show any significant difference in anesthesia effectiveness, although the potency of the anesthetics differed markedly. Regarding tooth location, no difference in anesthesia effectiveness was found between first and second primary molar, for any type of treatment examined (data not shown).

Establishment of anesthesia after a mandibular infiltration has been attributed to dissemination of the local anesthetic through the mandibular bone.[5] In our study, lower lip numbness, although of a shorter duration than a block, was noticed after infiltrating in between the first and second primary molars. In addition, the anesthesia established allowed for restoration of the mandibular canine on the side injected without requiring additional anesthesia. Dissemination of the anesthetic through the mental foramen could explain the anesthetic effect of infiltration.

In our study, evaluation of anesthesia effectiveness was based upon assessment of the child's pain and behavior. No continuous scale was used to measure pain. Even a single, mild sign of discomfort was received by the rater as presence of pain. The child had to be completely relaxed during treatment to evaluate an anesthesia technique as adequate. 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. Taking this into consideration, we believe that an independent trained observer can adequately assess a child's comfort. Comfort and behavior evaluation are usually adequate indicators of how well a child can tolerate a dental procedure, which is one of the goals in pediatric dentistry. It was encouraging that in most cases pain assessment agreed with behavior evaluation for both anesthesia techniques. Children who complained about pain during a dental procedure also behaved poorly compared with those who did not complain about pain.

It was our impression during the study that children tolerated the infiltration technique better at the injection time than the block. Another casual observation worth mentioning was that the dose of the anesthetic administered during the infiltration can be reduced without significantly affecting the depth of anesthesia. Furthermore, our experience from treatment of primary teeth following a mandibular infiltration indicates that the dose of the anesthetic administered during the infiltration can be reduced without significantly affecting the depth of anesthesia. However, both of the above parameters should be investigated in a future study.

Conclusions

Data derived from this investigation allowed us to draw the following conclusions:

1. Mandibular infiltration is an effective and reliable local anesthesia technique for amalgam and SSC restorations in primary molars, both in primary and mixed dentition.
2. Mandibular infiltration is effective but not reliable for pulpotomy in a primary molar, either in primary or mixed dentition.

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This work was presented in part at the 2nd Congress of the European Academy of Pediatric Dentistry in Athens, Greece.

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