

A clinical comparison between maxillary and mandibular posterior teeth using local anesthesia and normal saline by the periodontal ligament injection (An in vivo study)

Majidah K.W. AL-Hashimi, B.D.S., M.S. ⁽¹⁾
Raad S. Al-Doori, B.D.S., M.Sc. ⁽²⁾

ABSTRACT

Background: Local anesthesia is the primary method used in dentistry to control patients' pain. However, even in the presence of adequate soft tissue anesthesia, there may be incomplete pulpal anesthesia. This is particularly true in the mandible where obtaining profound pulpal anesthesia may be difficult. The periodontal ligament injection has received much attention in the dental literatures. Intraligamentary anesthesia has been advocated as a primary and a supplemental injection technique. The purpose of this study is to evaluate, with electrical pulp tester, the anesthetic efficacy of the periodontal ligament injection using 2% Lidocaine with 1:80000 epinephrine and normal saline in forty volunteers. The success rate was defined as no patient's response to the maximum output of an electrical pulp tester. Also pain rating during initial needle penetration and injection of solution were compared.

Material and method: Forty adult volunteers participated in this study. The subjects were divided into four groups (10 subjects each): Group Ia: each subject received a periodontal ligament injection in mandibular first premolar and first molar right or left side with Lidocaine injection and pulp tested each minute by EPT and Ethyl chloride. Group 1b: each subject received a periodontal ligament injection in mandibular first premolar and first molar right or left side with normal saline injection and pulp tested each minute by EPT and Ethyl chloride. Group IIa: each subject received a periodontal ligament injection in maxillary first premolar and first molar right or left side with Lidocaine injection and pulp tested each minute by EPT and Ethyl chloride. Group IIb: each subject received a periodontal ligament injection in maxillary first premolar and first molar right or left side with normal saline injection and pulp tested each minute by EPT and Ethyl chloride.

Results: The results showed that the duration of profound pulpal anesthesia, using 2% Lidocaine with 1:80000 epinephrine, was 10 minutes and injection of anesthetic solution and normal saline in clinically healthy teeth were only mildly discomforting. The periodontal ligament injection using normal saline was not effective in producing anesthesia. A conclusion was drawn from the study that the periodontal ligament injection can be used effectively, as a primary injection technique, to anesthetize mandibular posterior teeth especially the first molars.

Key words: Pain, PDL, local anesthesia. (J Bagh Coll Dentistry 2012; 24(sp. Issue 1):18-23).

INTRODUCTION

Painful treatment has been shown to be important in the etiology of dental fear. People, who were hurt while receiving dental care, are more likely to avoid dental treatment ⁽¹⁾. Local anesthesia is the primary method used in dentistry to control patient's pain. However even in the presence of an adequate soft tissue anesthesia after the standard injection by block or infiltration, there may be incomplete pulpal anesthesia ⁽²⁾.

Several methods of providing local anesthesia are available. These include the periodontal ligament injection (PDL) or intraligamentary injection, the intraseptal injection, intraosseous anesthesia, and the intrapulpal injection. The PDL or the bone-tooth fibrous joint is an intricate and a dynamic system with a cross-talk between several mineralized and soft tissue ⁽³⁾. The PDL injection technique is fundamentally intraosseous injection. A small amount of anesthetic solution is deposited adjacent to the tooth to be anesthetized, and considerable diffusion of the anesthetic solution

occurs within the alveolar bone, which provides pulpal anesthesia of one or more adjacent teeth and surrounding periodontium. Attaining local anesthesia for the treatment of teeth diagnosed with irreversible pulpitis ("hot" tooth) can be a big challenge ⁽⁴⁾. Supplementary injected anesthesia is particularly suited for providing effective pain control of teeth diagnosed with irreversible pulpitis ⁽⁵⁾. It was concluded that when the inferior alveolar nerve block failed to provide profound pulpal anesthesia in mandibular posterior teeth of patients presenting with irreversible pulpitis, the intraligamentary injection was successful approximately 56% of the time ⁽⁶⁾. The PDL injection and the IO injection are effective anesthetic techniques for managing nerve block failures and for providing localized anesthesia in the mandible ⁽⁷⁾. A great advantage of this injection is its ability to achieved nearly instantaneous anesthesia of one or two teeth in the mandibular arch without use of the mandibular block technique.

PDL injection is used primarily when conventional anesthesia is not fully effective, when dentists require only a short duration of anesthesia, and when a patient wants to avoid the

(1) Professor, Department of Conservative Dentistry, College of Dentistry, University of Baghdad.

(2) Assistant lecturer, College of Dentistry, University of Sulaimani.

lip and tongue numbness associated with mandibular block injections⁽⁸⁾. The use of this technique in the maxillary arch is possible but less frequent, except in the incisal area, where supraperiosteal injection can be painful⁽⁹⁾.

Successful use of the PDL injection technique depends on generating a considerable amount of pressure during the use of a fine short needle to engage the entrance to the PDL of individual teeth. The ligmaject syringe possesses the advantages of a measured (0.2 ml) delivery of solution with each trigger pull, with a protective shield around the anesthetic cartridge to protect against accidental glass breakage.

Unlike supraperiosteal (infiltration) or block anesthetic techniques, there is little or no sensations of soft-tissue anesthesia of the nearby mucosa, lip, chin, and so forth⁽¹⁰⁾.

The aim of this study was to compare the effect of PDL injection in producing pulpal anesthesia, using 2% Lidocaine with 1:80000 Epinephrine and Saline, in human maxillary and mandibular posterior teeth by using electrical pulp tester and ethyl chloride (cold application).

MATERIAL AND METHODS

Forty adult volunteers, 23 Males and 17 Females, participated in this study. The age of subjects ranged from 18-25 years with average age of 22 years. All subjects were in good health and were not taking any medications, which might alter their pain perception. No subject had contraindications or sensitivities to a PDL injection with any of the solutions tested.

The subjects had maxillary and mandibular first premolars and first molars free of caries, deep restorations, and had no exposed dentine. Any tooth exhibited mobility, more than 0.5 mm in any direction, was excluded. All subjects had mandibular first Premolar and first molar or maxillary first premolar and first molar, left or right sound and not inflamed. Each tooth was pulp tested by electrical pulp tester and ethyl chloride before and after anesthesia, or normal saline injections to verify a base line data of vitality. The subjects were divided into four groups (10 subjects each):-

Group Ia: each subject received a PDL injection in mandibular first premolar and first molar right or left side with 2% Lidocaine injection and pulp tested each minute by EPT and Ethyl chloride.

Group Ib: each subject received a PDL injection in mandibular first premolar and first molar right or left side with normal saline injection and pulp tested each minute by EPT and Ethyl chloride.

Group IIa: each subject received a PDL injection in maxillary first premolar and first molar right or left side with 2% Lidocaine injection and pulp tested each minute by EPT and Ethyl chloride.

Group IIb: each subject received a PDL injection in maxillary first premolar and first molar right or left side with normal saline injection and pulp tested each minute by EPT and Ethyl chloride.

The saline cartridges were prepared in the following manner: Empty anesthetic cartridges and plungers were washed for 5 minutes with soap and water using a nylon brush. All cartridges and plungers were then rinsed twice with distilled water for 1 minute and autoclaved for 50 minutes. Each cartridge was filled with 1.8 mL of sterile saline and the plungers were replaced.

PDL injections were given using ligament syringe with 30-gauge ultra short needle. The needle was inserted through the mesial and distal gingival sulcus of (maxillary and mandibular first premolars) and through the mesial, distal and palatal or lingual gingival sulcus of (maxillary and mandibular first molar) to a point of maximum penetration. The bevel of the needle was directed toward the crestal bone surface, at 30-degree angle to the long axis of the tooth. The trigger of the syringe was pulled firmly until backpressure was achieved and this pressure was sustained for 20 seconds, this procedure delivered 0.1 ml of the tested solution, (Figure 1).



Figure 1: Injection technique.

The pain rating of the initial needle penetration and injection of solution were obtained and it was as follows: score zero (no pain), score one (mild pain "pain which was recognizable but not discomforting"), score two (moderate pain "pain which was discomforting, but bearable"), score three (severe pain "pain which caused considerable discomfort and was difficult to bear"), all injections were given by the principle investigator, another operator recorded the scores of pain rating and of the EPT.

Each tooth was isolated and dried with air for 10 seconds. A small quantity of Sanino tooth paste was applied at the tip of the EPT probe and the probe tip was placed on the middle third of the buccal surface at experimental teeth. The EPT

used in this study was mains-operated unipolar constant- current generator. A spring-loaded micro switch was attached to the hand electrode and was operated by the subject to start and stop the current. A micro-ammeter measured the current flow and it was calibrated from 0 to 10 micro-amperes.

Two consecutive readings were obtained as base line vitality readings, and immediately after the completion of each injection, a stop watch timer was started. The depth of anesthesia was monitored by pulp testing the teeth and Ethyl chloride stimulation (the second reading of Ethyl chloride obtained at the minute of complete anesthesia). The experimental teeth were tested at postinjection times of 1, 2, 3, 4, 5, 6... until complete anesthesia obtained, which is the absence of the patient response at the maximum output of the pulp tester. At this minute the second reading of Ethyl chloride was obtained. The electrical pulp testing was repeated each minute until the effect of anesthesia was finished and the tooth returned to the normal status.

RESULTS

Using anesthesia, the percentages of needle insertion pain ratings are compiled in Table 1. Chi-square test showed no significant difference between two types of injections regarding the pain of initial needle insertion except in score two (moderate) there was a significant difference at the level (p<0.05), (Table 2).

Table 1: Percentages of needle insertion pain ratings

Groups	None	Mild	Moderate	Severe
Anesthesia	15%	55%	27.5%	2.5%
N. Saline	5%	52.5%	37.5%	5%

Table 2: Statistical comparisons of needle insertion pain ratings

Groups	None	Mild	Moderate	Severe
	p-value	p-value	p-value	p-value
U4 & U6	1.00	0.505	0.3 17	1.00
U4 & L4	0.391	0.639	0.640	1.00
U4 & L6	0.551	0.371	0.038 *	0.391
U6 & L4	0.391	0.827	0.640	1.00
U6 & L6	0.551	0.801	0.157	1.00
L4 & L6	0.357	0.639	0.09 1	1.00

* Significant difference at level P<0.05.

The percentages of solution deposition pain ratings followed by the Chi-square test which showed no significant difference regarding pain of solution deposition at the level (p<0.05), are seen in Tables 3 and 4.

Table 3: Percentages of solution deposition pain ratings

Groups	None	Mild	Moderate	Severe
PDL A	2.5 %	40 %	55 %	2.5%
PDL N	7.5 %	37.5 %	52.5 %	2.5%

Table 4: Statistical comparisons of solution deposition pain ratings

Groups	None	Mild	Moderate	Severe
	P-value	P-value	P-value	P-value
U4A & U4N	1.00	0.178	0.34	1.00
U6A & U6N	1.00	0.424	0.227	0.391
L4A & L4N	0.850	0.476	0.396	1 .00
L6A & L6N	0.551	0.151	0.561	0.391
U4A & L4A	0.391	0.677	0.641	1.00
U4N & L4N	0.198	0.796	0.726	1.00
U6N & L6N	1.00	0.795	0.515	0.391
U6N & L6N	0.357	0.347	1.00	0.391

Table 5 represents the mean onset time in minutes and standard deviation for anesthetic PDL injections.

Table 5: Mean onset time for anesthesia only

Variable	Mean (mm)	S.D.
U4.A	4.30	1.34
U6.A	4.60	1.35
L4.A	6.70	2.50
L6.A	5.90	2.08

Tables 6, 7 and 8 show statistical comparisons of mean (anesthetic, normal saline, and the both together) onset time in minutes.

Table 6: Statistical comparisons of mean anesthetic onset time (minutes)

Groups	Mean	t	P	Sig.
U4.A	4.30	0.50	0.62	NS
U6.A	4.60			
U4.A	4.30	2.68	0.019	S
L4.A	6.70			
U4.A	4.30	2.05	0.059	NS
L6.A	5.90			
U6.A	4.60	2.34	0.036	S
L4.A	6.70			
U6.A	4.60	1.66	0.12	NS
L6.A	5.90			
L4.A	6.70	0.78	0.45	NS
L6.A	5.90			

Table 7: Statistical comparisons of mean normal saline onset time (minutes).

Groups	Mean	t-value	p-value	Sig.
U4.N	0.00	1.43	0.19	NS
U6.N	1.10			
U4.N	0.00	0.00	1.00	NS
L4.N	0.00			
U4.N	0.00	1.48	0.17	NS
L6.N	0.70			
U6.N	1.10	1.43	0.19	NS
L4.N	0.00			
U6.N	1.10	0.44	0.66	NS
L6.N	0.70			
L4.N	0.00	1.48	0.17	NS
L6.N	0.70			

Table 10: Statistical comparisons of mean anesthetic duration time in minutes.

Groups	Mean	t	P	Sig.
U4.A	3.10	2.03	0.059	NS
U6.A	4.20			
U4.A	3.10	1.73	0.11	NS
L4.A	4.70			
U4.A	3.10	4.25	0.001	HS
L6.A	8.30			
U6.A	4.20	0.54	0.60	NS
L4.A	4.70			
U6.A	4.20	3.34	0.007	HS
L6.A	8.30			
L4.A	4.70	2.50	0.024	S
L6.A	8.30			

Table 8: Statistical comparisons of mean anesthetic and normal saline onset time (minutes).

Groups	Mean	t	P	Sig.
U4.A	4.30	10.17	0.000	HS
U4.N	0.00			
U6.A	4.60	3.99	0.001	HS
U6.N	1.10			
L4.A	6.70	8.49	0.000	HS
L4.N	0.00			
L6.A	5.90	6.42	0.000	HS
L6.N	0.70			

Table 11: Statistical comparisons of normal saline duration time in minutes.

Groups	Mean	t-value	p-value	Sig.
U4.N	0.00	1.50	0.17	NS
U6.N	0.20			
U4.N	0.00	0.00	1.00	NS
L4.N	0.00			
U4.N	0.00	1.41	0.19	NS
L6.N	0.30			
U6.N	0.20	1.50	0.17	NS
L4.N	0.00			
U6.N	0.20	0.40	0.70	NS
L6.N	0.30			
L4.N	0.00	1.41	0.19	NS
L6.N	0.30			

Table (9) represents the mean duration time in minutes and standard deviation for anesthetic PDL injections.

Table 9: Mean anesthesia duration in minutes.

Variable	Mean(mm)	S.D.
U4.A	3.10	1.20
U6.A	4.20	1.23
L4.A	4.70	2.67
L6.A	8.30	3.68

Tables 10, 11, and 12 represent statistical comparisons of mean (anesthetic, normal saline, and the both together) duration time.

Table 12: Statistical comparisons of mean anesthetic and normal saline duration time in minutes.

Groups	Mean	t	P	Sig.
U4.A	3.10	8.19	0.000	HS
U4.N	0.00			
U6.A	4.20	9.73	0.000	HS
U6.N	0.20			
L4.A	4.70	5.57	0.000	HS
L4.N	0.00			
L6.A	8.30	6.76	0.000	HS
L6.N	0.30			

DISCUSSION

In this study, the pain rating regarding needle insertion and solution deposition pain was mild to moderate discomforting. Several factors may explain the results of this study. First, no topical anesthetic was used. Second, pain perception can be modified by psychological, social, and situational factors. These factors can modify the normal response evoked by a relatively constant noxious stimulus so that the resulting pain sensation may be enhanced or reduced. Fear and anxiety may lower the pain threshold resulting in

that the non-painful stimuli will be experienced as painful stimuli⁽¹¹⁾. It is well known that previous painful treatment is very important in the etiology of dental fear⁽¹⁾. Some patients may have a good dental experience and generally find the injections painless. Others may have bad experience with both solutions and fear of the PDL injection because of the gun-like appearance of the syringe and generally find both solutions painful. Pain on injection of the anesthetic solution could be due to the low pH of the solution, which have been thought to cause burning sensation and thus the use of anesthetic solution with more neutral pH could reduce pain during injection of solution⁽¹²⁾.

Also, some of the discomfort caused during the injection could result from distension of the tissue and a local rise in pressure. Pain threshold and tolerance of each patient may vary and the results should be considered subjective evaluation of local anesthesia techniques⁽¹³⁾.

The results of this study demonstrated that 2% lidocaine with 1:80000 epinephrine produced significantly higher rates of successful pulpal anesthesia and the duration of anesthesia for lower first molars was greater than other teeth, which is may be due to the adjacent compact bone, therefore, there will be less amount of anesthesia infiltrated to adjacent bone and tissue, so more amount of anesthesia will reach the apex of the tooth.

In the present study, the success rate of injection of the anesthetic agent was 79.45%; indicating that the most important factor in the success of the PDL injection is the local anesthetics injected under strong backpressure. It was reported that, when PDL injection was given under a strong backpressure, the injected material would spread throughout the PDL, periapical tissues, medullary bone, and pulps of injected and adjacent teeth⁽¹⁰⁾.

It was documented that the duration of PDL anesthesia was unpredictable in some cases lasting just for few minutes but the depth of anesthesia was generally sufficient for both operative and endodontic procedures⁽¹⁴⁾. A clinical study has shown that profound pulpal anesthesia durated up to 20 minutes (using 2% Lidocaine with epinephrine)⁽¹⁵⁾. In this study, the mean duration time for PDL anesthesia was approximately 10 minutes using 2% lidocaine with 1:80000 epinephrine.

The results of this study, regarding the onset time, demonstrated that the onset time for mandibular first premolar was greater than the other teeth and this was due to its place on the corner of the mouth that has the amount of density

of bone more than the other and so less solution will be lost on infiltration.

Zakaria proved that the success rate of PDL injection anesthesia for crown preparation was 73.33% as a primary injection technique⁽¹⁶⁾. The PDL injection may be safer to patients of high blood pressure with ischemic heart diseases compared with IAN block injection which may be of a higher risk of rapid anesthesia diffusion into the general circulation⁽¹⁶⁾.

The results of this study demonstrated that 2% lidocaine with 1:80000 epinephrine produced significantly higher rates of successful pulpal anesthesia than saline. The highest success rate of pulpal anesthesia for 2% lidocaine with epinephrine was 79.45%.

CONCLUSIONS

1. Periodontal ligament injection is an effective technique in providing profound pulpal anesthesia for upper and lower posterior teeth especially for lower first molars.
2. Pain association with insertion of needle and deposition of solution was acceptable.
3. Anesthesia produces significantly higher rates of successful pulpal anesthesia than saline, so saline is not enough to produce profound anesthesia.
4. Good anesthesia may be gained with less amount of anesthetic solution.

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