Comparison of Anaesthetic Efficacy of 4% Articaine Primary Buccal Infiltration Versus 2% Lidocaine Inferior Alveolar Nerve Block in Symptomatic Mandibular First Molar Teeth

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ABSTRACT

Objective: To evaluate success of pulpal anaesthesia of mandibular 1st molar by using 4% articaine in buccal infiltration versus 2% lidocaine in inferior alveolar nerve block.

Study Design: Randomized control trial.

Place and Duration of Study: Department of Operative Dentistry, Sardar Begum Dental College, Gandhara University, Peshawar, from March to August 2014.

Methodology: One hundred and fifty-six emergency patients, who had 1st molar diagnosed with irreversible pulpitis, participated in the study. Subjects were divided into two groups by random allocation. One group received 4% articaine buccal infiltration and the other group received inferior alveolar nerve block of 2% lidocaine. Subjects’ self-reported pain response was recorded on Heft Parker Visual Analogue Scale after local anaesthetic administration during access cavity preparation and pulp extirpation.

Results: Mean age of subjects was 31.46 ±10.994 years. The success rate of 4% buccal infiltration was 76.9%; whereas the success rate of 2% lidocaine inferior alveolar nerve block was 62.8%. There was no statistically significant difference between the two groups.

Conclusion: 4% articaine buccal infiltration can be considered a viable alternative to 2% lidocaine inferior alveolar nerve block in securing successful pulpal anaesthesia for endodontic therapy.

Infiltration is significantly better than lidocaine buccal infiltration in mandibular molars.\textsuperscript{10,11} Success rates of 64\% and 54\% were recorded for an articaine formulation in these studies. Articaine and lignocaine has similar success rates when used for administering the IANB.\textsuperscript{12} When articaine is used either for an IANB or buccal infiltration, both techniques have similar success rates in providing mandibular 1st molar pulpal anaesthesia; however, a buccal infiltration has a faster latency.\textsuperscript{11} A recent study found that IANB anaesthesia with 4\% articaine plus buccal infiltration of 4\% articaine has a higher success rate (88\%) than IANB anaesthesia of 2\% lidocaine plus buccal infiltration of 2\% lidocaine.\textsuperscript{13} Corbett \textit{et al.} and Subbiya \textit{et al.} compared anaesthetic efficacy of 4\% articaine buccal infiltration vs. 2\% lidocaine IANB and showed that articaine buccal infiltration had a success rate of 74\% while success rate of 2\% lidocaine IANB was 55\%.\textsuperscript{10,14}

Degree of pulpal anaesthesia obtained after buccal infiltration of articaine depends on density of buccal cortical bone. Racial differences in bone density are well established. Bone mineral density could be a factor that can affect the dissociation of articaine into the mandible.

The rationale of this study is that very limited data is available locally or regionally where anaesthetic efficacy of 4\% articaine primary buccal infiltration is compared to 2\% lidocaine inferior alveolar nerve block in symptomatic mandibular 1st molar teeth. Therefore, purpose of this randomized, clinical trial was to compare the pulpal anaesthesia obtained with 4\% articaine primary buccal infiltration, against 2\% lidocaine inferior alveolar nerve block in symptomatic mandibular 1st molar teeth in a sample of Pakistani population.

**METHODOLOGY**

This study was approved by the Institutional Review Board of the Sardar Begum Dental College, Gandhara University, Peshawar, Pakistan. One hundred and fifty-six subjects experiencing moderate to severe pain in mandibular 1st molar, recruited from the outpatient department between March to August 2014, participated in this study. All subjects were in good health and were not taking any medications that would alter pain perception as determined by written health history and oral questioning. Sample size was calculated using WHO sample size calculator keeping confidence level 95\% and power of test 80\%. One hundred and fifty-six subjects participated in the study with 78 subjects in each group. Written informed consent was obtained from each subject.

Healthy volunteers aged between 18 and 60 years, who needed endodontic treatment in mandibular 1st molar teeth, fulfilling the criteria of symptomatic irreversible pulpitis and patients who were not on any medication that could alter the effect of local anaesthesia, were included in the study. Subjects placed under American Society of Anesthesiologists IV classification of systemic disorders, allergic to local anaesthesia, pregnancy and inability to give informed consent, were excluded from the study.

After history taking and investigations (periapical radiographs and pulp vitality tests), subjects were divided into two groups by random allocation using lottery method. Before starting the procedure, the subjects were asked to rate their pain on Visual Analogue Scale (VAS) to get the baseline reading of pre-operative pain. All anaesthetic injections were administered by a single operator, who was not involved in assessing the outcome. The injections were administered with a 27-G needle (brand name) attached to a standard aspiring syringe, and the anaesthetic solution (brand name) was deposited at a rate of 1.8 ml per 60 seconds. Group 1 consisted of subjects who received a standard IANB of 2\% lidocaine with 1:100,000 epinephrine using 27 guage 0.4 x 42 mm needle. After reaching the target area, aspiration was done, and 1.8 ml of local anaesthetic solution was deposited. Group 2 consisted of subjects who received BI of 4\% articaine with 1:100,000 epinephrine using 27 guage 0.4 x 25 mm needle. Buccal infiltration was administered adjacent to mandibular 1st molar, bisecting the approximate location of the mesial and distal roots. Induction of anaesthesia was evaluated after 10 minutes. Anaesthesia was evaluated by lip numbness and Electric Pulp Tester (EPT).

Subjects of both groups underwent same procedure which included rubber dam isolation, preparing the access cavity, and performing the initial filling of the canals. Subjects of both groups were instructed to raise their hand if they felt any pain. Subjects were considered successful in their respective group if they felt no pain or weak/mild pain on access cavity preparation and pulp extirpation. Subjects who reported moderate to severe pain (VAS) during access cavity preparation and pulp extirpation, were administered supplementary injections (intra-ligamental, intra-pulpal or intra-osseous), accordingly. They were considered as unsuccessful in their corresponding technique.

Visual Analogue Scale (VAS) was used to assess pre-operative pain and pain during the procedure. VAS was explained to every subject before starting treatment.\textsuperscript{15} To interpret the data, VAS was divided into 4 categories. No pain corresponded to 0. Mild pain was defined as greater than 0 and less than 4. Mild pain included the descriptors of faint, weak, and mild pain. Moderate pain was defined as greater than 4 and less than 7. Moderate pain included the descriptors of average, modest and medium. Severe pain was defined as equal to or greater than 7. Severe pain included the descriptors of strong, intense, and maximum possible. Mean values and
standard deviation were calculated for quantitative variables like age, pain score, before administration of local anaesthesia and pain score after the administration of local anaesthesia. Frequency and percentage were calculated for qualitative variables like gender, local anaesthetic technique and anaesthetic success. The outcome of anaesthetic technique was marked as successful or unsuccessful. Pearson chi-square test and Fisher's exact test were applied using SPSS version 20 to compare anaesthetics efficacy of the two groups. Results were taken as significant at p < 0.05.

RESULTS

Volunteers were recruited from the outpatient department of Operative Dentistry, Sardar Begum Dental College. The study sample was calculated to be 156. Ninety two subjects were males. Average age of subjects was 31.46 ±10.994 years. Table I shows average pain score before starting the treatment. The overall success and failure rate of both anaesthetic techniques is shown in Table II.

Sixty subjects experienced anaesthetic success (76.9%) after buccal infiltration of 4% articaine compared to 49 subjects (62.8%) who received IANB of 2% lignocaine. This difference was not significant (p=0.055, Table II). Both groups were stratified with respect to age and gender (Tables III and IV) and no significant difference was found. No adverse reactions were recorded after administration of local anaesthesia with either technique.

Table I: Mean pain with standard deviation which subjects experienced before administration of local anaesthesia and pain during the procedure.

<table>
<thead>
<tr>
<th>Local anaesthesia technique</th>
<th>Pain before treatment (mean ± SD)</th>
<th>Pain during treatment (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IANB</td>
<td>3.8667 ± 0.77421</td>
<td>2.1538 ± 0.47446</td>
</tr>
<tr>
<td>STD Deviation</td>
<td>0.77421</td>
<td>0.47446</td>
</tr>
</tbody>
</table>

Table II: Number of subjects who secured successful anaesthesia after administration of local anaesthesia.

<table>
<thead>
<tr>
<th>Anesthetic efficacy</th>
<th>Local anaesthetic technique</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inferior alveolar nerve block with lignocaine</td>
<td>Buccal infiltration with articaine</td>
</tr>
<tr>
<td>Yes</td>
<td>49</td>
<td>60</td>
</tr>
<tr>
<td>No</td>
<td>29</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
<td>78</td>
</tr>
</tbody>
</table>

p-value = 0.055

DISCUSSION

Although IANB is a common technique for anaesthetizing mandibular teeth, yet it has a number of complications. Lignocaine when administered as IANB has a failure rate of 15 - 20%, especially in cases of irreversible pulpitis. IANB produces unnecessary anaesthesia of full quadrant and half tongue, which is sometimes quite disturbing for the patients. Although buccal infiltration is not without disadvantages, avoiding IANB has many advantages. Trismus and nonsurgical paraesthesia, due to needle injury to inferior alveolar or lingual nerve, are avoided in infiltration technique. It produces less unwanted soft tissue anaesthesia. In addition, infiltration technique can be preferred in certain patient groups such as patients suffering from haemophilia in order to avoid chances of dangerous haemorrhage.

So the aim of this study was to find out an alternative technique which is simple and produces profound anaesthesia of specific tooth without involving other adjacent structures and tissues.

A total of 156 subjects were treated in the study, 78 of whom received 4% articaine buccal infiltration. The primary anaesthetic efficacy parameter was the subjective evaluation of pain during access cavity preparation and pulp extirpation. Evaluation of pain was done on VAS, which provided validated and meaningful measure of anaesthetic efficacy. The patients’ age, gender and initial pain score were not statistically significant between the two groups at the start of study (Table I).

Results of this study showed that successful pulpal anaesthesia achieved after 4% articaine buccal infiltration was 76.9%. This is similar to that reported by Currie et al. who reported 72.7% success rate of articaine in buccal infiltration. The success rate of buccal infiltration of articaine in this study is similar to the work of Ashraf et al., although they had administered buccal infiltration after the failure of IANB with articaine in mandibular 1st and 2nd molars. As this study did not include 2nd molars, which have thicker buccal cortical plates, that’s why our results were matched with the results of Ashraf et al. Success rate of 87% has been reported by Robertson et al. which is on a higher side as compared to this study. Higher success may be due to lower sample size and inclusion of only asymptomatic
teeth. Higher success rate in asymptomatic teeth may be because of the absence of local acidosis and absence of activation of nociceptors due to inflammation, thereby enhancing anaesthetic success. Study by Kanaa et al. showed better results (84%) after buccal infiltration of articaine. This may be due to higher volumes of anaesthetic solutions used (2.0 ml) compared to this study (1.8 ml) and assessment of asymptomatic teeth with EPT.

After the administration of local anaesthetic (articaine / lidocaine) by either technique, a wait of 10 - 15 minutes was observed for induction of anaesthesia. This is based on time as suggested by previous studies for injection to take full effect.

Anaesthetic success in this study after buccal infiltration of articaine was higher than the values reported by Dressman et al., Corbett et al. and Haas et al. as 59%, 65% and 64%, respectively. Dressman injected local anaesthetic at the site of mental foramen which may have caused reduced anaesthesia in mandibular 1st molar tooth. Lower value in the study by Jung et al. of 54% may be due to race specific effect.

Lip numbness was present in all subjects in this study. This may be due to close proximity of the mental nerve to the mandibular 1st molar tooth.

To assess pulpal anaesthesia, different techniques have been used. Bjorn used EPT in his study. Maximum stimulation of EPT was applied and subjects with negative response were correlated to painless dental treatment. EPT is used frequently before endodontic treatment for assessing the pulpal anaesthesia in teeth with normal and inflamed pulps. However, the pulpal anaesthesia is not guaranteed in teeth with irreversible pulpitis, to no response with EPT only. Hence, the best alternative is measurement of pain, while access cavity stimulation of EPT was applied and subjects with negative response were correlated to painless dental treatment.

Anaesthetic success of 4% articaine BI was statistically comparable to success rate of 2% lidocaine IANB. This anaesthetic success of articaine may be attributed to concentration effect. Articaine, which is 4-methyl-3 (2-[propylamino]propionamido)- 2-thiophene carboxylic acid, methyl ester hydrochloride is the only amide local anaesthetic that contains a thiophene ring and an additional ester ring. This thiophene ring increases its liposolubility as well as its potency. Penetration of articaine through buccal cortical plate is also dependent of density and porosity of bone, which vary among races. Robertson and colleagues suggested BI of articaine might be due to penetration of solution through mental foramen leading to higher success rate in premolars and 1st molar teeth.

There are some limitations to this study. Duration for which the local anaesthetic agent remained effective, was not measured. This is an important factor as some of the dental procedures may take longer time to complete. Post-injection discomfort was not assessed.

**CONCLUSION**

Within the limitations of this study, we can conclude that there is no statistically significant difference between articaine buccal infiltration and lidocaine inferior alveolar nerve block. It can be deduced that a better substitute for IANB in symptomatic mandibular 1st molar teeth is BI of 4% articaine as it has similar success and fewer complications.

**REFERENCES**


