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Original Research Article

Comparative evaluation of anesthetic efficacy of buccal & palatal infiltration of maxillary permanent first molar: An in vivo study

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ABSTRACT

Background: An essential pre-requiste to success in dentistry is to achieve good quality local anesthesia. Local anesthesia forms the backbone of pain control technique in dentistry & there has been substantial research interest in finding safe & more effective technique for maxillary 1st molar.
Aim & Objective: The purpose of this prospective, randomized, single-blind crossover study was to evaluate the anesthetic efficacy of a combination of buccal and buccal plus palatal infiltration of the maxillary first molar.
Materials and Methods: In a crossover study, 42 participants received two maxillary first molar injections at separate appointments spaced by at least a week. Each side of the mouth acted as either the experimental or control group. The anesthetic used was 2% lidocaine with 1:80,000 epinephrine.One injection set consisted of a buccal infiltration of 1 mL of 2% lidocaine with 1:80,000 epinephrine followed by a palatal infiltration of 0.5 mL of the same anesthetic two minutes later. The other set involved a 1 mL buccal infiltration of 2% lidocaine with 1:80,000 epinephrine followed by a same palatal infiltration, where only the needle pierced the palatal tissue. The first molar was tested for pulp sensation using an electric pulp tester five minutes after the final injection. The testing continued at two-minute intervals for ten minutes, reaching a maximum of 80 readings. Anesthetic success was defined as the absence of a response to two consecutive readings of 80 on the electric pulp tester. If a participant did not achieve anesthesia within ten minutes, they were excluded from the study. The depth of anesthesia was monitored throughout using the electric pulp tester. Pulp test readings were also taken on the buccal and lingual surfaces of the first molar five minutes after the final injection.
Results: The success rates were 78.6% for the buccal infiltration and 92.8% for the buccal plus palatal infiltration. The difference was not statistically significant. The buccal plus palatal infiltration significantly increased the incidence of pulpal anesthesia from 21 minutes through 57 minutes. Although there was an increased incidence of pulpal anesthesia with the combination buccal plus palatal infiltration, anesthesia was not provided for 60 minutes.
Conclusions: In conclusion, adding palatal infiltration of 0.5ml of 2% lignocaine with 1:80,000 epinephrine with the buccal infiltration did not significantly increase the anesthetic success in maxillary first molar.

1. Introduction

Discomfort is a frequent occurrence in dental procedures. Throughout history, dentists have employed numerous techniques to achieve numbness, such as electrical

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stimulation, cold-induced anesthesia, and pressure anesthesia, in order to alleviate pain and facilitate surgical interventions. Dentistry has consistently strived to be at the leading edge of providing patients with comfortable experiences.[1] Local anesthetics are substances that temporarily halt the transmission of nerve membrane action potentials. A fundamental requirement for dental proficiency is the attainment of effective local anesthesia. This plays a crucial role in alleviating the apprehension and distress often linked with dental procedures. While numerous local anesthetics exist, lidocaine stands as the benchmark, offering a broad array of vasoconstrictive agents that enhance both clinical effectiveness and the duration of local anesthesia.[2] Epinephrine extends both the length and intensity of anesthesia. It proves efficient in averting or minimizing blood loss during surgical interventions.[3]

The upper first molar boasts the greatest volume among teeth and ranks among the most intricate in terms of root and canal anatomy, and has thick zygomatic buttress bone. To numb the upper molars for root canal treatment (endodontic purpose), dentists typically use a combination of techniques. The main one is a block injection targeting the posterior superior alveolar nerve (PSAN). This is often supplemented with injections directly into the gum tissue around the tooth (infiltration anesthesia), either alone or with additional injections on the cheek and palate sides (buccal and palatal infiltration). But PSAN block is not routinely used due to its nonreliable landmark, complex technique, variation in depth and complication (like hematoma (most commonly) diplopia, blurring of vision etc.).[4] A frequently used technique for numbing the upper teeth is local infiltration. During this procedure, the numbing medication seeps through the spongy bone and the thin, hard outer layer, achieving a success rate of 72% to 100% for healthy tooth pulp.[5]

The most commonly used anesthetic agent in India is 2% lignocaine with 1:80,000 epinephrine. This study was designed to evaluate the effect of a combination of buccal and palatal infiltration in healthy, asymptomatic vital pulp of the maxillary first molar using 2% lignocaine with epinephrine (1:80,000 dilution).

2. Materials and Methods

A total of 42 healthy individuals, both men and women, ranging in age from 18 to 65, enrolled in this clinical investigation. All participants were free of any medications and in good health. In present study the same patient was serve as control and study group. Control group – For control group opposing canine was used as control tooth. Study group – Randomised selected left or right maxillary first molar was used as study group. In this study, 42 volunteers underwent two rounds of injections in their upper first molars. These injections occurred at separate appointments spaced by at least a week. To avoid bias, a random number table was used to assign a unique four-digit code to each injection type before the experiment began. Researchers documented the moment participants first felt the stimulation. Buccal infiltration: 1 milliliter (mL) of 2% lidocaine with epinephrine (1:80,000 dilution) was administered over a 60-second period. The injection site was centered between the middle cheekside and back cheekside root tips of the upper first molar. The needle was carefully placed into the gum tissue with the slanted edge facing the bone and inserted until the needle was believed to be at or just above the tips of the first molar. Palatal infiltration: A half-milliliter (0.5 mL) of lidocaine solution, containing two percent (2%) lidocaine and diluted with epinephrine at a ratio of one in eighty thousand (1:80,000), was slowly injected over a thirty-second (30-second) period. The injection location was centered precisely between the midline ridge of the roof of the mouth (midpalatine raphe) and the gumline (gingival margin) closest to the first permanent back tooth (first molar). The needle was carefully inserted into the tissue lining the roof of the mouth (palatal mucosa) with the sharp edge (bevel) pointed towards the bone. The needle was then advanced gently until it touched the bone. Buccal infiltration plus mock palatal infiltration: The other group received an injection in the cheek of 1 milliliter of a 2% solution with epinephrine diluted 1:80,000, along with a simulated injection in the roof of the mouth. For the mock infiltration, the needle achieved transmucosal penetration only (Transmucosal - across the mucous membrane). The level of unconsciousness induced by the anesthesia was assessed using an electrical pulp stimulator. Five minutes after administering the local anesthetic injections, the responsiveness of the pulp tissue in the cheekbone (buccal) and tongue (lingual) sides of the first molar was tested with the stimulator. This testing, along with testing of a control canine tooth, was repeated at four-minute intervals for a total of one hour. Anesthesia was considered successful if participants did not react to two consecutive stimulations at the highest setting (80) on the electric pulp tester. We employed statistical methods to assess the data. Specifically, we performed multiple McNemar tests to compare the two infiltration groups regarding successful anesthesia, focusing on the prevalence of pulpal anesthesia (80). A p-value of less than 0.05 was considered statistically significant.

3. Results

Twenty-two males and twenty females, between the ages of 18 and 52 years, having an average age of 35 years, were included in this investigation. The gender distribution among the two groups were similar (males 52.3% and females 47.7%). In the present study, out of 42 subjects, 39 (92.8%) showed successful anaesthesia for buccal and palatal infiltration, and 3 subjects showed unsuccessful

anesthesia. Out of 42 subjects for buccal infiltration, 33 (78.6%) show successful anaesthesia, and 9 show unsuccessful anesthesia. In this study Mc Nemar test was used to evaluate anesthetic efficacy between study groups. The two study groups showed a minimal difference of 0.18. This difference isn't considered statistically significant because a p-value less than or equal to 0.05 is typically used as the benchmark for significance. In other words, there's no clear distinction between the effectiveness of buccal and palatal infiltration in this study. Success rates ranged from 78.6% for buccal infiltration to 92.8% for buccal plus palatal infiltration. As seen in the graph the incidence of pulpal anesthesia at 9min is almost same in both buccal and buccal plus palatal. At 17 min buccal infiltration anesthesia effect starts to decline whereas buccal plus palatal infiltration anesthesia effect increases. At 21 min buccal plus palatal anesthesia was at its peak but after 21 min it was starts to decline. At 29 min 41 min 51 min and 59 min there were no clear distinction between the 2 sets of anesthetic infiltrations. But there was significant difference at 37 min between the two sets of infiltrations.

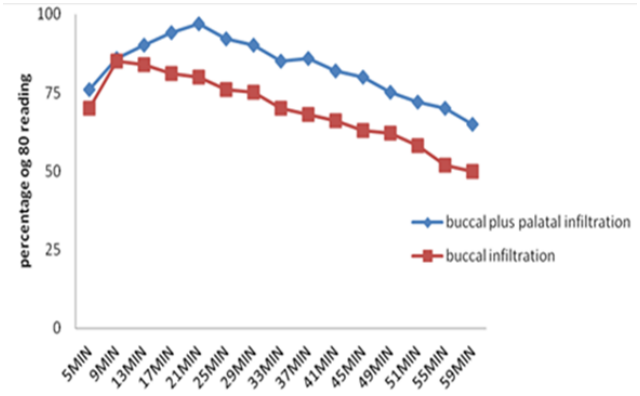

Figure 1: Percentage of 80 readings vs time plot

4. Discussion

In dentistry, local anesthetics are the cornerstone of pain management. The growing expectations and aspirations of patients for dental procedures, especially root canals, necessitate a comfortable and pain-free endodontic experience.[6] The decision was made to use 2% lidocaine with a 1:80,000 epinephrine dilution due to its fast-acting properties, achieving numbness within 2-3 minutes on average. However, it's important to note that 2% lidocaine with a 1:80,000 epinephrine concentration can cause a significant increase in heart rate and blood pressure, especially systolic blood pressure. This effect is more pronounced compared to lidocaine with a 1:200,000 concentration. In India, 2% lidocaine with 1:80,000 epinephrine is a common choice, despite the minimal impact of 1:200,000 epinephrine concentration on cardiovascular parameters. In fact, one study found that local infiltration with 2% lidocaine diluted with epinephrine at a 1:80,000 ratio resulted in a longer duration of anesthesia compared to the same amount of lidocaine diluted with epinephrine at a 1:200,000 ratio.[7]

Our decision to use an electric pulp test reading of 80 (indicating the highest stimulation level) as a benchmark for pulp numbness is supported by research from several authors. Their studies demonstrated that a complete absence of patient response at this maximum setting (80) guaranteed pulp anesthesia in healthy teeth without any symptoms. Furthermore, some studies revealed that readings below 80 on the electric pulp test resulted in discomfort during procedures on healthy teeth. Consequently, employing the electric pulp tester before initiating dental procedures on healthy teeth with living pulp provides dentists with a dependable indicator of pulp anesthesia.[8]

Studies using various anesthetic combinations and volumes up to 1.8 mL achieved pulp anesthesia success (measured by maximum electric pulp tester output) between 62% and 100%.[9] We opted for a 0.5 mL injection of 2% lidocaine delivered to the palate, considering this a suitable amount for the palatal tissue. Research suggests that increasing the lidocaine volume for buccal infiltration of the first molar, from a maximum of 1.8 mL to 3.6 mL, can extend the duration of pulp anesthesia.[10]

This study investigated the effectiveness of a maxillary first molar buccal infiltration using 1ml of 2% lidocaine with epinephrine (1:80,000 dilution). The success rate was 78.6%. Several previous studies[9–14] employed a similar approach and reported higher success rates (88%, 82%, 100%, 72%, 97%, and 83% respectively) with a larger volume (1.8 mL) of 2% lidocaine with a slightly weaker epinephrine dilution (1:100,000). It's important to acknowledge that even with a higher volume and slightly weaker epinephrine, a buccal infiltration with 2% lidocaine may not always achieve complete anesthesia (100% success).[15] This variability can be attributed to individual differences in how patients respond to the medication, variations in injection technique between dentists, and underlying anatomical differences in patients' mouths.

Both infiltration techniques showed a decrease in anesthetic effectiveness over time. Buccal infiltration: In this study, around 74% of subjects had numbness at 29 minutes, dropping to 63% at 45 minutes and 50% at 59 minutes (using 1ml of 2% lidocaine with epinephrine). Similar results were found in prior research[9–14] with 1.8mL of 2% lidocaine (epinephrine concentration differed). Buccal plus palatal infiltration: This technique followed a similar pattern to buccal infiltration alone, but with a statistically greater number of subjects experiencing numbness throughout (21 to 60 minutes). Here, about 87% had numbness at 29 minutes, 75% at 45 minutes, and 65% at 59 minutes. Previous studies[9–14] showed slightly lower percentages

with this combination.Therefore, adding a palatal injection to a buccal infiltration did not significantly extend the duration of anesthesia. However, dentists should be aware that even the combined technique may not provide complete numbness for a full 60 minutes.

5. Conclusion

In this study, 42 participants were randomly assigned to one of two groups to assess the effectiveness of numbing the maxillary first molar using a combined injection on the roof (palatal) and cheek (buccal) sides. This was a single-blind trial, meaning the participants didn't know which group they were in. The 42 subjects were randomly divided into two groups**.** Forty-two subjects (22 men and 20 women) participated in the research. Their ages varied between 18 and 52, with a mean of 35 years. The palatal infiltration anesthesia was given either of the two experimental site spaced at least 1 week apart. The study showed that the effectiveness of buccal infiltration was 78.6%, whereas the combination of buccal and palatal infiltration achieved a success rate of 92.8%. From the result of this study, it was concluded that the efficacy of buccal infiltration anesthesia was increased when additional palatal infiltration 0.5ml of 2% lidocaine solution with epinephrine (1:80,000 dilution) was used. In addition, supplemental palatal infiltration also prolonged the duration of anesthesia. However, there was no significant difference in the effectiveness of anesthesia between the buccal and buccal plus palatal infiltration techniques.

6. Source of Funding

None.

7. Conflict of Interest

None.

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