Original Article

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Posterior superior alveolar nerve block alone in the extraction of upper third molars: a prospective clinical study

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Background: Third molar extraction is the most commonly performed minor oral surgical procedure in outpatient settings and requires regional anesthesia for pain control. Extraction of the maxillary molars commonly requires both posterior superior alveolar nerve block (PSANB) and greater palatine nerve block (GPNB), depending on the nerve innervations of the subject teeth. We aimed to study the effectiveness of PSANB alone in maxillary third molar (MTM) extraction.

Methods: A sample size comprising 100 erupted and semi-erupted MTM was selected and subjected to study for extraction. Under strict aseptic conditions, the patients were subjected to the classical local anesthesia technique of PSANB alone with 2% lignocaine hydrochloride and adrenaline 1:80,000. After a latency period of 10 min, objective assessment of the buccal and palatal mucosa was performed. A numerical rating scale and visual analog scale were used.

Results: In the post-latency period of 10 min, the depth of anesthesia obtained in our sample on the buccal side extended from the maxillary tuberosity posteriorly to the mesial of the first premolar (15%), second premolar (41%), and first molar (44%). This inferred that anesthesia was effectively high until the first molars and was less effective further anteriorly due to nerve innervation. The depth of anesthesia on the palatal aspect was up to the first molar (33%), second molar (67%), and lateromedially; 6% of the patients received anesthesia only to the alveolar region, whereas 66% received up to 1.5 cm to the mid-palatal raphe. In 5% of the cases, regional anesthesia was re-administered. An additional 1.8 ml PSANB was required in four patients, and another patient was administered a GPNB in addition to the PSANB during the time of extraction and elevation.

Conclusion: The results of our study emphasize that PSANB alone is sufficient for the extraction of MTM in most cases, thereby obviating the need for poorly tolerated palatal injections.

Keywords: Local Anesthesia; Nerve Block; Superior Alveolar Nerve; Upper Third Molar.

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INTRODUCTION

Third molar extraction is the most commonly performed minor oral surgical procedure in the outpatient setting and requires regional anesthesia for pain control. Evidence suggests that fear and anxiety are the most attributable factors for pain after oral injections [1]. Maxillary third molars (MTM) are frequently amenable to removal with low intraoperative pain thresholds due to favorable anatomical considerations, such as porosity and high penetrability of the anesthetic solution, when

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compared to that of the mandible.

Extraction of the maxillary molars commonly requires both posterior superior alveolar nerve block (PSANB) and greater palatine nerve block (GPNB), depending on the nerve innervations of the subject teeth. Pain during the administration of palatal injection is high because of the tightly adherent mucosa and underlying periosteum, and numbness of the soft palate and pharyngeal region is noted post-anesthesia, leading to a gag reflex.

Numerous techniques have been used to reduce the discomfort associated with palatal injections, including topical anesthetic application [2], topical cooling of the palate [3], computerized injection systems [4], pressure administration, eutectic mixture of local anesthetics, and transcutaneous electrical nerve stimulation [5]. Topical anesthesia is a well-known and frequently used treatment option; however, it is only effective on the surface tissues (2–3 mm) [6]. Most authors prefer to block only the posterior superior alveolar nerve, considering the anatomy and quality of the maxillary bone, with a high diffusion rate to any local anesthetic solution [7-10].

The purpose of this study was to achieve regional anesthesia both buccally and palatally in the area of interest with only one injection and to evaluate the efficacy of PSANB alone for extraction of the permanent maxillary third molar using intermittently acting local anesthetic solution 2% lignocaine with 1:80,000 adrenaline.

METHODS

A prospective clinical trial with a sample size of 100 patients was conducted in the Department of Oral and Maxillofacial Surgery at our institute between January 2020 and December 2021, after obtaining ethical clearance from the Institutional Ethical Committee (IEC REF NO: ANIDS/IEC/2019011) and CTRI approval (REF NO 2021/06/044263), following the Helsinki guidelines.

Clinical evaluation of the patients was performed with proper history taking and clinical examination, followed by preoperative blood (routine surgical profile) and radiological investigations (OPG/IOPA) before considering the patients for the surgical procedure.

Inclusion criteria:

- MTM (erupted and partially erupted), which were decayed, infected, or therapeutic, and indicated for extraction under local anesthesia
- Patients were willing to provide informed consent for the study.

Exclusion criteria:

- MTM with mobility and surgical intervention.
- Patients with a history of allergy to lignocaine
- Medically compromised patients.

1. Methodology

A total of 100 MTM were selected and subjected to study for extraction. Each patient was instructed how to use the pain rating scale, which is an 11-point numerical rating scale (NRS) with a score of 0 to 10 and a visual analog scale (VAS) anchored with expressions (0–5; with 0 indicating no pain and 5 indicating the worst pain).

Under strict aseptic conditions, the patients were subjected to classical local anesthesia with 2% lignocaine hydrochloride and adrenaline 1:80,000 (NEON®) using a self-aspirating syringe. After a latency period of 10 min, objective assessment of the buccal and palatal mucosa was performed using Shepherd's probe. The extent of anesthesia, including the posterior-to-anterior distance from the hamular notch to the most anterior aspect of the buccal and palatal gingiva, was recorded and mapped. On the palatal side, the area of anesthesia was checked from the free gingival margin to the midline for objective and subjective pain symptoms.

Reflection of the mucoperiosteal flap on both sides was performed with a no. 9 Molt periosteal elevator, followed by luxation and extraction using upper third molar forceps, wound toileting, and suturing as per the requirement. At each level, an assessment was performed using both the scales for inter-comparability.

The post-extraction objective signs and subjective

Table 1. Comparison of average time taken for the completion of surgical procedure between different difficulty scores categorized radiologically

Radiological difficulty score	n	Mean duration	Mean rank of total duration	Mann Whitney U statistic value	P value
Easy (Score 1)	49	23.26 ± 8.007	51.19	1215.50	0.809
Moderate (Score 2)	51	22.84 ± 7.228	49.83		

Test: Mann-Whitney U Test; n, number of individuals.

Table 2. Comparison of average time taken for the completion of surgical procedure between different age groups

Age group in years	n	Mean duration	Mean rank of total duration	Kruskalwallis H statistic value	P value
19-35	74	23.58 ± 7.69	52.47	1.835	0.399
36-45	13	22.69 ± 7.80	48.58		
46-65	13	20.38 ± 6.60	41.23		

Test: Kruskal-Wallis Test; n, number of individuals.

symptoms of pain were assessed for (1) numbness in the region of anesthesia and (2) pain in relation to the period of weaning of the anesthetic solution for further evaluation. The effectiveness of anesthesia and its local absorption were assessed at different intervals after completion of the procedure. The anesthetic block efficacy was assessed 10 min post-delivery of the anesthetic solution and at different levels of the procedure. Postoperatively, readings were taken in the next four hours as this time would indicate the lapse in the efficiency of the administered drug. The duration of postoperative analgesia was determined by subjective and objective symptoms on both the buccal and palatal aspects, every 15 min for the first hour and every 30 min for the next two hours i.e., up to 240 min.

2. Statistical analysis

The data were analyzed using SPSS 25.0. The Kolmogorov–Smirnov test was used to check the normality of the quantitative variables. The Mann–Whitney U test was used to compare the average time taken for the surgical procedure between the different difficult scores categorized radiologically. The Kruskal-Wallis test was used to compare the average time taken for surgical procedures in the different age groups. The Friedman test with post-hoc was performed for the paired data with three or more than three groups.

Quantitative variables were represented as means and standard deviations, whereas qualitative variables were represented as percentages. Statistical significance was set at $P < 0.05$.

RESULTS

Of the total sample comprising 100 patients, 43 were male and 57 were female. The ages of the individuals ranged from 19 to 65 years, with a mean age of 32.3 years and a standard deviation of 10.17. Of the total sample, 86 and 14 third molars were present in the right and left maxillae, respectively.

The average time taken to perform tooth extraction was 23.05 min with a standard deviation of 7.58. The mean total duration was higher for individuals with difficulty scoring index 1 (23.26 ± 8.007) than for those with difficulty scoring index 2 (22.84 ± 7.228) (Table 1). It was observed that the mean time taken for the completion of extraction for the 19–35, 36–45, and 46–65 years age groups was 23.58 ± 7.69, 22.69 ± 7.80, and 20.38 ± 6.60 min, respectively. However, this difference was not statistically significant (Table 2).

During the post-latency period of 10 min, the depth of anesthesia obtained in our sample on the buccal side extended from the maxillary tuberosity posteriorly to the mesial of the first premolar (15%), second premolar (41%), and first molar (44%). This inferred that anesthesia was effectively high until the first molars and was less effective further anteriorly due to nerve

Table 3. Distribution of individuals according to the Objective symptoms with the level of anesthesia definite area buccally 10 minutes after PSANB

Definite area buccally	Number of individuals	Percentage of individuals	Cumulative percentage
Mesial to 14	15	15%	15%
Mesial to 15	36	36%	51%
Mesial to 16	35	35%	86%
Mesial to 25	5	5%	91%
Mesial to 26	9	9%	100%

PSANB, posterior superior alveolar nerve block.

Table 4. Distribution of individuals according to the Objective symptoms with the level of anesthesia definite area palatally mesial to the tooth 10 minutes after PSANB

Definite area palatally mesial to the tooth	Number of individuals	Percentage of individuals	Cumulative percentage
Palatal to 16	32	32%	32%
Palatal to 17	51	51%	83%
Palatal to 26	1	1%	4%
Palatal to 27	16	16%	100%

PSANB, posterior superior alveolar nerve block.

Table 5. Distribution of individuals according to the Objective symptoms with the level of anesthesia definite area palatally up to mid palatal raphe 10 minutes after PSANB

Definite area palatally up to mid palatal raphe	Number of individuals	Percentage of individuals	Cumulative percentage
1 cm from mid palatal raphe	28	28%	28%
1.5 cm from mid palatal raphe	66	66%	94%
2 cm from mid palatal raphe	6	6%	100%

PSANB, posterior superior alveolar nerve block.

Table 6. Comparison of VAS scores on the palatal aspect among individuals assessed at different levels of surgical procedure

Level of surgical procedure	N	Mean rank of VAS score	Friedman test statistic value	P value
Flap Reflection	100	3.94	139.8	< 0.001*
Elevation of tooth	100	4.37		
Delivery of tooth	100	4.06		
Socket Toileting	100	2.80		
Wound closure	100	3.34		

Test: Friedman Test; N, total number of individuals; VAS, visual analog scale. *statistically significant

innervation. The depth of anesthesia on the palatal aspect was up to the first molar (33%), second molar (67%), and lateromedially; 6% of the patients received anesthesia only to the alveolar region, whereas 66% received up to 1.5 cm to the mid-palatal raphe (Tables 3, 4, and 5).

The Friedman test was performed to compare the VAS scores on the palatal side between different levels of the intraoperative procedure, and it was found that the mean rank of the VAS score was highest during the elevation of the tooth, followed by tooth delivery, and the lowest was observed for wound toileting. This difference was statistically significant among the different levels of intraoperative surgical procedures (P = 0.001) (Table 6).

DISCUSSION

The discovery of lignocaine in 1943 [11,12] has been a landmark in the history of local anesthesia and is now considered a standard reference against which other local anesthetic agents are compared. Lignocaine 2% combined with a vasoconstrictor at 1:80,000 concentration provides reliable and profound pulpal anesthesia for approximately 60 min, with the duration of soft tissue anesthesia ranging

from 3 to 5 h [11,13].

The selection of an anesthetic solution depends on the time required for the procedure with minimal pain and discomfort to the patient. Different anesthetic solutions, such as lignocaine, articaine, and bupivacaine, have been used to extract the upper third molars with a single PSANB [14,15] and have been compared among them [13,14,16,17].

A comparative clinical study conducted by Isabel Peixoto Tortamano et al. [18] between articaine and lignocaine reported that the diffusion of articaine was better than that of lignocaine; however, the superiority of articaine could not be proven statistically. In 1993, Vähätalo et al. [19] conducted a double-blind study to compare the anesthetic properties of articaine hydrochloride with 1:2,00,000 epinephrine and lignocaine with 1:80,000 epinephrine for maxillary infiltration anesthesia. In this study, the latency time was 187 s (± 66) for articaine and 201 s (± 88) for lignocaine, and there was no statistically significant difference in the onset and duration of anesthesia between articaine with epinephrine 1:200,000 and lignocaine with epinephrine 1:80,000. In a comparative study [18] of articaine and lignocaine, the superiority of articaine over lidocaine was not statistically corroborated. Both solutions presented similar behaviors and were not entirely efficient in controlling pain during the treatment of irreversible pulpitis, revealing their similar properties.

The duration of anesthesia is proportional to the degree of protein binding. However, the duration of the effect of the local anesthetic is also dependent on the injection site and concentration of the vasoconstrictor present in the anesthetic solution, among other factors [12]. The reasons for the effectiveness of the depth of anesthesia are the three opinions that explain the efficiency of this technique. First, it has been suggested that the anesthetic requirement for tooth extraction is not as high as that for routine conservative dental treatment [20]. Second, lignocaine diffuses more readily through soft and hard tissues, although some studies have contradicted this finding. Articaine, on the other hand, has greater diffusibility and protein binding; however, the diffusibility and depth of anesthesia achieved using lignocaine favor the results of our study. Finally, it has been suggested that the porous nature of the maxilla facilitates the diffusion of local anesthetics. All of these opinions may be valid, but the diffusion of the local anesthetic solution to the palatal side should be the most determinative factor [21].

The extraction of teeth, particularly the upper third molars, requires a minimum time of 30 min in cases of eruption or semi-eruption. In our study, the time required to obtain the maximum anesthetic effect in the regional block was standardized for a lag period of 10 min, which was achieved in all patients using objective symptoms with VAS. The average time taken to perform tooth extraction was 23.05 min with a standard deviation of 7.58 min.

In the post-latency period of 10 min, the depth of anesthesia obtained in our sample on the buccal side extended from the maxillary tuberosity posteriorly to the mesial of the first premolar (15%), second premolar (41%), and first molar (44%). This inferred that anesthesia was effectively high until the first molars and was less effective further anteriorly due to nerve innervation. The depth of anesthesia on the palatal aspect was up to the first molar (33%), second molar (67%), and lateromedially; 6% of the patients received anesthesia only to the alveolar region, and 66% received up to 1.5 cm to the mid-palatal raphe (66%).

The depth of anesthesia in our study was contrary to that in the study conducted by Kubilay Isik et al. [22], which compared the depths of anesthesia in different parts of the maxilla when only buccal anesthesia was administered. The diffusion of the anesthetic solution to the palatal side was considered negligible in the regions of the third molar due to the presence of a thick maxillary tuberosity.

Diffusion of the solution to the palatal side requires a latency period. Some authors [9,23,24] concluded that all successful cases of buccal infiltration of 2% lignocaine achieved palatal anesthesia within 5 min, whereas a study

conducted by Kumaresan et al. [25] found that an 8.5 to 10 min latency period was required to achieve palatal anesthesia in the molar region when only buccal infiltration of lidocaine local anesthetic solution was administered. In a study conducted by Kandasamy et al. [26], a latency time of 10 min was maintained to extract maxillary teeth. The diffusion of the anesthetic solution in our study was statistically significant ($P < 0.001$), with a latency of 10 min around the third molar, with no pain elicited by VAS, which was in agreement with the above studies.

To eliminate bias, we used two pain rating scales. Objective buccal and palatal symptoms were measured using the VAS and NRS. The VAS scale was assessed by the operator, whereas the numerical rating scale was rated by the patient. Pain on instrumentation was not elicited in 93% of the patients, whereas 7% had mild or negligible pain on palatal instrumentation before the start of the procedure.

The intraoperative pain intensity was measured at every step of the procedure (flap reflection, tooth elevation, delivery, toileting of the socket, and wound closure). Anesthesia on the buccal side was scored as nil by the VAS and NRS, which represented no pain at different levels of the intraoperative surgical procedure. The VAS scores on the palatal side were compared between different levels of the intraoperative procedure, and it was found that the mean rank of the VAS score was highest during the elevation of the tooth, followed by tooth delivery, and the lowest was observed for wound toileting. This difference was statistically significant among the different levels of intraoperative surgical procedure ($P = 0.001$).

Here, supplemental anesthesia was required during tooth elevation in a negligible number of cases, which can be attributed to factors such as patient anxiety and perception of pain. No pain (VAS) was noted during suturing between the second and third molars with respect to the duration of the procedure.

The duration of postoperative analgesia was determined by subjective and objective symptoms on both the buccal and palatal aspects, every 15 min for the first hour and every 30 min for the next two hours i.e., up to 240 min. The pain intensity was measured using NRS. The mean NRS rank was the highest after 240 min, and the lowest mean rank was observed at 15, 30, and 45 min; this difference was found to be statistically significant ($P < 0.001$).

A multipair test was performed for the numerical scale to re-establish the significant value throughout the study. A non-significant P-value (1.00) with moderate pain was recorded at 45 min postoperatively on the buccal aspect, and as the study progressed, the numerical value increased until the end of the study.

The mean duration of postoperative analgesia with lignocaine was (60 ± 10 min) in patients who received PSANB alone. Additional anesthesia was required in five patients, including two males and three females; two were vertically positioned, two were distoangular, and one was mesioangular with class I and position A/B with no deflections.

In 5% of the cases, regional anesthesia was re-administered. An additional PSANB of 1.8 ml was required in four patients, and another patient was administered GPNB in addition to PSANB during the time of extraction and elevation for grossly decayed teeth (1), periapical abscesses (2), and root fractures (2). Fan et al. and Uckan S et al. [7,9] listed the detailed indications for the type of extraction (wisdom teeth, orthodontic teeth, fractured teeth, profound caries, periodontitis, etc.) and reported the success rate according to the indications of a single PSANB in different dental treatments (orthodontic treatment > periodontitis > prophylactic extraction > apical lesion > profound caries). The indications described here are in correspondence with our study.

In conclusion, the results of our study emphasize that PSANB alone is sufficient for the extraction of MTM in most cases, thereby obviating the need to eliminate poorly tolerated palatal injections, which can diminish the fear of injection. The average time for third molar extraction with a single injection technique coincided

with the maximum anesthetic effect produced by lignocaine with 1:80,000 adrenaline.

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