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Evaluation of the Anaesthetic Efficacy of 4% Articaine with 1:200000 Epinephrine Versus 2% Lignocaine with 1:200000 Epinephrine in Simple Extractions of Mandibular Posterior Teeth

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Abstract

Background: The aim of the study was to evaluate the anaesthetic efficacy of 4% articaine hydrochloride with epinephrine/adrenaline 1:200000 versus 2% lignocaine hydrochloride with epinephrine/adrenaline 1:200000 in extractions of permanent mandibular posterior teeth.

Materials and methods: One hundred (100) patients were selected for the study in the Department of Oral and Maxillofacial Surgery and Implantology. Patients were equally but randomly divided into two different groups: i) Group 1-4% articaine solution; ii) Group 2-2% lignocaine solution, both with equal concentration of epinephrine (1:200000). Standardized clinical parameters included the Visual Analogue Scale (VAS) score for each, Pain on injection, Intraoperative Pain, Onset of anaesthesia, Duration of anaesthesia, Need of reanaesthesia.

Results: On statistical evaluation of the values obtained for each patient, it was observed that Group I (4% articaine with 1:200000 epinephrine) demonstrated low pain on injection, early onset of anaesthesia (shorter latency), low intraoperative pain and reasonable duration of soft tissue anaesthesia compared to Group II (2% lignocaine with 1:200000 epinephrine) that demonstrated slow onset, more intraoperative pain and minimally longer duration of soft tissue anaesthesia.

Conclusion: it can be stated that Septanest (4% articaine hydrochloride with 1:2000000 epinephrine) may be preferred to Xylocaine (2% lignocaine hydrochloride with 1:2000000 epinephrine) in simple minor oral surgical procedures.

Keywords: Articaine; Lignocaine; Visual Analogue Scale (V.A.S.); Extraction

Introduction

Neighborhood sedatives are the most prominent medications that are utilized as a part of the dentistry now days, framing the foundation of pain control strategies. They likewise symbolize the most tried and true and most productive medications in all of therapeutic claim to fame for the control and counteractive action of pain. The safety of local anaesthetics may be gathered from the following statement attributed to Dr. Leonard Monheim, an icon in the chronicle of dental anaesthesiology, "Nobody ever died in a conscious state" [1].

In dentistry tooth extractions are more common in outpatient clinic procedure in oral surgery. Ordinarily, it is followed by an inflammatory reaction characterized by pain, mild swelling, and discomfort. Application of better local anaesthesia and treatment techniques decreases cardiovascular risk caused by anxiety and improves dental treatment [2]. For the management of postoperative pain after surgical procedure can be attained by usage of long acting local anaesthetic agents, cold ice therapy, opioid and NSAIDS. Bupivacaine and mepivacaine are long acting local anaesthetic agents used most commonly [3,4].

Rusching et al. synthesized Articaine hydrochloride, an amide local anaesthetic. The chemical structure of articaine is 3-N-Propylamino-proprionylamino-2-carbomethoxy-4-methylthiophene hydrochloride. Articaine is unique among amides as it has thiophene group, which increases its lipid solubility and has an ester group, enabling articaine to undergo biotransformation in both plasma and liver. Its primary metabolite articainic acid is pharmacologically inactive. It reversibly blocks nerve conduction similar to other amide anaesthetics. Adrenaline is added in clinical formulations to retard its absorption, prolonging duration and depth of anaesthesia and to minimize systemic absorption of the active drug. The anaesthetic activity of articaine with adrenaline is comparable to lignocaine with adrenaline combinations. It is used clinically as 4% solution with adrenaline 1:100000 or 1: 200000 [5,6].

The present study was performed to evaluate the anaesthetic efficacy of 4% articaine hydrochloride with epinephrine/adrenaline 1:200000 (Septanest, Septodont, France) versus 2% lignocaine hydrochloride with epinephrine/adrenaline 1:200000 (Xylocaine, Astra Zeneca, India) in simple extractions of permanent mandibular posterior teeth [7-9].

Materials and Methods

Patient's selection criteria

The present clinical study was performed in the department of oral and maxillofacial surgery and implantology, at I.T.S Centre for Dental Studies and Research, Muradnagar, Ghaziabad, India.

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The total duration of the study was 6 months. The research protocol was reviewed and approved by the ethical committee of the institution. All the patients were educated about the study and then written consent was acquired before enrollment in the study.

A flow diagram for complete methodology is presented in Figure 1. One hundred (100) patients were diagnosed with the problem of lower posterior molar that was gone for simple extraction of mandibular posterior teeth. Patients were between the age group of 18-55 years and which require two or more extractions of mandibular posterior teeth were included in the study. Medically comprised, gestation or lactation period, allergy to the medicament employed in the study, patients who were unable to provide informed consent at the time of procedure were excluded from the study.

Patient's allocation

Patients were assigned equally but randomly to one of the two treatment groups (N=50). Envelopes containing identifications for treatment groups were enclosed, mixed, and then numbered. Each participant was randomly selected to one of the following group.

Group 1: 4% articaine solution.

Group 2: 2% lignocaine solutions, both with equal concentration of epinephrine (1:200000).

Procedure for extraction

All the patients included were in good health (ASA I and II) and were not taking any medications that could alter their perception of pain. Thorough case history and clinical evaluation was documented as mentioned in the performa. Prior to extraction I.O.P.A radiographs to rule out the need for surgical extraction of any of the mandibular posterior teeth included in the study. The patients were allocated in two groups in a randomized sequence to receive either 4% articaine or 2% lignocaine solution, both with equal concentration of epinephrine (1:200000) for anaesthesia, at two separate appointments, spaced at least 3 days to 1 week apart for subsequent extraction of mandibular posterior teeth in either of the quadrants. Each patient was randomly assigned any of the two solutions to determine which local anaesthetic solution would be administered at each appointment. The anaesthetic solutions administered were blinded by masking them with labels. All standard classical inferior alveolar nerve blocks were administered with a 26 gauge, single use, 1½ inch (0.45 × 38 mm) dispovan needle attached to a standard 5 ml dispovan disposable syringe. After the target area was reached and aspiration was performed, the anaesthetic solution was deposited over a time period of 1 min respectively. In the cases where anaesthesia of long buccal nerve was required, a separate long buccal nerve block using the same anaesthetic solution (0.8 ml) was administered concomitantly with inferior alveolar nerve block on the same operated site. The same experienced surgeon gave all the local anaesthetic injections [10-12].

Immediately after inferior alveolar nerve block injection each subject was asked to rate, the pain felt on deposition of the solution and the intraoperative pain on a V.A.S. The V.A.S is a 10 cm line with various descriptive terms. All patients placed a mark on the V.A.S scale with a pen that best described their pain threshold. The method of marking was explained previously to the patient in the language, in which he/she understood. The 10 cm V.A.S ranged from "it did not hurt" (smiling face=0 cm) to "worst hurt imaginable" (frowning face=10 cm). To interpret the data, V.A.S was further divided into the following 4 categories:

Gradually after 30 s of administration of the block, each patient was asked that if his/her lip and tongue was getting numb to assess the subjective symptoms. Parameters were reassessed after every 30 s for a baseline time of 4 min. Instrumentation with a Moons probe was done every 30 s to evaluate absence of pain sensation objectively. After anesthesia if lip numbness was not reported within 5 min, the block was considered unsuccessful and local anaesthetic solution was reinjected. Evaluation also determined the need to re-anaesthetize the surgical zone, specifying the technique and amount of anaesthetic injected after withdrawal of the needle. The induction (onset time) was recorded as the time from the deposition of anaesthetic solution until the appropriate subjective and objective manifestations of anaesthesia appeared as depicted.

Efficacy was determined immediately following the procedure by having both the subject and an independent investigator rate the pain experienced during the procedure, using a V.A.S. The investigator marked the 10 cm scale identical to the one given to the patient to indicate his/her opinion of the patient's. Duration of anaesthetic effect was measured from the time, of initial perception of anaesthetic effect to the moment the effect begins to fade. This was further assessed by a printed questionnaire provided to the patient after discharge from the office in the language, which he/she could understood. In the recall period of study, no adverse effects for any subjective signs (like an allergic reaction, ulceration, or with objective signs like redness of mucosa) were observed.

Statistical analysis

The statistical analysis was performed for each parameter. The mean and standard deviation were calculated using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 16.0 for Windows). Wilcoxon signed rank test was used. The value of $P<0.05$ was considered to be significant.

Results

Pain on injection and Intraoperative Pain were recorded on a V.A.S scale. In both the groups, more than four-fifth patients reported pain scores up to 2.5 cm thereby indicating no pain. Only one (1%)

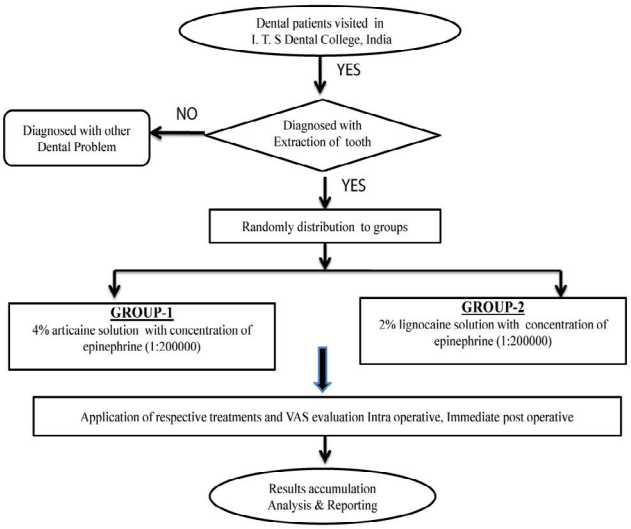

Figure 1: Flow chart indicating the methodology implemented in the present clinical study.

patient in Group I and two (2%) patients in Group II reported pain scores ranging from 5 cm to 7.5 cm indicating moderate pain. Mean pain score amongst patients in Group I was 1.65 ± 1.10 cm whereas in Group II it was 1.75 ± 1.20 cm (Table 1 and Figure 2) indicating no statistically significant difference between two groups (p=0.381). Onset of anaesthesia following injection for two groups is shown in Table 2. In Group I, majority (88%) had onset of anaesthesia within 2-3 min while in Group II majority (57%) had onset of anaesthesia within 3-4 min. All the patients in Group I had onset of anaesthesia before 4 min while in Group II, 33 patients (33%) had onset of anaesthesia between 4-5 min. In neither of the two groups >5 min were taken as the time of onset. The mean onset time in Group I was 2.66 ± 0.45 min while in Group II the mean onset time was 3.96 ± 0.72 min (Table 2 and Figure 3). On comparing the data statistically, a significant difference between two groups was observed (p<0.001).

Assessment of intraoperative pain in two groups is shown in Table 3 in Group I around three-fourth (73%) patients had pain scores up to 2.5 cm indicating no pain as against 41 (41%) in Group II. 25 (24.8%) patients reported mild pain up to 5 cm in Group I while 50 (51%) patients had mild pain in Group II. Moderate pain (scores between 5 to 7.5) were reported by 2 (2%) patients in Group I and 9 (9%) patients in Group II respectively. Mean pain scores in Group I were 2.15 ± 1.43 cm while mean pain scores in Group II were 3.22 ± 1.68 cm (Table 3 and Figure 4). On comparing the data statistically, the pain scores demonstrated in Group II were significantly higher as compared to Group I (p<0.001).

Duration of anaesthesia is being depicted in Table 4 in Group I, all but 2 (2%) patients had duration of anaesthesia up to 3-4 h while in Group II, and 58 (58%) patients had duration of anaesthesia up to 3-4 h. In Group I,

S.No.	Pain score	Group I (n=100)		Group II (n=100)	
		No.	%	No.	%
1.	0 to 2.5 – No pain	73	73	41	41
2.	2.5 to 5.0 – Mild pain	25	25	50	50
3.	5.0 to 7.5 – Moderate pain	2	2	9	9
4.	>7.5 – Severe pain	0	0	0	0
Mean pain score ± SD		2.15 ± 1.43		3.22 ± 1.68	

Z=0.876; p=0.381 (Wilcoxon Signed Rank test)

Table 1: Assessment of pain on injection in two groups.

S. No.	Onset of Anaesthesia (min)	Group I (n=100)		Group II (n=100)	
		No.	%	No.	%
1.	2 to 3 min	88	88	10	10
2.	3 to 4 min	12	12	57	57
3.	4 to 5 min	0	0	33	33
4.	>5 min	0	0	0	0
Mean onset time ± SD		2.66 ± 0.45		3.96 ± 0.72	

Z=8.702; p<0.001 (Wilcoxon Signed Rank test)

Table 2: Assessment of onset of anaesthesia in two groups.

S.No.	Pain score	Group I (n=100)		Group II (n=100)	
		No.	%	No.	%
1.	0 to 2.5 – No pain	73	73	41	41
2.	2.5 to 5.0 – Mild pain	25	25	50	50
3.	5.0 to 7.5 – Moderate pain	2	2	9	9
4.	>7.5 – Severe pain	0	0	0	0
Mean pain score ± SD		2.15 ± 1.43		3.22 ± 1.68	

Z=6.003; p<0.001 (Wilcoxon Signed Rank test)

Table 3: Assessment of intraoperative pain in two groups.

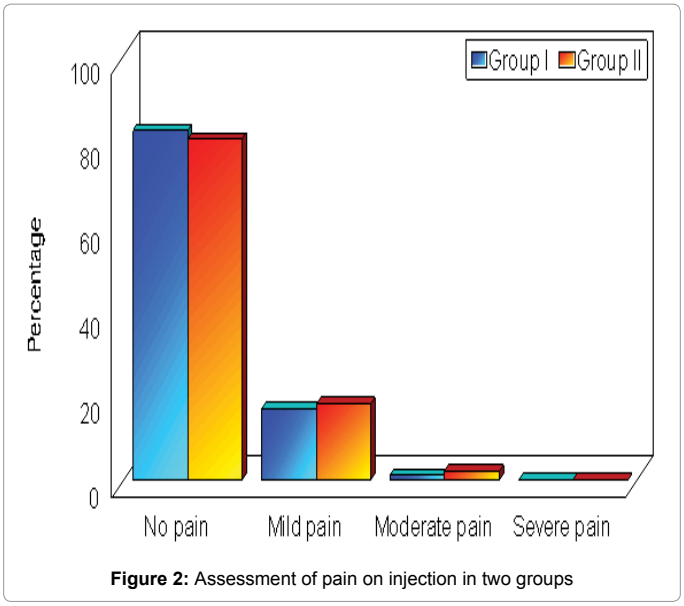

Figure 2: Assessment of pain on injection in two groups

2 (2%) patients had duration of anaesthesia between 4-5 h while in Group II, 42 (42%) patients had duration of anaesthesia between 4-5 h. None of the patients had duration of anaesthesia above 5 h. The mean duration of anaesthesia was 3.48 ± 0.38 hrs in Group I and 4.23 ± 0.48 h in Group II (Table 4 and Figure 4). As compared to Group I, the duration of anaesthesia in Group II was significantly longer (p<0.001). Need of reanaesthesia in two groups is depicted. Only two patients required reanaesthesia in Group II (Table 5; Figures 5 and 6). Statistically there was no significant difference between two groups (p=0.155).

On statistical evaluation of the values obtained for each patient, it was observed that Group I (4% articaine with 1:200000 epinephrine) demonstrated low pain on injection, early onset of anaesthesia (shorter latency), low intraoperative pain and reasonable duration of soft tissue anaesthesia compared to Group II (2% lignocaine with 1:200000 epinephrine) that demonstrated slow onset, more intraoperative pain and minimally longer duration of soft tissue anaesthesia. However, the duration of the surgical procedure was much below than the effective period of anaesthesia. Therefore, for faster onset of anaesthesia coupled with reduced intraoperative pain and optimum soft tissue anaesthesia Group I could be judged having an edge over Group II.

Discussion

Effective control of pain during dental procedures has been one of the most important pre-requisite for practice of painless dentistry [13]. Postoperative pain control in patients who undergo oral and maxillofacial surgeries is frequently performed with the administration of short acting local anaesthetics and oral analgesics. The choice of the anaesthetic solution is based on the following clinical considerations: Anaesthetic potency, latency (time of onset of anaesthesia), duration of the anaesthetic effect. Other important aspects are the pharmacokinetics (absorption, distribution, metabolization and excretion) and toxicity of the drug [7].

Lignocaine, an amide type anaesthetic, is the most commonly employed local anaesthetic worldwide and is considered as gold standard for comparison.4 In contrast, there are few studies in dental literature concerning the use of articaine. Its use greatly spread, entering North America in Canada in 1983 and in the United Kingdom in 1998.7 Articaine is used clinically as a 4% solution with epinephrine 1:100000 or 1:200000 solution [9].

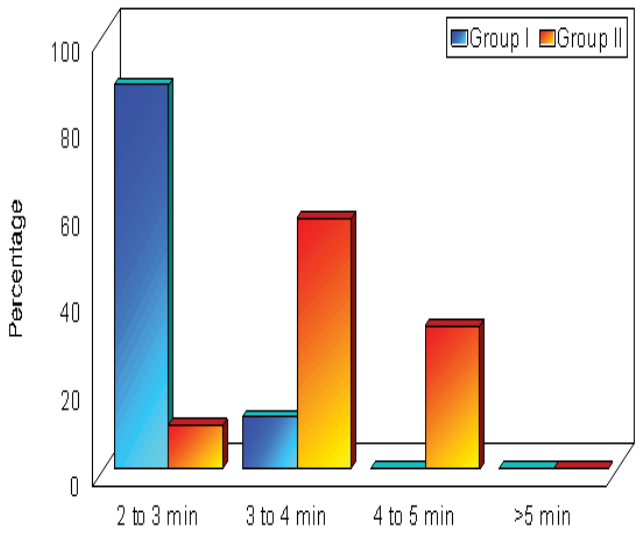

Figure 3: Assessment of onset of anaesthesia in two groups

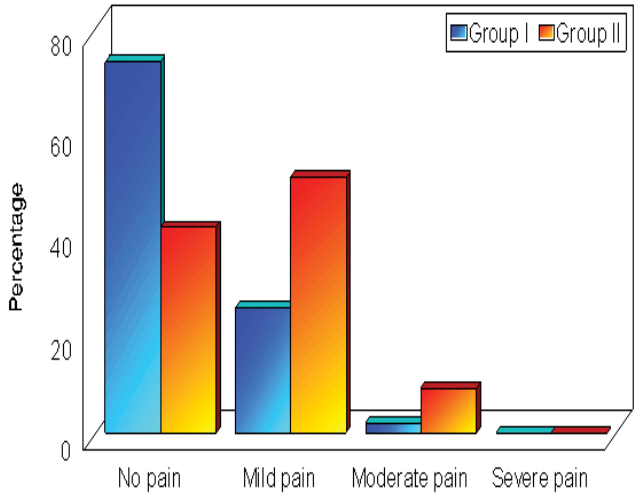

Figure 4: Assessment of intraoperative Pain in two groups

In our study, pain on injection with either of the anaesthetic solutions showed a moderate to minimal pain response with both of the solutions. The mean pain on solution deposition was found to be 1.66 ± 1.10 cm for 4% articaine and 1.74 ± 1.21 cm for 2% lignocaine respectively. Only 1% of the patients reported moderate pain with articaine group as compared to 2% observed in lidocaine group respectively. Ridenour et al. reported a 14% incidence of moderate or severe pain with 2% lignocaine solution [10] Mikesall et al. found no significant differences in discomfort ratings of solution deposition in a randomized double blind study for comparison of 4% articaine and 2% lignocaine for IANB success. The authors reported 34% moderate pain on injection with either 4% articaine or 2% lignocaine. Their findings indicated that an inferior alveolar nerve block has the potential to be painful at times though the solution was deposited over 1 min time period. The authors assumed that inferior alveolar nerve block using either articaine or lignocaine could result in some initial moderate post injection pain [11].

Malamed et al. reported the onset of anaesthesia with 4% articaine containing 1:200000 epinephrine to be 1.4-3.6 min for inferior alveolar nerve block [9,14]. Our study, showed a mean onset time of 2.66 ± 0.44 min for 4% articaine group as compared to 3.96 ± 0.72 min for the 2% lignocaine group respectively. Rebolledo et al. stated that latency of an anaesthetic depends on a number of factors, such as the intrinsic properties of the drug substance used and the anaesthetic technique employed. On the other hand, latency is directly influenced by the corresponding pKa value: smaller pKa values being associated with shorter latency. Accordingly, 4% articaine (pKa=7.8) would at least in theory present a shorter latency than 2% lignocaine (pKa=7.9) [4,7]. Our results coincide with this assumption, as shorter latency or faster onset of anaesthesia was observed with 4% articaine group as compared to 2% lignocaine group respectively.

Duration of anaesthetic effect of a local anaesthetic agent is proportional to its degree of protein binding. However, it is also influenced by various factors like concentration of the vasoconstrictor, type of technique and accuracy, individual variation in response, anatomical differences, type of injection administered, presence of infection and hyperemia at recipient site. Articaine presents one of the greatest protein binding percentages of all amide local anaesthetics, which implies a longer duration of the anaesthetic effect [7]. According

S. No.	Duration of Anaesthesia (h)	Group I (n=100)		Group II (n=100)	
		No.	%	No.	%
1.	2 to 3 h	0	0	0	0
2.	3 to 4 h	98	98	58	58
3.	4-5 h	2	2	42	42
4.	>5 h	0	0	0	0
Mean Duration ± SD		3.48 ± 0.38		4.23 ± 0.48	

Z=8.604; p<0.001 (Wilcoxon Signed Rank test)

Table 4: Assessment of duration of anaesthesia in two groups.

S. No.	Need of Anaesthesia	Group I (n=100)		Group II (n=100)	
		No.	%	No.	%
1.	No need	100	100	98	98
2.	Anaesthesia needed	0	0	2	2

Table 5: Need of re-anaesthesia in two groups.

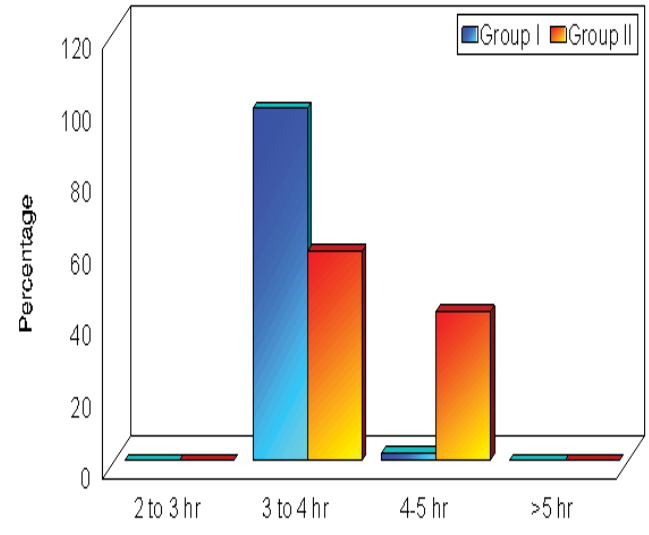

Figure 5: Assessment of duration of anaesthesia in two groups

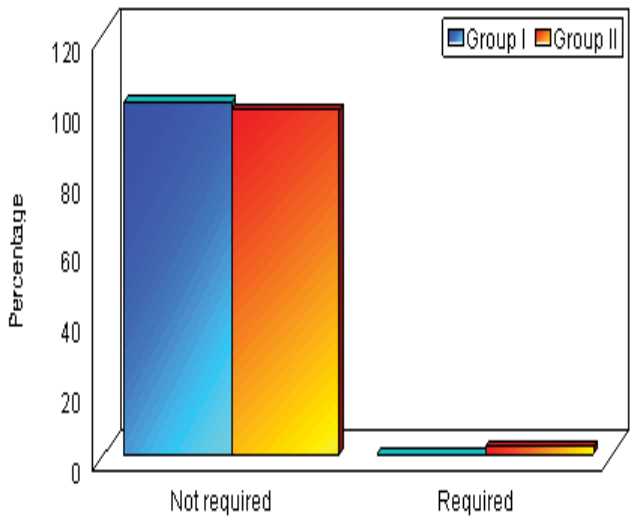

Figure 6: Need of re-anaesthesia in two groups

to Malamed et al., duration of soft tissue anaesthesia with 4% articaine is approximately 4 h for inferior alveolar nerve blocks [9]. Vahatalo et al. did not find any significant difference between 4% articaine and 2% lignocaine regarding the required time for anaesthetic response and duration of anaesthetic effect [12]. In our study, the duration of articaine soft tissue anaesthesia varied from 3.48 ± 0.38 h compared to lignocaine (4.23 ± 0.48 h) respectively. These values are comparable to those reported in the literature and are equivalent or comparable to lignocaine [11].

One of the important parameter determining the efficacy of the two anaesthetic solutions was the need for reanaesthesia during the surgical procedure [7]. None of the patients in our study required supplemental anaesthesia i.e., local infiltrations, field block, inferior alveolar and lingual nerve blocks after administration of 4% articaine solution. However, two patients in the 2% lignocaine group required supplemental anaesthesia using inferior alveolar and lingual nerve block due to lack of profound anaesthesia. Malamed et al. in their study reported 4% articaine to be more efficacious than 2% lignocaine however, difference in both the mean frequency and amount of solution used for reanaesthesia of the surgical zone failed to reach statistical significance [8].

Subjective evaluation of intraoperative pain experience using 4% articaine and 2% lignocaine was done by means of a visual analogue scale (V.A.S) in which the patients were instructed to score intraoperative pain intensity during the procedure [4,7]. The mean intraoperative pain scores for lignocaine group were 3.22 ± 1.67 cm and 2.13 ± 1.42 cm for articaine group respectively. On comparing the data statistically, the pain scores were found to be significantly higher for 2% lignocaine as compared to 4% articaine ($p<0.001$). These results are comparable to those obtained in other studies by Vahatalo et al. [12] and Malamed et al. [8] thereby contrasting the performance of these two local anaesthetic agents.

In our study, none of the patients reported any altered or painful sensations postoperatively with any of the anaesthetic solutions administered [14]. This is in striking contrast to the study of Haas and Lennon who advised precautions regarding usage of 4% articaine for inferior alveolar nerve block and lingual nerve block and reported that 4% articaine has 21 times more risk of nerve injuries compared to its counterparts [15]. Persistent altered sensation according to the authors could be attributed to high concentration of articaine (4%), however the authors mentioned that the injection technique could not be excluded as the cause for nerve injury [16,17].

Our study based on limited number of patients advocates Septanest (4% articaine hydrochloride with 1: 200000 epinephrine) as an efficacious local anaesthetic agent [18,19] with mild injection pain, faster onset of anaesthesia, low intraoperative pain and reasonable duration of anaesthesia relative to Xylocaine (2% lignocaine hydrochloride with 1:200000 epinephrine) which is suitable for minor oral surgical procedures.

Conclusion

Evaluating the results of conducted studies indicated, considering the limitations and variables involved, it can be stated that Septanest (4% articaine hydrochloride with 1:2000000 epinephrine) may be preferred to Xylocaine (2% lignocaine hydrochloride with 1:2000000 epinephrine) in simple minor oral surgical procedures.

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