

Comparative Evaluation of 4% Articaine versus 2% Lignocaine for Anesthetic Efficacy, Onset, Duration, and Postoperative Analgesia in Periodontal Access Flap Surgery: A Randomized Double-Blind Clinical Trial

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Abstract: ***Background:** Profound and prolonged local anesthesia is essential for patient's comfort during and after periodontal access flap surgery (AFS). Articaine is reported to possess superior tissue diffusion and longer soft-tissue anesthesia compared with lignocaine. **Aim:** To compare the anesthetic efficacy, onset, duration, and postoperative analgesic requirement of 4% articaine hydrochloride with 1:100,000 epinephrine versus 2% lignocaine hydrochloride with 1:100,000 epinephrine in patients undergoing AFS for chronic periodontitis. **Materials and Methods:** Forty systemically healthy adults (20 per group) requiring AFS in maxillary or mandibular posterior sextants with probing depth >5 mm were randomly allocated to receive either 4% articaine or 2% lignocaine as buccal and, when needed, palatal infiltration. Pain intensity was recorded with the Heft-Parker visual analogue scale (HPVAS). Onset and duration of anesthesia, presence and intensity of pain after anesthesia wore off, and number of analgesic tablets consumed in the first 24 hour were recorded using a standardized questionnaire. Data were analyzed with one-way ANOVA and chi-square tests ($\alpha = 0.05$). **Results:** Mean HPVAS scores were significantly lower with articaine (44.40 ± 10.97) than with lignocaine (78.80 ± 12.19) ($F = 88.034$, $p < 0.001$). Onset was faster with articaine (2.38 ± 0.48 min) than lignocaine (4.00 ± 0.92 min) ($F = 49.098$, $p < 0.001$). Duration of soft-tissue anesthesia was longer with articaine (4.53 ± 0.50 h) than lignocaine (3.28 ± 0.50 h) ($F = 62.665$, $p < 0.001$). Pain after wearing off and analgesic consumption showed no statistically significant inter-group differences. **Conclusion:** 4% articaine provides significantly faster onset, lower intraoperative pain scores, and longer duration of anesthesia than 2% lignocaine during AFS, although postoperative analgesic requirements remain comparable.*

Keywords: Articaine, lignocaine, periodontal surgery, access flap, Heft-Parker VAS, local anesthesia

1. Introduction

Successful periodontal surgery depends on profound local anesthesia that lasts throughout the procedure and provides residual analgesia in the early postoperative period. The choice of anesthetic agent influences onset time, depth of anesthesia, duration of soft-tissue numbness, and the patient's need for systemic analgesics. Lignocaine (lidocaine) has remained the gold-standard amide local anesthetic in dentistry for decades because of its rapid onset,

reliable anesthesia, and established safety profile. Articaine, introduced clinically in the 1980s, differs chemically by the presence of a thiophene ring and an additional ester linkage. These structural features increase lipid solubility and allow rapid hydrolysis by plasma esterases, resulting in a shorter systemic half-life and, theoretically, lower systemic toxicity. Several studies have demonstrated that articaine diffuses more readily through soft tissue and bone, enabling more profound anesthesia after a single buccal infiltration and, in some cases, eliminating the need for a separate palatal injection [1–4].

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In periodontal access flap surgery the surgical field involves both buccal and palatal (or lingual) soft tissues, and the procedure itself may last 45–90 min. An anesthetic that provides rapid onset, deep intraoperative anesthesia, and prolonged postoperative soft-tissue analgesia can therefore improve patient comfort and reduce the requirement for immediate postoperative analgesics. Previous investigations comparing articaine and lignocaine have focused mainly on extraction or endodontic procedures; relatively few randomized trials have evaluated the two agents specifically for periodontal flap surgery [5–8].

The present randomized, double-blind clinical trial was therefore designed to compare 4% articaine with 1:100,000 epinephrine and 2% lignocaine with 1:100,000 epinephrine with respect to (1) intraoperative pain scores recorded by the Heft-Parker visual analogue scale, (2) onset and duration of soft-tissue anesthesia, and (3) intensity of pain and analgesic consumption after the anesthetic effect had worn off.

2. Aim of the Study

To evaluate and compare the anesthetic efficacy, onset time, duration of soft-tissue anesthesia, and postoperative analgesic requirement of 4% articaine hydrochloride versus 2% lignocaine hydrochloride when used for access flap surgery in patients with chronic periodontitis.

3. Materials and Methods

3.1 Study design and ethical considerations

A prospective, randomized, double-blind clinical trial was conducted in the Department of Periodontology, Government Dental College and Hospital, Jamnagar, Gujarat. The study protocol was approved by the Institutional Ethics Committee. Written informed consent was obtained from every participant after a full explanation of the procedure and possible risks. The trial followed the principles of the Declaration of Helsinki.

3.2 Sample size and randomization

Sample size was calculated on the basis of previously published data comparing articaine and lignocaine for periodontal procedures. A minimum of 20 sites per group provided >80% power to detect a clinically relevant difference in HPVAS scores at $\alpha = 0.05$. Forty consecutive patients who required access flap surgery in at least one posterior sextant were enrolled and randomly assigned by computer-generated sequence to either the articaine group ($n = 20$) or the lignocaine group ($n = 20$). Allocation concealment was maintained with sealed opaque envelopes opened only after the patient was seated for surgery. Both the operator and the patient remained blinded to the identity of the anesthetic solution; cartridges were prepared and coded by a nurse not involved in the clinical procedure or data collection.

3.3 Inclusion criteria

(1) Age 25–60 years; (2) Systemically healthy adults; (3) Clinical and radiographic diagnosis of chronic generalized

periodontitis; (4) At least one posterior sextant with probing pocket depth >5 mm requiring access flap surgery.

3.4 Exclusion criteria

(1) Systemic diseases (uncontrolled diabetes, hypertension, cardiovascular disease); (2) Known allergy to amide local anesthetics; (3) Tobacco use in any form; (4) Pregnancy or lactation; (5) Acute periodontal or periapical abscess; (6) Immunocompromised status; (7) Periodontal therapy within the preceding six months; (8) Need for osseous recontouring; (9) Presence of gingival recession that would alter flap design.

3.5 Clinical procedure

All patients first received thorough scaling and root planing. Four weeks later, residual probing depths were re-evaluated and only sites that still required surgical intervention proceeded to access flap surgery.

Under aseptic conditions the assigned local anesthetic (either 4% articaine HCl with 1:100,000 epinephrine or 2% lignocaine HCl with 1:100,000 epinephrine) was administered by buccal infiltration (1.5–1.8 mL) using a 27-gauge needle. If the patient reported residual sensation on the palatal/lingual aspect, an additional 0.3–0.5 mL of the same solution was deposited as a supplemental infiltration.

An access flap was elevated, thorough open-flap debridement was performed with ultrasonic and hand instruments, and the flaps were repositioned and sutured with 4-0 silk sutures. A periodontal dressing was placed. Postoperative instructions and a standardized questionnaire were given to each patient.

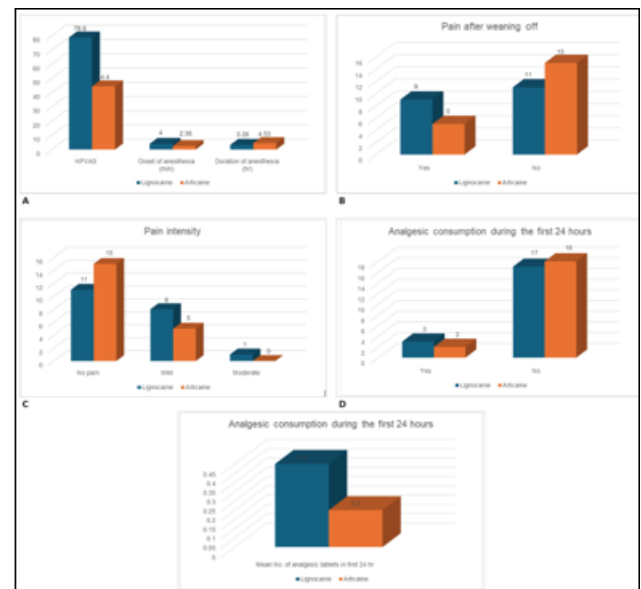


Figure 1: Table A: mean comparison of postoperative pain, onset, and duration of anesthesia between lignocaine and articaine groups, Table B: comparison of pain after wearing off of anesthesia between lignocaine and articaine groups Table C: comparison of pain intensity after wearing off of anesthesia between lignocaine and articaine groups Table D: comparison of analgesic consumption during the first 24

hours between lignocaine and articaine groups Table E: no.
Of tablets taken in first 24 hour

3.6 Outcome measures

- 1) Intraoperative pain intensity – recorded immediately after completion of surgery on the Heft-Parker visual analogue scale (HPVAS; 0–170 mm).
- 2) Onset of anesthesia – time (min) from injection until the patient reported complete numbness of the surgical site.
- 3) Duration of soft-tissue anesthesia – time (hour) from onset until the patient first experienced a “pins-and-needles” sensation or complete return of normal sensation.
- 4) Presence of pain after anesthesia wore off (yes/no).
- 5) Intensity of residual pain (none / mild / moderate / severe).
- 6) Analgesic consumption – number of diclofenac sodium 50 mg tablets taken in the first 24 h.

3.7 Statistical analysis

Data were entered into Microsoft Excel and analyzed with SPSS version 22. Continuous variables (HPVAS, onset, duration, number of tablets) were expressed as mean $\pm$ standard deviation and compared by one-way ANOVA. Categorical variables (pain after wearing off, pain intensity, analgesic use) were compared by chi-square test. A p-value < 0.05 was considered statistically significant.

4. Results

Forty patients (20 per group) completed the study. Baseline demographic characteristics (age, sex distribution) and preoperative probing depths were comparable between groups.

4.1 Intraoperative pain (HPVAS)

Mean HPVAS score was significantly lower in the articaine group (44.40 ± 10.97) than in the lignocaine group (78.80 ± 12.19) ($F = 88.034$, $p < 0.001$). (Table 1, Figure 1A)

4.2 Onset of anesthesia

Onset was significantly faster with articaine (2.38 ± 0.48 min) than with lignocaine (4.00 ± 0.92 min) ($F = 49.098$, $p < 0.001$). (Table 1, Figure 1A)

4.3 Duration of soft-tissue anesthesia

Duration was significantly longer with articaine (4.53 ± 0.50 h) than with lignocaine (3.28 ± 0.50 h) ($F = 62.665$, $p < 0.001$). (Table 1, Figure 1A)

Table 1: Mean comparison of Postoperative Pain, Onset, and Duration of Anesthesia Between Lignocaine and Articaine Groups

Parameter	Lignocaine Mean $\pm$ SD	Articaine Mean $\pm$ SD	F-value	p-value
HPVAS	78.80 ± 12.19	44.40 ± 10.97	88.034	$< 0.001^*$
Onset (min)	4.00 ± 0.92	2.38 ± 0.48	49.098	$< 0.001^*$
Duration (hr)	3.28 ± 0.50	4.53 ± 0.50	62.665	$< 0.001^*$

*Statistically significant at $p < 0.05$ (one-way ANOVA)

4.4 Pain after wearing off

Pain was reported by 9/20 (45%) patients in the lignocaine group and 5/20 (25%) patients in the articaine group; the difference was not statistically significant ($\chi^2 = 1.785$, $p = 0.185$). (Table 2, Figure 1B)

Table 2: Comparison of Pain After Wearing Off of Anesthesia

Pain after wearing off	Lignocaine N (%)	Articaine N (%)	χ^2 / p
Yes	9 (45.0%)	5 (25.0%)	1.785/
No	11 (55.0%)	15 (75.0%)	0.185

4.5 Intensity of residual pain

No pain was reported by 11 (55%) subjects in the lignocaine group and 15 (75%) subjects in the articaine group. Mild pain was reported by 8 (40%) subjects in the lignocaine group compared with 5 (25%) subjects in the articaine group, while moderate pain was reported by 1 (5%) subject in the lignocaine group and none in the articaine group ($\chi^2 = 2.308$, $p = 0.315$). (Table 3, Figure 1C)

Table 3: Comparison of Pain Intensity After Wearing Off of Anesthesia

Pain intensity	Lignocaine N (%)	Articaine N (%)	χ^2 / p
No pain	11 (55.0%)	15 (75.0%)	2.308 / 0.315
Mild	8 (40.0%)	5 (25.0%)	
Moderate	1 (5.0%)	0 (0%)	

4.6 Analgesic consumption

Three patients (15%) in the lignocaine group and two patients (10%) in the articaine group required analgesics ($\chi^2 = 0.229$, $p = 0.633$). Mean number of tablets taken in the first 24 h was 0.45 ± 0.89 (lignocaine) versus 0.20 ± 0.62 (articaine) ($F = 1.072$, $p = 0.307$). (Table 4, Figure 1D) Table 5, Figure 1E)

Table 4: Comparison of Analgesic Consumption During the First 24 Hours

Analgesic consumption	Lignocaine N (%)	Articaine N (%)	p
Yes	3 (15.0%)	2 (10.0%)	0.633
No	17 (85.0%)	18 (90.0%)	
Mean tablets (Mean $\pm$ SD)	0.45 ± 0.89	0.20 ± 0.62	0.307

Table 5: No. of tablets taken in first 24 hour

	Lignocaine Mean $\pm$ SD	Articaine Mean $\pm$ SD	f-value	p-value
No. of analgesic tablets in first 24 hr	0.45 ± 0.89	0.20 ± 0.62	1.072	0.307

5. Discussion

The present randomized double-blind trial demonstrated that 4% articaine provides statistically and clinically superior intraoperative anesthesia, faster onset, and longer soft-tissue duration compared with 2% lignocaine when used for periodontal access flap surgery.

The lower HPVAS scores observed with articaine are consistent with its greater lipid solubility conferred by the thiophene ring, which facilitates more rapid and extensive diffusion through soft tissue and cortical bone. Previous investigations in extraction and endodontic settings have reported similar advantages of articaine for buccal infiltration anesthesia; the present data extend these observations to the more prolonged and technically demanding environment of periodontal flap surgery [6–8].

The mean onset time of 2.38 min for articaine versus 4.00 min for lignocaine is clinically meaningful. A faster onset reduces chair time and patient anxiety before the surgical incision. The prolonged duration of soft-tissue anesthesia (approximately 4.5 h with articaine versus 3.3 h with lignocaine) is particularly advantageous after flap surgery, because residual numbness can blunt the early inflammatory pain that peaks 2–6 h postoperatively [9, 10].

Interestingly, despite the longer residual anesthesia, the proportion of patients who reported pain after the anesthetic wore off and the number of analgesic tablets consumed did not differ significantly between groups. This finding suggests that once the anesthetic effect dissipates, the inflammatory cascade triggered by surgical trauma becomes the dominant source of discomfort and is not fully mitigated by the choice of local anesthetic alone. Nevertheless, the absolute numbers of patients requiring analgesics remained low in both groups, indicating that modern periodontal flap procedures are generally well tolerated when adequate local anesthesia is achieved.

Hemostasis was not formally quantified in the present study; however, the operators did not report any clinically relevant difference in bleeding that compromised visibility. Earlier literature has occasionally noted increased bleeding with etidocaine or bupivacaine when the epinephrine concentration is reduced to 1:200,000. Both agents used in the present trial contained 1:100,000 epinephrine, which appears to provide adequate vasoconstriction for periodontal surgery.

Limitations of the study include the relatively small sample size, the restriction to posterior sextants, and the lack of objective measurement of pulpal anesthesia or cortical bone thickness. Future multicenter trials with larger cohorts and inclusion of anterior sites would strengthen the evidence base.

In summary, 4% articaine offers a clinically useful combination of rapid onset, profound intraoperative anesthesia, and prolonged soft-tissue duration that makes it an attractive alternative to 2% lignocaine for periodontal access flap surgery. Postoperative analgesic requirements, however, remain comparable, underscoring the multifactorial nature of postsurgical pain.

6. Conclusion

Within the limitations of this randomized double-blind trial, 4% articaine hydrochloride with 1:100,000 epinephrine demonstrated significantly lower intraoperative pain scores, faster onset, and longer duration of soft-tissue anesthesia

than 2% lignocaine hydrochloride with 1:100,000 epinephrine during access flap surgery for chronic periodontitis. Postoperative pain incidence and analgesic consumption did not differ significantly. Articaine may therefore be preferred when rapid and prolonged local anesthesia is desired for periodontal surgical procedures.

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Nil.

Conflicts of Interest

There are no conflicts of interest.

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