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International Journal of Medical Science and Dental Health (ISSN: 2454-4191)
Volume 11, Issue 08, August 2025,
Doi: https://doi.org/10.55640/ijmsdh-11-08-05

A Comparative Study Between Manual vs. Electric Dental Anesthesia

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Received: 24 July 2025, **accepted:** 29 July 2025, **Published Date:** 13 August 2025

Abstract

Electric Dental Anesthesia (EDA) defined as a technique that achieving a local anesthesia by applying of "Transcutaneous Electrical Nerve Stimulation" (TENS). TENS first discovered in 1970s and introduced as "alleviate chronic pain" (intractable cancer pain, Phantom pain, back pain, …) and the acute pain in addition to find the utilities in areas of the sports medicine. The study aims to compare the effectiveness, onset time, and patient comfort levels between manual and electric dental anesthesia. It is hypothesized that electric anesthesia provides faster onset, lower pain perception, and higher patient satisfaction compared to manual methods. Despite the benefits, electronic anesthesia may have limitations including cost, equipment availability, and operator training requirements. However, its potential to improve patient experience and reduce failure-related complications justifies further investment and adoption in clinical practice.

Keywords

Electric Dental Anesthesia, Visual Analogue Scale, Lickert scale

Introduction

Francis from Philadelphia was the 1St person described the dental pain relief by an electricity. He noticed the analgesia production through a process of tooth extraction by applied of one electrode to the offending tooth, while another was held in the patient's hand (1). As compared, a chronic pain was a common problem and a lot of people complaint from an in-adequate management (2). Dental anesthesia is a critical component of pain management in clinical dentistry. Manual syringe delivery has been used for decades, but newer electric systems offer more controlled and potentially less painful delivery (3)(4).

Many of developed techniques purpose to administer no-pain anesthesia, like topical gel anesthesia /or injected site pre-cooling by using vibration /or pressure at the injected site through using a slow injection with a computer-controlled anesthesia delivery system, and finally a needle-less jet injection (5). Advantages of E-flow (Dental anesthesia delivery system): High-precision sensor is used for more precise control; the injection pressure is just hydraulic pressure, high-precision liquid control: while achieving precise drug delivery accuracy, real-time dynamic pressure: reflecting the injection pressure based on the value and dynamic bar graph of which dentists can adjust the operation to bring a painless and safe treatment, provide additional voice reminders not available in the standard mode, help users quickly learn the proper operation, timely voice reminders under low anesthesia dose and high system pressure (in PDL mode), autoclavable: prevent cross infection, safe and economical, prevent swelling and pain caused by excessive liquid, lighter and smaller: only weighs 40g, and easier to operate, intelligent Foot Pedal Control: The injection flow rate can be switched by pressing the foot pedal to the "front section" /or "back section "of the stroke. In addition, a speed reducing and injection pressure is an effective method to decrease

pain and a quite laborious manual control (6). Does electric dental anesthesia offer better clinical outcomes compared to manual anesthesia?

Method

A study designated in a cross-section observation-analytical study which designated for evaluation of the EDA efficacy by involving 60 participants visiting a private dental clinic. Then, divided the total number into; Group A: manual anesthesia (30 patients) and Group B: Electric anesthesia (30 patients). The study period from March to July 2025. All the participants with formal written consent. The included people involve those had been need a "pain relief" before a restorative treatment (fillings/ or stainless steel crown), or non-surgical periodontal surgery (root planning, supra-gingival, and sub-gingival scaling), simple extractions, orthodontic, trauma management (repositioning of tooth /or splinting). In addition, participants with cardiac pacemakers, neurophysiological disorders, and pregnancy. The instruments needed in research**:** Standard manual syringe, electric anesthesia device. The Pain measured using VAS (0-10).

Figure (1): Electric administrated anesthesia (E. FLOW Eighteeth®).

Figure (2): Specifications of E. FLOW Eighteeth® (https://www.eighteeth.com/Dental-Anesthesia-Delivery-System/126.html)

Data Collection

Data were collected on onset time (in seconds), pain scores, anesthesia success, and satisfaction immediately after treatment.

Data are analyzed by using SPSS software program. The descriptive data analysis measured by; mean, standard deviation, while an Inferential data analysis measured by; "paired t-test" and "chi-square" tests. The Significance level stated at p value= < 0.05.

The following (table.1) showed compares between the onset time of anesthesia in manual vs. electric administration, evaluate pain perception using the Visual Analogue Scale (VAS), determine patient satisfaction with both techniques, and assess failure rates of anesthesia delivery.

Table.1: statistical analysis demonstrated the compares between manual and electric anesthesia.

parameter	Manual Anesthesia	Electronic Anesthetic	p-value
Mean Onset Time (sec)	120 ± 15	9.0 ± 10	0.002
Mean Pain Score (VAS)	5.5 ± 1.2	3.1 ± 1.0	0.001
Anesthetic Failure Rate %	10 %	3 %	0.041
Patient satisfaction	75 %	92 %	0.008

Table.2: "Lickert scale"

scale	Description
1	-Uncomfortable /or ineffectiveness
2	-Moderately Uncomforted /or ineffectiveness
3	-Minor Discomforted /or slightly effectiveness

4	-Moderate Comforted / or effectiveness
5	-Very Comforted / or very effectiveness

** for measuring of the comfort and effect of anesthesia (7).

Table.2: "Visual Analogue Scale" for Pain measurement (8).

scale	Description
0	Painless
1	Mild-Pain Can recognize, but not discomforted
2	Moderate-Pain can discomforted, but bearable
3	Severe-pain Is a considerable discomforted, and difficult to bear
4	Very-severe /or unbearable pain

Discussion

EDA is based on the criteria of (TENS), that provides a promising road for producing dental anesthesia by utilizing a "Gateway Theory" of pain-controlling which was given by **Malzack** and **Wall**, in 1965 (9). A lot of explanations of TENS effects demonstrate an electrical stimulation caused a release of the Endorphins, that attached to Receptors of the opioid and blocked of the transmission of pain stimuli (10).

Another explanation theory, it is "Serotonin, Dopamine, and Norepinephrine". The roles of an elevation in the Serotonin which has a direct correlation with the analgesic effect that producing by **TENS** (11,12).

Electric delivery systems likely reduce pain perception due to slower and more consistent delivery of anesthetic. Increased satisfaction and reduced failure rates may encourage broader adoption in clinical practice (13).

Although, some of the studies had been reported a successful rate of 56-100% for EDAs (14). On other hand, they have not reported a significant difference between the use of this method and an inactive-instrument (15). The comparative analysis of manual versus electronic anesthesia techniques reveals a marked clinical advantage of the electronic method across all evaluated parameters. These findings are consistent with emerging trends in modern pain management strategies that emphasize patient comfort, efficacy, and efficiency.

Electronic anesthesia demonstrated a significantly shorter onset time, suggesting that it may be particularly useful in procedures requiring rapid action. This rapid onset is likely due to the mechanism of transcutaneous electrical nerve stimulation (TENS), which activates both sensory and motor nerves, facilitating faster drug uptake (16).

Moreover, pain scores were substantially lower in the electronic group. This aligns with the growing body of evidence showing that TENS-based techniques modulate pain perception by stimulating endogenous opioid release and inhibiting nociceptive signals at both spinal and supraspinal levels (17). Additionally, increased serotonin and norepinephrine levels—secondary to electrical stimulation—further suppress pain pathways (18).

The failure rate of anesthesia was also significantly reduced, which may be attributed to more uniform drug distribution and consistent nerve stimulation in the electronic method. This consistency likely contributes to the higher patient satisfaction observed (19). Patient-centered care metrics are increasingly influencing clinical

decisions, and techniques offering comfort and predictability are favored (20).

Conclusion

Electric dental anesthesia presents a superior alternative to manual methods in terms of onset time, pain reduction, and satisfaction. Adopting this technology could improve patient care standards.

Conflict of Interest: None

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