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Comparative Evaluation of Classical Inferior Alveolar Nerve Block and Gow-Gates Nerve Block for Surgical Removal of Mandibular Third Molar

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ABSTRACT

Effective anesthesia is essential for the surgical removal of mandibular third molars. While the classical inferior alveolar nerve block is widely used, its success may be limited by anatomical variations. The Gow-Gates technique is considered a potential alternative offering broader mandibular anesthesia. **Objectives:** To evaluate and compare the classical inferior alveolar nerve block and Gow-Gates nerve block for surgical removal of mandibular third molars in terms of Anesthetic success rate, Onset and duration of anesthesia, and patient-reported pain using a visual analog scale. **Methods:** A quasi-experimental, comparative study was performed in which a total of 160 patients were selected and randomly allocated to receive Gow-Gates (GG) nerve block or inferior alveolar nerve block (IANB) for the extraction of mandibular molars. Onset time, pain levels, and volume of anesthesia were recorded as data. SPSS statistical analysis version 26.0 was used for data analysis. **Results:** Regarding gender, females were counted more, 87, comprised 54.43 % of the sample, whereas 73 men accounted for 45.57 %. The onset time of the Gow-Gates group took 6.16 minutes, which is slower than IANB, 2.78 minutes; however, the success rate of both techniques is about the same, 87.5%. Furthermore, the mean volume of local anesthesia used to anesthetize tissues was higher in the IANB group than in the GG group. **Conclusions:** Both methods are useful in mandibular anesthesia, and Gow-Gates has a high rate of success and less chance of aspiration, though IANB has a quicker onset. Patient and clinician factors determine the technique to be used.

INTRODUCTION

One of the greatest aspects of oral and maxillofacial surgery is pain control, and local anesthesia represents an essential step to its achievement. The mechanism of action of a local anesthetic is that they temporarily affect the nerve conduction of nerve impulses, like they temporarily block the feeling of pain [1]. Globally, the prevalence of impacted third molars ranges from approximately 16% to 68%, making their surgical removal one of the most common oral surgical procedures. Effective local anesthesia is essential for pain control during these procedures, with the classical inferior alveolar nerve block (IANB) being the most widely used technique. However, IANB has been reported to have a failure rate ranging from 15% to 25%, which may compromise patient comfort and surgical efficiency. The Gow-Gates mandibular nerve block has been proposed as an alternative technique with potentially higher success rates and lower incidence of positive aspiration. Despite these advantages, comparative evidence regarding the efficacy of these techniques during mandibular third molar surgery remains limited, particularly in the regional and local population. Therefore, this study was conducted to compare the effectiveness of the classical inferior alveolar nerve block and Gow-Gates nerve block for the surgical

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removal of mandibular third molars [2]. Two percent lidocaine is the most widespread local anesthetic drug in dentistry and is frequently mixed with a vasoconstriction agent, adrenaline (epinephrine) [3]. Vasoconstrictor also increases the life of an anesthetic, not only by decreasing vascular pick-up but also in terms of reducing systemic toxicity, and gives a clean, hemorrhage-free surgical field. All these contribute greatly to the general efficiency and safety of dental surgical operations [4]. Successful local anesthesia is an achievement towards the success of any oral surgery. But the working of anesthesia depends upon various factors [5]. These encompass the method adopted and employed by the clinician during the procedure of anesthesia, plus the individualized conditions of the patient, such as variations of anatomy, the existence of infection or inflammation, psychological factors, including fear or anxiety, and so on [6]. With the rather thin and porous bone containing the tooth roots, which is present in the maxilla, the local anesthetic solutions have a tendency to diffuse easily, thereby making the local infiltration technique a highly successful technique. Consequently, maxillary anesthesia is expected to be associated with a positive success rate in common dental practices [7]. Contrary to this, a more difficult procedure is mandibular anesthesia, especially among adults. Mandibular teeth have dense cortical bone around the roots, leading to poor infiltration, and in such cases, it requires the application of nerve block procedures [8]. The inferior alveolar nerve block (IANB), despite its widespread use, does not ensure an effective pulpal anesthesia. The failure rates reported are comparatively high, and the result can be affected by a variety of factors [6]. These are: anatomical variation, e.g., bifid mandibular nerves or supernumerary foramina, wrong injecting technique, individual differences in drug response, and factors such as intravascular injection or injection-site infection [10]. Alternative techniques, such as the Gow-Gates mandibular nerve block, have been developed to address these issues. By injecting the anesthetic solution closer to the neck of the mandibular condyle, a higher anatomical location than that of the standard IANB, he aimed to provide a more thorough and efficient anesthesia of the branches of the mandibular nerve in 1973 [11]. This enables anesthesia of the inferior alveolar nerve and related nerves, including lingual, buccal, and mylohyoid. The Gow-Gates technique depends upon the accuracy of needle placement based on both extraoral and intraoral landmarks of the anatomy and on more technical skill; however, the benefit of the technique is extension and more consistent distribution of anesthesia [12].

Despite widespread use of the inferior alveolar nerve block, high failure rates and variable anesthesia success highlight the need for more effective techniques. Limited comparative evidence exists on the efficacy of the Gow-Gates versus classical IANB, particularly in local populations. Therefore, this study aimed to compare the effectiveness of the classical inferior alveolar nerve block and Gow-Gates nerve block for the surgical removal of mandibular third molars in patients presenting to Dow University of Health Sciences Karachi.

METHODS

This study was designed as a quasi-experimental, comparative study involving two independent groups. Group 1 received the classical inferior alveolar nerve block, while Group 2 received the Gow-Gates mandibular nerve block. Patients in each group were different, and outcomes were compared between the groups was carried out at the Department of Dental and Maxillofacial Surgery, Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences, Dow University of Health Sciences, Karachi in time frame of six months from (April to September 2024) following the institutional ethical review committee of Dow University of Health Sciences Karachi's synopsis approval (Ref: IRB-334-/DUHS/Approval/2024/99; dated 28th March, 2024). Written informed consent was obtained from each patient using a non-probability sequential (convenience) sampling technique. Using a proportion of positive aspiration in Group 1 (P_1) = 2.5% and Group 2 (P_2) = 15% [13], power (1–β) = 80%, and a 95% confidence level, the sample size was determined using WHO sample-size software to be 80 patients per group (n=80). Consequently, a total of 160 patients will be included, 80 in each of the two groups. The primary outcome of this study was anesthetic success rate, defined as the ability to complete surgical removal of the mandibular third molar without supplemental anesthesia, assessed intraoperatively and using a 0–10 Visual Analog Scale (VAS). Secondary outcomes included the onset time of anesthesia and the duration of anesthesia. Inclusion Criteria consisted of patients undergone extractions of mandibular molars requiring different local anesthesia techniques, having an age of 18–60 years, and patients with known allergy to local anesthetics, local inflammation, or tenderness at the injection site. Current users of antidepressant or antipsychotic medication were excluded from the study. The primary outcome of the study was anesthetic success rate, defined as the ability to complete the surgical extraction of the mandibular third molar without the need for supplemental anesthesia. A nerve block was considered successful if the patient achieved adequate lip numbness and the procedure was completed without significant pain or the need for additional anesthetic injections. Pain perception was assessed using a Visual Analog Scale (VAS) ranging from 0 to 10, where 0 indicated no pain, and 10 indicated the worst imaginable pain.

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Patients were instructed to indicate their pain intensity on the scale during the surgical procedure. Pain scores were recorded at the time of tooth extraction, and any score ≥4 was considered indicative of inadequate anesthesia, requiring supplemental anesthesia and recorded as anesthetic failure. Participants were randomly allocated into two equal groups using a computer-generated randomization method. Group A received the classical inferior alveolar nerve block, while Group B received the Gow-Gates mandibular nerve block. Allocation concealment was ensured using sealed opaque envelopes opened at the time of intervention. The study followed a single-blind design, while outcome assessment was performed by an independent investigator blinded to group allocation. To ensure procedural standardization, all injections were administered by the same experienced operator using the same armamentarium and local anesthetic solution (2% lidocaine with 1:100,000 epinephrine), following standardized protocols for both techniques. Outcome variables were monitored intraoperatively and postoperatively using standardized assessment criteria. During the surgical procedure, patients were observed for signs of inadequate anesthesia, and pain was assessed using a Visual Analog Scale (VAS, 0–10). If a patient reported moderate to severe pain (VAS ≥4) or showed signs of discomfort during the procedure, supplemental anesthesia was administered, and this was recorded as anesthetic failure. Intraoperative monitoring also included observation for the onset of anesthesia, and patients were followed for 24–48 hours to assess complications such as pain, swelling, trismus, or any adverse reactions to the anesthetic technique. Outcome assessments were recorded immediately after anesthesia administration, during the surgical procedure, and at the postoperative follow-up visit to ensure consistent evaluation of all study parameters. A complete medical and dental history was recorded. The principal investigator (PI) will leave the operatory while a consultant administers the assigned block. After injection, the PI will re-enter, double-blinded to the technique, and assess the following parameters: Onset time of anesthesia (minutes), Maximum mouth openness (mm) prior to and following each block, and Surgical pain (visual analogue scale). A 27-gauge long dental needle attached to a standard aspirating syringe was used for both the classical inferior alveolar nerve block and Gow-Gates mandibular nerve block techniques. Approximately 1.8 mL of anesthetic solution was deposited following the standard protocol for each technique. All injections and surgical procedures were performed by a single experienced oral surgeon with more than five years of clinical experience to minimize operator variability. The surgical removal of mandibular third molars was carried out using a standardized surgical protocol, including mucoperiosteal flap elevation, bone removal, when necessary, tooth sectioning if required, and wound closure with sutures, ensuring consistency across all participants. Following administration of the anesthetic, the onset of anesthesia was assessed clinically by the presence of lip numbness and soft-tissue anesthesia. To control potential confounders, the same anesthetic agent, surgical protocol, operator, and assessment criteria were used for all participants. Patient confidentiality was maintained by assigning unique identification codes and storing data in password-protected files accessible only to the research team. After data collection, information was entered and analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using the independent-sample t-test, while categorical variables were analyzed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Among the 160 patients whose gender was recorded in the dataset, the gender distribution where females outnumbered males: 87 women comprised 54.43 % of the sample, whereas 73 men accounted for 45.57 %.In the conventional IANB group 44(55%) patients were female, while 36(45%) were male, with a mean age of 35 ± 36.89 years, while the Gow-Gates group had a mean age of 35.37 ± 34.71 years, with 52 (65%) female patients and 28 (35%) male patients (Table 1).

Table 1: Distribution of Gender and Age

Techniques	Female (%)	Male (%)	Mean Age
IANB	44 (55%)	36 (45%)	34 ± 36.89
Gow-Gates	52 (65%)	28 (35%)	35.37 ± 34.71

Seventy patients (87.5%) and ten (12.5%) in each group attained complete anesthesia after receiving an Inferior Alveolar Nerve Block (IANB) and a Gow-Gates block, respectively. Direct comparison of the two methods yields the same overall success rate (140/160=87.5%), and the corresponding p-value of 0.35 suggests that the difference is not statistically significant. To put it briefly, both the Gow-Gates method and the IANB are equally successful in achieving pulpal anesthesia (Table 2).

Table 2: Comparison of Success Rate between Two Groups

Success Status	Techniques	IANB (n=80)	Gow-Gates (n=80)	Total (n=160)	p-value
Successful	Inferior Alveolar Nerve Block	70 (87.5%)	70 (87.5%)	140 (87.5%)	0.350
	Gow-Gates	70 (87.5%)	70 (87.5%)	140 (87.5%)	
Un-successful	Inferior Alveolar Nerve Block	10 (12.5%)	10 (12.5%)	20 (12.5%)	
	Gow-Gates	10 (12.5%)	10 (12.5%)	20 (12.5%)	

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It indicates that the average time of onset of Gow-Gates is 5.77 ± 1.28 minutes, and of IANB, it is 4.87 ± 1.34 minutes. The IANB group's mean time of action was significantly earlier than the GG group's (p-value of <0.002). (Table 2). Additionally, the IANB group employed a larger mean volume of local anesthetic to anaesthetize tissues than the GG group. The p-value for the independent samples t-test was 0.004.

Table 3: Comparison of Two Groups' Anesthesia Onset Times

Techniques	N	Onset Time Mean ± S.D (min)	p-value
Gow-Gates	80	5.77 ± 1.28	0.002
IANB	80	4.87 ± 1.34	0.002
Volume Mean ± S.D (ml)			
Gow-Gates	80	4.0 ± 3.49	0.004
IANB	80	4.3 ± 1.56	

The majority of patients, or 30 (37.5%) cases in the IANB group, experienced moderate pain during the administration of anaesthesia, whereas the majority of patients, or 50 (62.5%) cases in the GG group, experienced mild pain, which compares the intensity of pain during the administration of anaesthesia between the two groups. The chi-square test revealed a significant difference between the two groups (p-value=0.001) (Table 4).

Table 4: Pain Comparison of Two Groups during LA Administration

Pain Status	IANB (%)	Gow-Gates (%)	Total (%)	p-value
No pain	10 (12.5%)	12 (15%)	22 (13.75%)	0.001
Mild	20 (25%)	50 (62.5%)	70 (43.75%)	
Moderate	30 (37.5%)	13 (16.25%)	43 (26.9%)	
Severe	20 (25%)	5 (6.25%)	25 (15.6%)	
Total	80 (100%)	80 (100%)	160 (100%)	

DISCUSSION

A successful procedure in oral surgery specifically requires proper anesthetizing of the mandible, which can be achieved through a few injection methods. One of the most used methods is the Classical Inferior Alveolar Nerve block (IANB) [13]. This is one of the methods that was developed in the late 19th century and has served as a basis in oral surgery during the provision of anesthesia to the teeth in the mandible. Nevertheless, it is said to be associated with a greater rate of clinical errors, though this procedure is quite easy to conduct [14, 15]. The challenge posed by IANB is mainly the anatomical variability of the patients, besides the dense thickness of the cortical bone around the teeth in the mandible, which may render the block procedure less predictable [16, 17]. To eliminate the shortcomings of the approach, Gow-Gates proposed a more thorough method of blocking the mandibular nerve in 1973. This method is used when the needle is brought near the mandibular condyle, giving a wider and higher span of anesthesia in several branches of the mandibular nerve [18, 19]. Gow-Gates has exhibited some usefulness since there have been increased success rates, lower proportions of positive aspiration, and good distribution of overall anesthetic [20]. It is, however, more technically demanding and may be more difficult to learn, especially for clinicians who have been using IANB. Other research conducted by Valenzuela *et al.* there was a shorter induction time using IANB, whereby the average period was 2.78 minutes as compared to 6.16 minutes by Gow-Gates [21]. This concurs with the findings of other research studies, such as Sarfaraz *et al.* which found that IANB had a higher onset speed [1]. The rapidity of onset of IANB can be attributed to the fact that the practitioner precisely placed the technique near the inferior alveolar nerve, which gives a quicker numbness. The two methods exhibited equal success rate in respect to quality of the anesthesia, as 87.5 percent of the patients in both cases experienced effective anesthesia. Although the amount of anesthetic used was equal between the two groups, other researchers, such as Saatchi *et al.* have proposed that a higher amount of the anesthetic may enhance the success rate and, in that regard, the Gow-Gates technique [22]. But this difference between the two techniques regarding the success rate was not significant in our study, which confirms the thought that both techniques work equally well when the required dose is administered [23]. The openness of the mouth showed one of the distinctions between the techniques, as the mouth opening was not measured accurately using one of the techniques. The Gow-Gates group developed a significant increase in mouth opening (0.5 mm), which was not noticed in the IANB group. This modest increase in mouth opening with the Gow-Gates technique can be explained by the fact that it covers all the anesthetic areas, as compared to the decrease in the number of muscles relaxed around the mandible [24]. In general, although the two methods have their merits, the preference of Gow-Gates and IANB can be based on the clinical condition, which should be comprised of patient anatomy and clinician experience. These two ways are both reliable forms of anesthesia, and Gow-Gates can induce a more consistent and broader block, especially in difficult cases [25].

The research had limitations that included a single-center design and a small sample, which can be used to indicate a limitation in the generalization of the research. Moreover, the operators might have been biased by the Gow-Gates technique experience. Further studies are necessary to involve more and more multi-centers and more populations, and also to conduct research to understand training protocols in order to enhance clinical acceptance and effectiveness of advanced mandibular nerve block methods.

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CONCLUSIONS

In general, the study comes to the conclusion that both the IANB and Gow-Gates methods are safe and accurate when it comes to mandibular anesthesia, and neither one has a serious advantage over the other, actually. However, patients who received GG block reported much less discomfort when anesthesia was administered, and less LA solution was needed to produce a sufficient level of anesthesia. Consequently, GG can be regarded as a good substitute anesthetic approach for the widely utilized IANB technique in the extraction of mandibular molars.

Authors' Contribution

Conceptualization: MMK, MI
Methodology: MMK, TS
Formal analysis: MI, SSA
Writing and Drafting: TS, AS, SSA, FK
Review and Editing: MMK, MI, TS, AS, SSA, FK

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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