Comparative assessment of the efficacy of conventional, Vazirani Akinosi, and Gow-Gates anaesthesia techniques for intra-alveolar extraction of mandibular molar teeth

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ABSTRACT

Introduction: Pain control during dental extraction is achieved with local anaesthesia. The impact of anaesthesia can be affected by the technique used in its administration. Dentists commonly use a conventional inferior alveolar nerve block (IANB) to administer anaesthesia to the mandible. However, alternatives like Gow-Gates (G-G) and Vazirani-Akinosi (V-A) techniques have been developed, and their level of efficacy as anaesthesia has yet to be determined. This study compared the efficacy of anaesthesia between these three local anaesthetic injection techniques during the intra-alveolar extraction of mandibular molars.

Method: Subjects who met the inclusion criteria were randomly allocated to a test group and a control group, using the balloting technique. The test group received local anaesthesia using the G-G and V-A techniques, and the control group received local anaesthesia using the conventional IANB. Time of onset of action, intra-injection pain, and depth of anaesthesia were assessed and compared among these three techniques. Data were analysed using the Statistical Package for Social Sciences (SPSS) version 24.

Results: 180 participants (60 in each group) were included in the study and analysed. The highest efficacy was the G-G technique, with the shortest time of onset (113.88±57.8 seconds, p=0.001), the least intra-injection pain (median score of 3.0, p=0.001), and the best depth of anaesthesia (median intraoperative pain score of 3.0, p=0.001). There was no statistically significant difference in the mean onset between V-A technique and IANB (p=0.994). However, there was a statistically significant difference in the intra-injection pain (p=0.025) and depth of anaesthesia (p=0.005).

Conclusion: This study determined that the G-G technique has a higher success rate than the V-A and IANB techniques during intra-alveolar extraction of mandibular molar teeth.

Keywords: efficacy, anaesthesia techniques, extraction, molar, Nigeria

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Introduction

Pain control is a vital part of dental extraction, which is achieved through the use of local anaesthesia.[1] The impact of anaesthesia can be affected by the technique used in the administration of the anaesthesia.[2] Dentists commonly use a conventional inferior alveolar nerve block (IANB) to administer anaesthesia to the mandible during dental procedures.[3]

However, alternatives like Gow-Gates (G-G) and Vazirani-Akinosi (V-A) techniques have been developed, and their level of efficacy as anaesthesia has yet to be definitely determined.[4] In the IANB technique, the nerve is approached from the premolars on the contralateral side.[4] The G-G technique was developed by George A. E. Gow-Gates. It is briefly described as follows: the needle is aimed at the level of the neck of the condyle, which is situated just under the insertion point of the lateral pterygoid muscle. This technique is used for more extensive anaesthesia or in cases where the IANB has not been successful.[5]

The V-A technique was invented by Sunder J. Vazirani in 1960 and later re-introduced in 1977 by Akinosi. This is a closed-mouth technique commonly used in patients with limitation in mouth opening or who cannot open wide enough for the IANB technique.[5]

This study compared the efficacy of anaesthesia between these three local anaesthetic injection techniques (IANB, G-G, and V-A) during the intra-alveolar extraction of mandibular molars.

Method

Patients aged 18 years and above were recruited and who presented to the Oral and Maxillofacial Surgery clinic, Lagos State University Teaching Hospital (LASUTH), Ikeja, Lagos, Nigeria, with indications for intra-alveolar extraction of at least one mandibular molar and who met the inclusion criteria. Eligibility criteria included adult subjects (18 years and above) with at least one mandibular molar indicated for intra-alveolar extraction and a completed consent form.

However, patients with dentoalveolar abscess, fascial space infection, reduced mouth opening, on contraceptives, steroids, tobacco, alcohol ingestion, with debilitating medical conditions, mobile mandibular teeth, impacted teeth, and pregnant patients were all excluded.

Patients were randomly assigned by balloting into three groups: A, B, and C, corresponding to IANB, V-A, and G-G, respectively.

The control group were subjects who received the conventional IANB prior to intra-alveolar extraction of the mandibular molar. The test groups received local anaesthesia using the G–G technique or the V-A technique.

Time of onset of action, intra-injection pain, and depth of anaesthesia were assessed and compared among these three techniques.

Data from all patients were analysed using Statistical Package for Social Sciences (SPSS) version 24, and there were no dropouts.

Results

We selected 180 patients undergoing intra-alveolar extraction of mandibular molar teeth who met the inclusion criteria. 60 patients were randomly assigned to each of the three groups.

The age range was 18 to 60 years, with the 31-40 age group being the most frequent. A total of 71.1% (128/180) of patients were female, with a male-to-female ratio of 1:2.5.

The onset of action of local anaesthesia across the three groups

The G-G group had 23.3% (14/60) of patients with an onset of action less than or equal to 60 seconds, with the highest percentage (36.7% (22/60)) of patients with an onset time between 121-180 seconds. In the IANB group, no participants had an onset of action less than or equal to 60 seconds, while the highest percentage (36.7% [22/60]) had an onset time between 121 and 180 seconds. In the V-A group, 6.7% (4/60) had an onset of action of less than or equal to 60 sec, with both onsets of action at 61-120 seconds and 181 -241 seconds having the highest numbers of patients, 30% (18/60) in each group. The G-G group had the fastest onset of action among the three groups, and this was statistically significantly different (Fisher's exact value = 30.134, $p < 0.001$) (Table 2).

Comparing efficacy using intra-injection pain across the three groups

18.6% (11/60) of patients in the V-A group had mild intra-injection pain, and 40% of patients had severe intra-injection pain. However, in the G-G group, 76.7% (46/60) of patients had mild intra-injection pain, with only 5% (5/60) of patients having severe intra-injection pain. Also, in the IANB group, 41.7% (25/60) of patients had mild intra-injection pain, with only 3.3% (2/60) of

Table 1. Age distribution among participants

Age group in Years	V-A (%)	GG (%)	IANB (%)	Total	X^2	p-value
≤20	7(11.7)	8(13.3)	6(10.0)	21(11.7)	2.811	0.946
21-30	14(23.3)	14(23.3)	13(21.7)	41(22.8)		
31-40	22(36.7)	19(31.7)	25(41.7)	66(36.7)		
41-50	10(16.7)	12(20.0)	7(15.0)	29(16.1)		
51-60	7(11.7)	7(11.7)	9(11.7)	23(12.8)		
Mean±SD	31.85±13.1	34.75±14	35.65±12.0		F=1.333	0.266

X^2: Chi-square; F=Analysis of Variance (ANOVA)

Table 2. Onset of action of local anaesthesia among patients

Onset of local anaesthesia (Sec)	V-Akinosi n (%)	Gow-Gates n (%)	IANB n (%)
≤60	4(6.7)	14(23.3)	0(0.0)
61-120	18(30.0)	19(31.7)	18(30.0)
121-180	16(26.7)	22(36.7)	22(36.7
181-240	18(30.0)	5(8.3)	17(28.3)
241-300	4(6.7)	0(0.0)	3(5.0)

Fischer exact value=30.134, p<0.001*

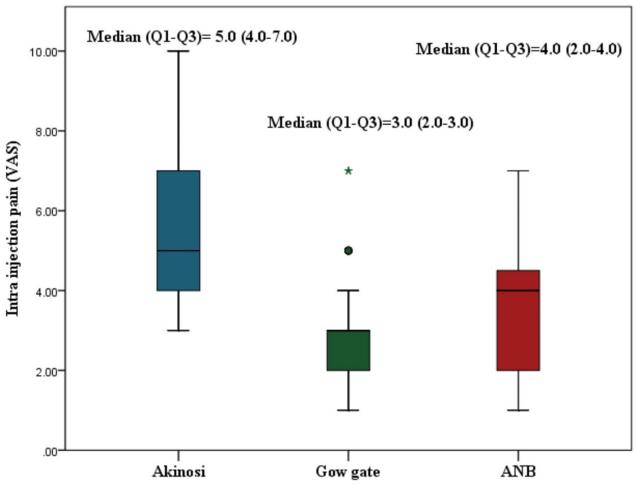

Figure 1. Median comparison of intra-injection pain across all three groups

Table 3. Intra-injection pain level among patients

Intra-injection pain	V-Akinosi n (%)	Gow-Gate n (%)	IANB n (%)	F	p-value
Mild	11(18.3)	46(76.7)	25(41.7)	65.421	**<0.001***
Moderate	25(41.7)	1(18.3)	33(55.0)		
Severe	24(40.0)	5(5.0)	2(3.3)		

F = Fisher's exact value

Table 4. Intraoperative pain levels among participants

Intraoperative pain	Akinosi n (%)	Gow-Gates n (%)	IANB n (%)	F	p-value
Mild	11(18.3)	39(65.0)	14(23.3)	42.349	**<0.001***
Moderate	34(56.7)	12(20.0)	20(33.3)		
Severe	15(25.0)	9(15.0)	26(43.4)		

F = Fisher's exact value

Table 5. Need for supplementary anaesthesia across the three groups

Need for supplementary anaesthesia	V-A (%)	G-G (%)	IANB (%)	X^2	p-value
Yes	15(25.0)	9(15.0)	26(43.3)		
No	45(75.0)	51(85.0)	34(56.7)	12.351	0.002

patients having severe intra-injection pain. There was a statistically significant difference in intra-injection pain across all three groups (Fisher's exact value=65.421, p<0.001) (Table 3).

The V-A group had a maximum Visual Analog Scale score of 9, a minimum of 3, and a median of 5 (interquartile range, 4-7). The G-G group had a maximum score of 7, a minimum of 1, and a median of 3 (interquartile range, 2-3). Also, the IANB group had a maximum VAS score of 7, a minimum score of 1, and a median score of 4, with an interquartile range of 2-4. In addition, across all three groups, there is a statistically significant difference in the median intra-injection pain (Kruskal-Wallis value 50.335, p=0.001<0.05) (Figure 1).

Measuring the depth of anaesthesia using intraoperative pain across the three groups

18.3% (11/60) of patients in the V-A group had mild intraoperative pain, and 25% (15/60) had severe intraoperative pain. However, in the G-G group, 65% (39/60) of patients had mild intraoperative pain, with only 15% (9/60) having severe intraoperative pain. On the other hand, 23.3% (14/60) of patients in the IANB group had mild intraoperative pain, while 43.4% (26/60) had severe intraoperative pain. Also, in the V-A and IANB groups, more patients reported moderate-to-severe intraoperative pain than in the G-G group, whereas the G-G group reported more mild intraoperative pain than the V-A and IANB groups. There was a statistically significant difference in intraoperative pain among all three groups (Fisher's exact test, p=0.042, p<0.001) (Table 4).

Need for supplementary anaesthesia across the three groups.

43.3% of the patients required supplementary anaesthesia

in the IANB group, 25% of the patients in the V-A group, and 15% of the patients in the G-G group. There was a statistically significant difference across the three groups (X2=12.351, p=0.002) (Table 5).

Discusion

Pain control is an essential part of dental surgical procedures, and local anaesthesia is the most commonly used method of ensuring pain control.[5] Traditionally, IANB has been used to anaesthetise mandibular teeth compared to G-G and V-A. However, there have been contradictory reports on its success rate, and the other two techniques are considered alternatives.[4] Over the years, conflicting results have been reported on the most effective anaesthetic injection technique for the intra-alveolar extraction of mandibular molars. This study compared the efficacy of the conventional IANB, G-G, and V-A during such extractions.

Regarding the onset of action, the G-G group had the fastest onset compared with the V-A and IANB groups, and this difference was statistically significant among the three groups. The rapid onset of action of G-G and the slowest onset of IANB in this study corroborate the findings of Haghighat et al.[6] and Wang et al.[7] This may be due to the use of constant landmarks (e.g., intertragic notch) for the G-G technique, which guide the placement and insertion of the local anaesthetic needle, compared with the V-A and IANB. In contrast, the IANB lacks reliable landmarks (e.g., the pterygomandibular raphe), and the needle insertion site is far from the inferior alveolar nerve.[6] In addition, the slow onset of action of the IANB may also be due to the diverse anatomies of patients' mandibular foramina.[5,6,7] These findings are in contrast to the findings of Yucel and Hutchison[8] and Goldberg et al.,[9] who reported a faster time of onset in the IANB group.

The intra-injection pain level in this study was highest in the V-A group, with an average score of 5, and lowest in the G-G group, with an average score of 3. Intra-injection pain differed significantly among the three groups. This is similar to the study by Goldberg et al.,[9] who also reported that the G-G technique had lower intra-injection pain than the V-A and IANB techniques. The lower intra-injection pain of the G-G group in this current study may be because the mucosa in the more superior position where needle penetration is performed in the G-G technique may be less sensitive and less resistant to the needle, possibly due to thinner musculofascial bands in the areas opposite to the more inferior point of insertion of the IANB technique, which penetrates through thicker muscle fibres and is more sensitive.[10] However, these findings contrast with those of Mishra et al.[11] and Donkor et al.,[12] who reported lower intra-injection pain in the V-A group. In Mishra et al., a smaller-bore injection needle (26-gauge) was used for the V-A technique, and they attributed the lower intra-injection pain in the V-A group to this. However, in the current study, an even smaller-bore (27-gauge) injection needle was used across the three groups, yet the V-A group still had the highest intra-injection pain compared to IANB and G-G.

Regarding the depth of anaesthesia, this study used intraoperative pain and the need for supplementary anaesthesia to assess it and found that the G-G technique was more effective than the IANB and V-A groups. No patients reported a score of zero, and none reported a score of 10. The implication of this is that all participants felt some degree of intraoperative pain, but none felt extreme intraoperative pain. It is intriguing that despite the role of anaesthesia (which is to provide complete loss of sensation to pain),[13] all the patients felt some degree of intraoperative pain, and no patient felt zero pain. One possible reason is the subjectivity of pain perception as any event resembling pain, e.g., pressure or discomfort, can be interpreted as pain by different individuals. In addition, these pain-like events cannot be evaluated with a pain assessment tool. The VAS is a valid, reliable, and arguably the best pain measurement scale used in research.[14] However, its inability to measure events such as pressure and discomfort that resemble pain could make it a less objective tool for measuring pain. In addition, one could argue that another possible reason for the lack of zero intraoperative pain among all patients in this study could be the inability of the solution to achieve absolute anaesthesia. This suggests that anaesthesia may not be a complete removal of pain sensation but rather a reduction in it.

In this study, the highest percentage of patients with severe intraoperative pain was in the IANB group, while the G-G group had the lowest percentage of individuals with severe intraoperative pain. For the above reason, the need for supplementary anaesthesia was highest in the IANB group. Intraoperative pain differed significantly among the three groups. This satisfactory depth of anaesthesia of the G-G group in this study is consistent with a study by Aggarwal et al.[15] The reason for this may be that the G-G injection involves the deposition of an anaesthesia near the pterygoid fovea adjacent to the head of the condyle.

The point of solution deposition is higher than in IANB. Because of gravity, the solution diffuses inferiorly, filling the pterygomandibular space and extending as far forward as the buccinator muscle.[15] Thus, all oral sensory branches of the mandibular nerve, including the nerve to mylohyoid, are exposed to anaesthesia. The length of nerve exposed to anaesthesia is significantly greater than in IANB, thus increasing the number of voltage-gated channels exposed to local anaesthesia.[14,15] In addition, the more satisfactory depth of anaesthesia of the V-A group when compared to the IANB is also consistent with the study by Aggrawal et al.[15] The reason for this could also be the point of deposition of the anaesthesia in this technique. With the V-A technique, the solution is deposited higher than in the IANB technique, thus increasing the length of the nerve exposed to the anaesthesia.[9,16,17]

Conclusion

The results suggest that the G-G technique has a higher success rate than the V-A and IANB techniques during intra-alveolar extraction of mandibular molar teeth.

Declarations

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Conflict of interest: None

Authors' contributions: All authors made substantial contributions to the conception and design of the study, data acquisition, analysis, and interpretation. They participated in drafting and critically revising the manuscript for important intellectual content, approved the final version for publication, and agree to be accountable for all aspects of the work.

Ethical approval: All procedures involving human participants in this study followed the ethical standards of the Health Research and Ethics Committee of the Lagos State University Teaching Hospital. Reference number: LREC/06/10/1240

Consent to participate: Informed consent was obtained from all individual participants included in the study.

Consent for publication: Informed consent was obtained from all individual participants for publication.

Availability of data and material: Documentation of data and material for the study are available on request.

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