RESEARCH PAPER

A Randomized Controlled Study Comparing Efficacy of Classical and Gow-Gates Technique for Providing Anesthesia During Surgical Removal of Impacted Mandibular Third Molar: A Split Mouth Design

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Abstract

Introduction Reliable profound mandibular block anesthesia is questionable when depositing the anesthetic solution at the lingula. The Gow-Gates technique is an useful alternative to the classical inferior alveolar nerve block and the incidence of unsuccessful anesthesia may be as high as classical technique. The aim of this study is to compare the clinical efficacy, degree of patient acceptability, advantages, disadvantages and limitations of the classical and Gow-Gates techniques for providing anesthesia in patients undergoing bilateral symmetrical surgical removal of impacted mandibular third molar under local anesthesia.

Material and Methods The split mouth design study was conducted on 100 patients aged between 20 to 40 years undergoing surgical removal of bilateral symmetrical impacted mandibular third molar performed by the same maxillofacial surgeon. 2 ml of 2 % lignocaine hydrochloride with 1:80,000 adrenaline was used as a standard local anesthetic solution in all the cases. By using four-digit numbers from a random number table, either Gow-Gates or

classical inferior alveolar nerve block were randomly assigned to either left or right sides in each patient. The injections were administered by another surgeon who was blinded to the experiment. The patient was assessed for Pain experienced during injection, frequency of positive aspirations, Onset and duration of anesthesia and Nerves anesthetized.

Results Results were statistically analyzed by Mann–Whitney and chi square test. A ‘P’ value of less than 0.05 was considered for statistical significance. Higher mean pain during injection was recorded in classical group, was found to be statistically significant. No significant association was observed between aspiration and the groups. Higher mean onset of anesthesia was recorded in Gow-gates group, was found to be statistically significant. Higher mean duration of anesthesia was recorded in Gow-gates group, was not statistically significant. Higher success rate was recorded in Gow-gates group and was statistically significant.

Conclusion If we ignore delayed onset of anesthesia of Gow gates technique, it is found to be more reliable, beneficial and have higher success rate than classical inferior alveolar nerve block technique.

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Keywords Gow-Gates technique · Classical inferior alveolar nerve block · Impacted mandibular third molar

Introduction

In November 1884, William S. Halsted and Richard J. Hall first achieved neuroregional anesthesia in the mandible by injecting a solution of cocaine in the vicinity of the mandibular foramen. Since that revolutionary injection, dentists have possessed the remarkable ability to deliver

invasive dental treatment in a pain-free manner and relieve suffering for patients [1]. The most-commonly used drugs in dentistry are anesthetics which are injected before painful procedures [2]. Local anesthetic is an integral part of every practicing dentist's daily work [3]. Achieving a predictable and effective outcome requires a series of specific conditions to be met. These conditions are closely interrelated, each building on one another. The clinician's knowledge and ability in addition to anatomic and pharmacologic variability are all factors that play a critical role [4]. The classical inferior dental nerve block is far the commonest used in dentistry, the reason being that it is very satisfactory way of achieving analgesia of the lower molars. An infiltration technique is almost invariably unsuccessful in molar region because of the thickness and density of the buccal alveolar bone and even in the premolar region the bone is comparatively thick [5]. The inferior alveolar nerve block (IANB) is the most frequently used mandibular injection technique for achieving local anesthesia for restorative and surgical Procedures. However, the IANB does not always result in successful pulpal anesthesia [6]. Primary factors for this failure rate are the greater anatomical variation in the mandible and the need for deeper soft tissue penetration [7]. Reliable profound mandibular block anesthesia is questionable when depositing the anesthetic solution at the lingula. Complications can occur and the needle may impact a number of important anatomical structures by deep penetration. The Gow-Gates technique for mandibular anesthesia obviates these problems [8]. The Gow-Gates block (GG) technique is a useful alternative to the inferior alveolar nerve block and is often used when the later fails to provide adequate anesthesia [7]. The target area of the needle is the lateral region of the condylar neck, just below the insertion of the lateral pterygoid muscle [9], but the Gow-Gates technique may have slower onset of Anesthesia and variable anesthesia of the buccal nerve [10]. The incidence of unsuccessful anesthesia may be as high as that for the inferior alveolar nerve block until the administrator gains clinical experience with it [7]. Considering all the above criteria it was decided to study and compare the clinical efficacy, degree of patient acceptability, advantages, disadvantages and limitations of the classical and Gow-Gates techniques of mandibular nerve block in patients undergoing surgical removal of impacted mandibular third molar under local anesthesia.

Materials and Methods

The split mouth design study was conducted on 100 healthy and ambulatory individuals (45 female and 55 male) aged between 20 and 40 years with a mean age of 26.4 years undergoing surgical removal of bilateral

symmetrical impacted mandibular third molar reporting to the department of Oral and Maxillofacial Surgery and was approved by ethical committee. Patient with Neurosensory defects of trigeminal neuralgia excluded from study. Patients with infection at the site of injection were excluded as it was felt that it may alter the actions of local anesthetic drug used. The patients were not administered any premedication as it was thought that the change in the level of consciousness due to the effect of the drugs could adversely alter the subjective symptoms.

Each patient was subjected to surgery in order to remove bilateral symmetrical impacted lower third molars with a 2 weeks interval between two operations. The surgical technique was same on both sides and was performed by the same maxillofacial surgeon. We used GG or IANB techniques for anesthetizing the jaw before surgery. One of these two techniques was randomly selected for the right side and the other for the left side.

2 ml of 2 % lignocaine hydrochloride (Lignox) with 1:80,000 adrenaline was used as a standard local anesthetic solution in all the cases. Conventional luer lock syringes of 26 gauge and 38 mm needles were used. By using four-digit numbers from a random number table, either IANB or GG were randomly assigned to either left or right sides in each patient. The injections were administered by another surgeon who was blinded to the experiment. Therefore, the surgeon who did the operations was not aware of the technique of anesthesia used in each side. In order to obtain buccal mucosa anesthesia during surgery, the long buccal nerve was anesthetized separately in IANB group and in GG group when it was not anesthetized. The patient was assessed for Pain experienced during injection, frequency of positive aspirations, Onset and duration of anesthesia and Nerves anesthetized.

Immediately before the anesthetic solution was injected an aspiration test was conducted twice by rotating barrel of syringe about 45° for second aspiration to avoid false negative aspiration. The patient was then asked about the pain experienced during injection which was recorded using visual analog scale (VAS) (Fig. 1) on a ruler marked

Fig. 1 Visual analog scale (VAS)

from zero to ten. The patient was questioned for the onset of anesthesia every 30 s. The onset of anesthesia was determined by subjective symptoms like tingling or numbness of the lower lip, cheek and half of the tongue on the side of injection. Objective signs like demonstration anesthesia between the first and the second premolars for the inferior alveolar nerve, the lingual gingiva for the lingula nerve, and the buccal gingiva in the third molar region for the long buccal nerve. Absence of subjective symptoms and objective signs, 10 min after the deposition of solution was considered as a failure of the block and it was repeated. When there was failure of long buccal nerve anesthesia following Gow-Gates technique, the whole procedure was not repeated and instead a long buccal nerve injection was given at the distobuccal aspect of the third molar tooth as in classical IANB only inferior and lingual nerve is anesthetized. The supplementary injections and the total amount of local anesthetic solution used was recorded. Any untoward reactions like tingling and numbness of upper lip, infraorbital anesthesia and posterior superior alveolar anesthesia were also recorded. Results were statistically analyzed by Mann–Whitney and Chi square test. A ‘*P*’ value of <0.05 was considered for statistical significance. The above study was conducted over a period of 2 years.

Results

Results were statistically analyzed by Mann–Whitney and Chi square test. A ‘*P*’ value of less than 0.05 was considered for statistical significance.

Mean Pain during injection of classical technique was 5.57 on VAS and during GG technique was 3.72 on VAS (Table 1; Fig. 2). Higher mean pain during injection was recorded in classical group compared to Gow-Gates group and the difference between them was found to be statistically significant. Positive aspiration was obtained in 6 and 3 of the cases in classical and Gow gate groups respectively. No significant association was observed between aspiration and the groups (Table 2; Fig. 3).

In classical group the onset of anesthesia was in the range from 80 to 240 s with a mean average of 148.7 s whereas, in Gow-Gates group it was in the range from 255 to 480 s with a mean average of 386.86 s (Table 3; Figs. 4, 5). Higher mean onset of anesthesia was recorded

Fig. 2 Mean distribution of pain during injection

in Gow-Gates group compared to Classical group and the difference between them was found to be statistically significant. The duration of anesthesia in classical group found to be in the range of 115–280 min with mean average of 190 min whereas, in Gow-Gates group it was found to be in the range of 140–275 min with mean average of 198.50 min (Table 4; Figs. 6, 7). Higher mean duration of anesthesia was recorded in Gow-Gates group compared to Classical group but the difference between them was not statistically significant. In classical group ten patients required supplementary inferior alveolar nerve and lingual nerve block due to failure of inferior and lingual nerve anesthesia to achieve a success rate of 90 %. Whereas in Gow-Gates group two patients required repetition of block due to failure of inferior and lingual nerve thus giving a success rate of 98 %. Higher success rate was recorded in Gow-Gates compared to classical group and the difference between them was statistically significant (Table 5; Fig. 8). In Gow-Gates group out of the 100 patients 28 patients required supplementary long buccal nerve giving success rate of 72 % of long buccal nerve anesthesia whereas in classical group the frequency of long buccal nerve anesthesia was not taken into considerations since this required a separate injection to anesthetize the long buccal nerve. No untoward reactions were seen in classical group whereas in Gow-gate group one patient experienced middle ear pain after injection which resolved after 2 weeks.

Statistical Analysis

See (Tables 1, 2, 3, 4, 5; Figs. 2, 3, 4, 5, 6, 7, 8).

Table 1 Mean distribution of pain during injection

Group	Mean	Std dev	SE of mean	Median	Mean difference	U (Mann–Whitney test)	<i>P</i> value
Classical	5.57	1.19	0.12	6	1.850	1314.50	0.0001 (<i>P</i> < 0.05 significant)
Gowgates	3.72	1.01	0.10	4			

Table 2 Distribution of frequency of aspiration

Group	Positive		Negative		Total	χ^2 (Chi square test)	P value
	n	%	n	%			
Classical	6	6 %	94	94 %	100	1.047	0.306 ($P > 0.05$ non significant)
Gowgates	3	3 %	97	97 %	100		
Total	9	4.5 %	191	95.5 %	200

Fig. 3 Distribution of frequency of aspiration

Discussion

This study evaluated the success rate of GG technique in comparison to IANB. Potential differences in pain on injection could be one of the determining factors in their selection. In our study, Higher mean pain during injection was recorded in classical group compared to Gow-Gates group and the finding was similar in Yamada and Jasstak [11], whereas no difference of pain was found in study by Jacobs [12]. In Gow gates technique, the needle point traverses a corridor of fat between the medial head of temporalis and the medial pterygoid muscle and neither muscle is impaled by the needle at any time and is probably the explanation for the reduced level of discomfort [13].

Decision to select one of these techniques should be based on factors other than pain on injection. These factors may include the ability to determine the techniques' respective anatomical landmarks, the presence of accessory innervation, the need to anesthetize the buccal nerve, trismus or a marked gag reflex.

The Aspiration test proved to be negative in most of the cases and no significant association was observed between aspiration and the groups. Gow-Gates and Watson [14] demonstrated positive aspirations in 1.6 % and are supported by Malamed who claims 1.9 % in 4275 injections,

Fig. 4 Mean distribution of onset of anesthesia (sec) in samples **Fig. 5** Range distribution of onset of anesthesia (sec) in samples

However, in 1981, Levy noted a positive aspiration 7.7 % of the time with the Gow-Gates injection, which is comparable to rates with the inferior alveolar injection. Although Malamed reported a much lower rate of aspiration, he speculated that the large internal maxillary artery that sits a few millimeters inferior to the target site (neck of the condyle) is the blood vessel usually penetrated during a positive aspiration test [15]. In our study we obtained positive aspiration in 6 % of cases in classical group which was not statistically significant compared to Gow-Gates group which obtained positive aspiration in 3 % of cases. Conventional technique, which aims the needle toward the mandibular foramen, is accompanied by risks for complications such as vascular or neural injury, intravascular injection, and muscular injury and high incidence of blood aspiration [16].

Table 3 Mean Distribution of Onset of Anesthesia (sec) in Samples

Group	Mean	Std dev	SE of mean	Median	Mean difference	U (Mann–Whitney test)	P value
Classical	148.70	29.62	2.96	150	−238.160	100.000	0.0001 ($P < 0.05$ significant)
Gowgates	386.86	53.17	5.32	390			

Table 4 Mean distribution of duration of anesthesia (min) in samples

Group	Mean	Std dev	SE of mean	Median	Mean difference	U (Mann–Whitney test)	P value
Classical	190.00	28.11	2.81	190	−8.500	4284.50	0.079 ($P > 0.05$ non significant)
Gowgates	198.50	32.02	3.20	195

Fig. 6 Mean distribution of duration of anesthesia (min) in samples **Fig. 7** Range distribution of duration of anesthesia (min) in sample

With regard to onset of anesthesia in our study it was found to be 148.7 s (approx 2 min 29 s) in classical technique and 387 s (6 min 27 s) in Gow gates technique and the difference was statistically significant. Study by Sisk [10] revealed the mean time of onset of anesthesia for the successful Gow-Gates injections was 7.68 min, while that for the conventional inferior alveolar nerve block was 5.08 min. Malamed [17] gave possible explanation for slower onset of anesthesia with the Gow gates technique as the greater diameter of the nerve trunk at the site of

Fig. 8 Frequency of inferior alveolar, lingual and long buccal nerve anesthesia

injection and the distance (5–10 mm) from the anesthetic deposition site to the nerve trunk.

The mean duration of anesthesia in classical group was 190 min and Gow gates group was 198.5 min. Higher mean duration of anesthesia was recorded in Gow-Gates group compared to Classical group but the difference between them was not statistically significant.

Kafalias et al. [8] reported success rates of various studies on conventional and Gow gates technique. The success rate for mandibular anesthesia in conventional technique is as follows, Robertson (71 %), Yamada (82 %), Allen L Sisk (79 %), and Gow-Gates (90.3 %) The success rate for mandibular anesthesia in Gow-Gates technique are as follows, Robertson (92 %), Malamed (97.25 %), Yamada (100 %), Allen L Sisk (95 %), Gow-Gates (100 %). In our study we achieved a success rate of 90 % with classical technique and 98 % with Gow-Gates technique of mandibular anesthesia and the difference between the groups was statistically significant. Bernhard et al. [18] revealed long buccal nerve anesthesia of various studies while using Gow-Gates technique of mandibular

Table 5 Frequency of inferior alveolar, lingual and long buccal nerve anesthesia

Techniques	No of injections	Inferior alveolar		Lingual		Buccal	
		Pain	No pain	Pain	No pain	Pain	No pain
<i>Frequency of inferior alveolar, lingual and long buccal nerve anesthesia</i>							
Classical	100	10	90	10	90	Not Applicable	Not Applicable
Gow-Gates	100	2	98	2	98	28	72
Significance	Chi square test (χ^2), probability (P)	$\chi^2 = 4.344, P = 0.0371$ ($P < 0.05$ significant)		$\chi^2 = 4.344, P = 0.0371$ ($P < 0.05$ significant)		P cannot be assessed	

anesthesia which are Robertson, Malamed, and Levy with a successful buccal anesthesia of 62, 68 and 77 %, respectively. Sisk [10] achieved a successful buccal anesthesia of 78 % in his study. In our study we obtained 72 % success rate of long buccal nerve anesthesia with the Gow-Gates technique.

Aker [19] dissected eight head and mandibular specimens to observe that anatomical relations of the buccal nerve in the conventional block method essentially shield the nerve from being bathed by anesthetic solution while in the Gow-Gates method the relations are such that the buccal nerve can be exposed to anesthetic solution and thus blocked.

In our study none of the patients in the classical group experienced untoward reaction whereas in Gow-gate group one patient experienced middle ear pain which resolved after 2 weeks. Brodsky and Dower Jr [15] in their study revealed that it is absolutely impossible to determine the exact mechanism middle ear pain after Gow-gate injection complication, but it also may have been a problem in technique. Deflection of the needle away from the bevel may or may not have played a role in the misguidance. This medially placed injection would have resulted in blockage of the tube and the patient's inability to equalize pressure. Soon after, it is possible that trauma from the needle may have led to a secondary inflammatory reaction in the auditory tube, around it or both, which would have prolonged the blockage for about a week until the inflammation dissipated.

With all above findings of our research, if we ignore delayed onset of anesthesia of Gow gates technique, it is found to be more reliable, beneficial and have higher success rate than classical inferior alveolar nerve block technique.

Compliance with Ethical Standards

Conflict of interest Authors Dr. Madan Nanjappa, Dr. Shashidhara Kamath K, Dr. Gopinath A.L, Dr. Yashvanth A, Dr. Vaibhav Nagaraj and Dr. Praveen G declare that they have no conflict of interest.

Research Involving Human Participants All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

Informed Consent Informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

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