Gow-Gates Technique: A Pilot Study for Extraction Procedures With Clinical Evaluation and Review

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The aim of this study was to compare the effectiveness of 2 different volumes of anesthetic solution for a premolar-molar extraction, and to determine the onset of complete mandibular conduction anesthesia via a Gow-Gates mandibular block. One operator performed 32 blocks with a 27-gauge needle on patients who required a dental extraction: 16 blocks using 1.8 mL of anesthetic solution, and 16 blocks using 3.6 mL of anesthetic solution. The parameters evaluated were frequency of successful anesthesia and onset of complete anesthesia. Significant differences ($P < .005$) were observed in the evaluation of volume: the 3.6 mL group yielded a higher success rate (82.5%) than the 1.8 mL group (17.5%). The onset of complete conduction anesthesia was achieved in 8 minutes by 56% of the subjects (9 of 16) with 3.6 mL and only one subject in 16 (6%) with 1.8 mL. A larger volume of anesthetic solution (3.6 mL) is required to achieve a higher success rate and a faster onset of action for a dental extraction without the use of reinforcement anesthesia. The volume of anesthetic solution is indirectly proportional to the onset of complete anesthesia. A premolar-molar extraction can be done, with 3.6 mL of anesthetic solution, in more than 50% of the patients 8 minutes after injection.

Key Words: Gow-Gates; Mandibular conduction anesthesia; Mandibular block; Onset of complete anesthesia; Needle deflection.

In dentistry, predictable anesthesia is an essential requirement for both the patient and the dentist. The patient's opinion about his dental treatment is closely related to the local anesthesia experiences he has had. The proper use of local anesthesia techniques and pain management are indispensable for successful dental treatment. The mandibular nerve block seems to be the best choice to attain successful anesthesia in mandibular molars and premolars. For achieving profound mandibular anesthesia, the following techniques are available: inferior alveolar nerve block, Var-

izani-Akinosi, and the Gow-Gates technique. It is reasonable to use infiltration anesthesia in the region between the mandibular left and right canines to achieve complete anesthesia. The Gow-Gates technique, in comparison to other techniques, has the highest success rates in achieving successful anesthesia approximately 99% in Dr Gow-Gates' experienced hands.

This block is very close to a true mandibular nerve block, because it provides sensory anesthesia to virtually the entire distribution of the mandibular trigeminal division.¹ In other words, it provides mandibular conduction anesthesia.² The terminology of anesthesia achieved after deposition of anesthetic solution in the pterygomandibular space is summarized in 2 main terms. The first is inferior alveolar anesthesia or inferior alveolar nerve block. This term is more applicable to

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the use for regional anesthesia of the inferior alveolar nerve, including added anesthesia of the lingual nerve. The second is mandibular conduction anesthesia (mandibular nerve block). Mandibular conduction anesthesia provides regional anesthesia to all mandibular intraoral branches of the trigeminal nerve at the foramen ovale.^{1,2} Latency is defined as the time period elapsed after injection until the first symptoms of anesthesia. Onset of complete anesthesia means the period of time required to begin a safe, painless procedure.

Before choosing a mandibular block, there are factors to be evaluated: the type of procedure for the teeth involved and the possible inflammation processes that are present in the tissue puncture target point and in the apical region of the tooth that is to be treated or extracted. Operator experience also needs to be considered. Malamed suggested 2 approaches for becoming proficient with the Gow-Gates technique. The first method is to start using the technique on all patients requiring mandibular anesthesia, allowing a minimum of 1 to 2 weeks, gaining clinical experience. The second method is to continue using the conventional inferior alveolar nerve block but administering the Gow-Gates technique whenever clinically inadequate anesthesia occurs, ie, reanesthetizing the patient using the Gow-Gates technique.

The Gow-Gates technique has been used in various studies.³⁻⁷ The volume of anesthesia used in these studies is dissimilar (Table 1). The type of procedure has not been standardized to analyze the results. Also, the onset of complete anesthesia has different results.^{5,8,9} Montagnese et al⁸ suggested further studies to determine the optimal time to wait after injection and to determine the optimal dose of local anesthetic solution to be used in these blocks. In the literature, needle deflection and position during this technique and its relation to the anesthetic amount has never been documented.

This study intends to provide more practical information for beginners in the clinical use of this Gow-Gates mandibular block with a 27-gauge needle, especially when it is used for extraction procedures.

METHODS

This study is based on the experience gained from 32 patients, 13 male and 19 female, age 12 to 79 years, scheduled for simple lower molar and premolar extractions and who have given their informed consent to participate. Third molars, canines, and incisors were not included. The patients selected were normally healthy patients, ASA I, who were not taking any

Table 1. Results Reported by Other Authors

Author	Successful Anesthesia*			Unsuccessful Anesthesia		mL	Anesthetic Agent	Onset (min)
	Grade A	Grade B	% Rate	Grade C				
Gow-Gates GAE, Watson JE - 1977 - ¹² †	96.2 %	3.80 %	100 %	-	-	2.2	3% Prilocaine with 1:300,000 adrenaline	-
Malamed SF - 1981 - ⁵	98.4 %	1.60 %	100 %	-	-	2.2	3% Prilocaine with octapressin	-
Jofre J, Münzenmayer C - 1998 - ⁴	91.90 %	5.35 %	97.25 %	2.75 %	-	1.8	-	5-7
	77.50 %	-	77.5 %	2.50 %	-	1.8†	2% Lidocaine 1:100,000 epinephrine†	7-9
	97.5%†	2.50%†	100%†	-	-	-	-	8-25‡
Watson JE, Gow-Gates GAE - 1976 - ¹³	98.20 %	1.80 %	100 %	-	-	2.2	-	-
Robertson WD - 1979 - ²¹	-	-	92 %	8 %	-	1.8	-	-
Yamada A, Jastak JT - 1981 - ⁷	100 %	-	100 %	-	-	1.8	2% Lidocaine 1:100,000	-
Levy TP - 1981 - ¹⁶ §	96 %	-	96 %	4 %	-	3.0	4% Prilocaine	-
Todorovic L, Stajic Z, Petrovic V - 1986 - ² §	-	-	90 %	10 %	-	2.0	2% Lidocaine 1:80,000	10

* Grade A = Completely successful; Grade B = successful after additional anesthetic; Grade C = Unsuccessful.

† Two groups of patients in the same study.

‡ With the aim instrument.

§ Only extraction to procedure.

- Data not available.

Table 2. Frequency and Rate (%) of Subjective Anesthesia in the Auriculotemporal Region

Subjective Anesthesia	Positive			Negative
	8 min	12 min	16 min	
Auriculotemporal nerve with 3.6 mL	15 (93.75%)	0	0	1 (6.25%)
Auriculotemporal nerve with 1.8 mL	10 (62.5%)	1 (6.25%)	1 (6.25%)	4 (25%)

medication and have never had allergic or toxic reactions to any local anesthetic agent. The patients were randomly selected in 2 groups of 16 subjects each. Patients assigned to the first group received 1.8 mL of anesthetic solution via the Gow-Gates technique. Those assigned to the second group received 3.6 mL in 2 separate injections of 1.8 mL each using the same technique. In all cases 2% lidocaine hydrochloride with 1:100,000 epinephrine was the anesthetic solution, and a disposable 27-gauge 5/8 inch needle was used. The time elapsed after each block was measured with a digital chronometer, and the parameters evaluated were pain in response to puncture, and pain during treatment, meaning onset of complete anesthesia.

In this study 3 time stages were designed (8, 12, and 16 minutes). At 8, 12, and 16 minutes after injection a sharp dental explorer test (sharp stimuli) was used on the buccal mucosa test side, apical to the second mandibular permanent molar. On the lingual mucosa test side, the test was done apical to the first mandibular premolar. On the second buccal mucosa test side, the test was done apical to the first mandibular premolar, then another puncture was made into the buccal and lingual gingival tissue of the teeth involved in the corresponding extraction procedure. The subject's response was recorded for each test side, and also the sensory subjective response of the auriculotemporal nerve was determined and was compared with the contralateral one. The following question was asked: "Does this area feel numb compared to the other area?"

The first procedures tested the response of the buccal, lingual, and inferior alveolar nerves, respectively. This test was used because it is still the most available practical clinical test to ensure an objective anesthesia sign before any dental extraction. The test procedures began 8 minutes after the injection, and if pain persisted, additionally every 4 minutes until 16 minutes after injection time. The anesthesia response was recorded as positive or negative.

Immediately after achieving a positive response for anesthesia in all 3 terminal nerve test areas, the extraction began. In this study Grade A anesthesia was considered completely satisfactory anesthesia by the

patient and did not require any kind of reinforcement. Grade B was less complete anesthesia, which required another injection for the patient. If pain appeared during the extraction before the 16 minutes after injection, additional time was allowed until the next time level (8, 12, or 16 minutes); pain appearance after 16 minutes post injection was considered Grade B category. Postoperatively, anesthesia was classified as successful anesthesia (Grade A) or unsuccessful anesthesia (Grade B).

All procedures were carried out by the senior author. The patient was placed in a semi supine position and was instructed to open his mouth as widely as possible during the injection. The anterior border of the ramus was palpated with the forefinger. The puncture point was lateral to the pterygotemporal depression and medial to the tendon of the temporal muscle. The injection height was established by the placement of the needle tip just below the mesiopalatal cusp of the maxillary second molar.

Before needle insertion, the area was dried. The needle was then aligned with the plane that extended from the lower border of the intertragic notch through the corner of the mouth. The needle was aimed toward the target area on the tragus of the ear. The target area was the lateral side of the condylar neck, just below the insertion of the lateral pterygoid muscle. A small amount of anesthetic solution was deposited to anesthetize the buccal nerve as the needle was advanced until the bone was contacted at the base of the neck of the condyle. The needle was withdrawn 1 mm prior to injection. Aspiration was performed and the solution deposited over a time interval of 1 mL/min. The patient was instructed to keep the mouth open for 2 minutes after injection. Anesthetic success and failure were analyzed using the χ^2 test.

RESULTS

The 1.8 mL Gow-Gates block was performed in 16 patients (7 male and 9 female) with an average age of 35.6 years. The group subjected to 3.6 mL of anesthetic solution was performed in 16 patients (6 male and 10 female) with a mean age of 32.8 years. The re-

Table 3. Frequency and Success Rate (%)

Grade of Anesthesia*	No. of Subjects	1.8 mL	3.6 mL
Grade A	16	2 (12.5%)	14 (87.5%)
Grade B	16	14 (87.5%)	2 (12.5%)
No. of Subjects	32	16	16

* Grade of anesthesia: A = completely satisfactory anesthesia; B = feeble anesthesia, another injection required.

sponses to the question concerning numbness in the auriculotemporal region at 8, 12, and 16 minutes after injection are summarized in Table 2. In response to the question, "Does this region feel numb compared to the other one region?" 75% (12 of 16) of the first group reported that their auriculotemporal region was anesthetized, whereas 93.75% (15 of 16) of the second group reported to be anesthetized.

In relation to anesthetic success, 2 (17.5%) of the 16 patients of the first group (who received the Gow-Gates mandibular block) were provided with successful anesthesia. Of the 16 patients who received 3.6 mL (second group), only 2 were not completely anesthetized, resulting in 82.5% successful anesthesia. The results can be seen in Table 3. The χ^2 test indicated a statistically significant difference ($P < .005$) between the first group and the second group in relation to anesthetic success.

The onset of clinically adequate anesthesia was achieved in 8 minutes by 56% of the subjects (9 of 16) of the second group and in 1 of 16 (6.25%) in the first group. At 12 minutes, only 1 subject of the second group reported onset of complete anesthesia (6.25%). At 16 minutes in the second group, 4 of 16 (25%) subjects confirmed onset of complete anesthesia and 1 of 16 (6.25%) of the first group (data not shown).

The responses to the sharp explorer tests, at 8, 12, and 16 minutes after injection, are presented in Table 4.

In the first group, the buccal nerve test area had the highest failure rate; 68.75% (11 patients) felt pain. The lingual and inferior alveolar nerve test areas both had a 56.25% (9 patients) failure rate. The second group had only a 12.5% (2 patients) failure rate for the buc-

cal nerve test area; the lingual and inferior alveolar nerve test areas had no failure. The Kruskal-Wallis variance test was used to compare these results. Significant differences were found ($P < .005$) between the first and second group with respect to the buccal, lingual, and inferior alveolar nerve test areas.

DISCUSSION

The sensory branches of the auriculotemporal nerve are anesthetized with the Gow-Gates technique.^{1,5,10} The subjective results in this study in relation to numbness in the auriculotemporal region indicate that further studies are required to prove objective anesthesia but demonstrate that with this technique a clinician can regularly obtain effective anesthesia in this region. The majority of the patients (27 of 32) confirmed numbness in the auriculotemporal region. The second group achieved anesthesia in 15 of 16 (94%) of the patients at 8 minutes post injection. Anesthesia in the first group was achieved in 12 of 16 (75%) of the patients.

This study achieved an 82.5% incidence of complete anesthesia without the use of reinforcement injections in any nerve when using 3.6 mL of anesthetic solution. Two of 16 patients (17.5%) in the second group (3.6 mL) failed to achieve buccal anesthesia. One of these patients required a first premolar (3.4 international, #21 US) extraction and exhibited pain during the explorer test in the buccal nerve area after 16 minutes post injection. It is possible that extraction of the premolar was not achieved painlessly because of the buccal nerve location that could reach the second permanent premolar buccal tissue; but this study considered successful anesthesia when all test areas were anesthetized (mandibular conduction anesthesia) and when the extraction procedure was intervened without pain, at maximum time of 16 minutes.

The first group achieved only 17.5% completely satisfactory anesthesia. One first molar (3.6 international, #19 US) of this group successfully passed the explorer test, but failed during the extraction because the patients reported diffuse pain in the ramus near the gonion area. It is possible that supplemental innervation

Table 4. Frequency of Negative Response to Puncture in Three Time Periods

Onset of Successful Anesthesia	8 min	12 min	16 min	Grade B
Buccal nerve with 1.8 mL	2	2	1	11
Lingual nerve with 1.8 mL	4	2	1	9
Alveolar nerve with 1.8 mL	1	2	4	9
Buccal nerve with 3.6 mL	11	1	2	2
Lingual nerve with 3.6 mL	14	0	2	0
Alveolar nerve with 3.6 mL	12	2	2	0

of the cervical transverse nerve gave sensory branches to the buccal periosteum.

The author³ of the mandibular block "Gow-Gates technique" gave various reasons to explain the small, but significant, failure rates in achieving mandibular anesthesia. One related to unsatisfactory dosage, he stated that 2.0 mL of anesthetic solution is inadequate in no less than 15% of cases.¹¹ Gow-Gates and Watson¹² and Watson and Gow-Gates¹³ used 2.2 mL of anesthetic solution (volume contained in 1 dental cartridge manufactured in Australia). Gow-Gates, with his approximately 30 years of experience, achieved a success rate of approximately 99% in his practice.^{3,4}

Monheim¹⁴ stated that the inability to diffuse throughout the large nerve trunk with an insufficient amount of anesthetic solution and concentrations to block the nerve fibers may result in inadequate local anesthesia. Rood¹⁵ stated that an insufficient amount of anesthetic solution could alter an otherwise adequate nerve block. Levy¹⁶ found that the standard amount of solution, 1.8 mL, did not provide reliable third molar anesthesia.⁸

The buccal nerve is commonly blocked (75% of the time) with the Gow-Gates technique¹⁰ along with the other branches of the mandibular division of the trigeminal nerve. Watson and Gow-Gates¹³ reported to have attained consistent buccal nerve anesthesia. The anatomically close relationship of various divisions of the mandibular nerve at the level of the Gow-Gates injection would suggest that buccal nerve anesthesia should be a consistent occurrence.¹⁷ The volume of the pterygomandibular space has been estimated by Murphy and Grundy¹⁸ to be approximately 2 mL.¹⁹ From the estimated volume of the pterygomandibular space, a 2.2 mL dose would completely fill in the space and probably diffuse anteroinferiorly from the mandibular neck, which could account for consistent buccal nerve anesthesia, which they¹³ have reported.²⁰ Young and D'Aguiam¹⁹ stated that studies have shown a higher success rate of buccal nerve anesthesia when 3.0 mL of solution are used versus 1.8 mL, so a more effective diffusion appears to occur with larger volumes.

Also Robertson,²¹ Malamed,⁵ and Levy¹⁶ accomplished successful buccal anesthesia of 62%, 68%, and 77%, respectively. In these cases, except for Levy, the anesthetic solution probably diffused in an antero-inferior direction through the pterygomandibular space before reaching the buccal nerve.²² To achieve successful anesthesia, the solution has to bathe a certain length of the nerve.^{23,24} This indicates that the aim of their studies was not to achieve mandibular conduction anesthesia because molar extraction re-

quires buccal anesthesia. With restorative procedures, only inferior alveolar anesthesia is required. Levy¹⁶ reported that 6 of 26 patients required supplemental injections for the long buccal nerve when the Gow-Gates technique was used.⁹ In his study he used third molar extractions to evaluate clinical pain control. The operations were always started on the standard injection side, whereas the Gow-Gates side benefited from increased time to reach complete anesthesia as the standard side was being operated. His study reached the highest success of buccal anesthesia by using 3 mL of local anesthesia.

Malamed⁵ reported in his study that 48.4% of subjects received only the Gow-Gates injection as the primary technique for mandibular anesthesia. The remaining subjects, 51.8% Gow-Gates injections were employed in an effort to achieve clinically adequate pain control when the inferior alveolar conventional technique had proved inadequate. This would increase the amount of anesthetic solution for blocking nerve conduction and then presumably increase the success rate of anesthesia for that group of patients. That 51.8% of the subjects received more than 1.8 mL of anesthetic solution; indeed they received over 3 mL of local anesthesia. Malamed¹⁰ stated that Gow-Gates³ originally recommended 3 mL of anesthetic to be deposited. Yamada and Jastak⁷ achieved a 100% success rate in young patients. That may have been possible because he used restorative procedures mostly with only 2 extractions to analyze the Gow-Gates technique in his study. Also, the reduced size of the pterygomandibular region of children is easier to fill in with 1.8 mL of anesthetic solution. Needle deflection in children is less frequent because of the thinness of the tissue.

Even if signs of subjective numbness appear after 3 to 5 minutes post injection on the lip, tongue and cheek, the block sometimes was not profound enough to begin a dental procedure. The possible causes to the high time periods to attain onset of complete anesthesia are the following: First, the mandibular nerve at that height is of a thicker diameter,⁵ which practically makes it difficult to ensure blockade of the depolarization of the entire nerve fibers. Second, the distance from the objective site of anesthetic solution deposition to the main mandibular nerve trunk is approximately 5 to 10 mm.⁵ Third, the difficulty to reach the small objective site of anesthetic infiltration with a 27-gauge needle in this technique is greater because of needle deflection.

Gaum and Moon²⁵ suggested that a waiting period of at least 15 minutes should be allowed to provide adequate anesthesia and sufficient time for the anesthetic agent to work.

Malamed⁵ stated that the Gow-Gates technique has 5 to 7 minutes latency. Levy¹⁶ stated that the latency for a central incisor was achieved in 10 to 12 minutes. Ägren and Danielsson⁹ stated that the latency can be from 10 to 20, even to 30 minutes, and in rare cases to 45 minutes. Jofre and Münzenmayer⁴ achieved a range of 8 to 25 minutes of induction time in his results. Tiol²⁶ stated that 10 to 15 minutes post injection is a prudent time to wait if anesthesia symptoms have not appeared yet.

Onset of anesthesia depends on the proximity of the nerve-blocking drug to the related nerve trunk. It is possible that the senior author may not to be sufficiently experienced with this technique and did not deposit the anesthetic solution closely enough to the oral sensory branches of the mandibular nerve in the pterygomandibular space. Accuracy in performing the injection should not, therefore, be neglected in the overall evaluation of the success rate and frequency of successful anesthesia.

It could be that in this study 16 minutes post injection was not an adequate time interval for complete mandibular conduction anesthesia with 1.8 mL of anesthetic solution. A longer time interval may be needed regardless of the technique, for the onset of the profound mandibular anesthesia.

CONCLUSION

In conclusion, an inexact target area and quantity of anesthetic solution can produce a prolonged onset of complete anesthesia and an incomplete block in this technique.

This study suggests that there is an indirect relationship between the onset of complete anesthesia and the quantity of anesthetic solution injected in this technique. This study suggests from a clinical observation that two 1.8 mL cartridges (3.6 mL) more adequately fill the pterygomandibular space. Coleman and Smith²⁰ observed that the pterygomandibular space is larger than the volume contained in one 1.8 mL cartridge. A greater volume of anesthetic solution probably fills more rapidly and provides a higher concentration of anesthetic solution to the mandibular nerve trunk with a less dilution effect. For this reason even though the optimal dose for a patient is the minimum for achieving the necessary effects, 3.6 mL of local anesthesia solution is recommended. No matter how successful the clinician judges the block to be, if any pain is perceived by the patient, the quantity in that block must be classified as failure none the less.²⁵

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