

Prevalence of inferior alveolar nerve block failure among undergraduate dental students: susceptible reasons and how to avoid them?

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ABSTRACT

Inferior alveolar nerve block (IANB) is the main technique for anaesthetization in the mandible. Profound inferior alveolar nerve block (IANB) anesthesia remains difficult to achieve at all cases. Multiple causes of failure or incomplete anesthesia were reported. To assess IANB failure rate among dental students and instructors, the susceptible causes of failure, and how it is overcome. In addition to investigate the awareness of alternative techniques of IANB and the rate of IANB-related complications. A questionnaire containing twenty questions was distributed for 300 of dental students and interns and also for 100 of instructors at the vision colleges /Jeddah -Riyadh/Saudi Arabia. It included demographic questions, questions on IANB failure rate and causes, how the failure is usually overcome, awareness of different alternative anaesthetic techniques and the most common encountered complications. 356 participants were involved in the study. Most of surveyed sample (91.3%) had experienced IANB failure. The most commonly reported causes of failure were unclear landmarks (46.1%) and anatomical variations (38.5%). The most common alternative technique used was intraligamentary injection (49.4%). The most common reported complications according to our respondents were facial paralysis (17.1%) and trismus (16.3%). More training of students on IANB injection is needed. In addition alternatives to IANB, such as the Gow-Gates and Akinosi techniques should be activated and emphasized, theoretically and clinically, in the anesthesia courses of the dental curriculum.



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1. Introduction

Inferior alveolar nerve block (IANB) is a widely used anesthetic technique in the mandible. It is often used in many dental procedures, and provides adequate anesthesia for a wide anatomical area [1].

IANB has been considered as gold standard for the hemimandible blocking. It provides adequate anesthesia

for one side of the mandibular teeth and gingival mucosa, the body and inferior ramus of the mandible, and

the anterior two-thirds of the tongue and floor of the mouth effectively [2], [3].

Unfortunately, it also proves to be the most frustrating, with the highest percentage of clinical failures even when administered properly [1].

Reported failure rates for the IANB are commonly high, ranging from 31% and 41% in mandibular second and first molars to 42%, 38%, and 46% in second and first premolars and canines, respectively, and 81% in lateral incisors [1].

A higher failure rate was reported in literature when anaesthesia of the pulp was needed [4- 6], which represents the highest percentage of all clinical failures achieved using oral anesthesia.

To achieve the success of IANB, the anesthetic solution must be brought close to the mandibular foramen and the needle should be inserted at a depth of 20–25 mm to the pterygotemporal depression between the pterygomandibular raphe and coronoid notch [3].

Multiple factors interfere in the failure of IANB: The most common cause of absent or incomplete IANB is deposition of anesthetic too low or too far anteriorly from the mandibular foramen [1]. Accessory innervation from several nerves that provide mandibular teeth with accessory sensory innervation such as mylohyoid nerves, lingual, buccal, contralateral inferior alveolar nerves, cervical cutaneous coli, and the superior and inferior laryngeal branches of the vagus nerve [7], [8]. Current thinking supports the mylohyoid nerve as the prime candidate [1]. Another factor is anatomical variations in foramen position and bifid alveolar nerve which develops with a prevalence of 0.35–1% [9], and cause incomplete anesthesia of the mandible after IANB [10]. Pulpal inflammation and patient anxiety can also affect the success of IANB [11], [12].

Repeat IANB injection has been defined as the first option when the initial injection fails and may be effective in some cases [3]. Unfortunately this failure sometimes cannot be overcome with a repeated IANB injection. [13] reported success rate of repeated IANB as low as 32%. In addition, post injection pain and even trismus could result from repeated injections in the same area [3].

Many alternative techniques to overcome the failure of conventional inferior alveolar nerve block (IANB) were described and confirmed as effective injections such as Gow-Gates mandibular nerve block [14], Closed-mouth block (Vazirani Akinosi mandibular nerve block) [15], [16], and periodontal ligament injection (intra ligamentary injection) [17], [18].

Multiple complications were reported during and after IANB; such as facial paralysis that may result from administration of local anesthesia in the parotid area region due to the over-insertion of the needle towards the posterior border of the mandible, trismus which may occur because of mucosa tearing during the progression or withdrawal of the needle [19- 21], and hematomas that may develop due to the inadvertent injury of the pterygoid venous plexus or the intravascular injection of anesthetic solution [22].

Other complications were reported such as; paralysis of the lingual nerve, paresthesia, or dysesthesia, ptosis, extraocular muscle paralysis and necrosis of the skin over the chin and diplopia [22].

Even for the most experienced dental practitioners, profound mandibular anesthesia remains difficult to achieve 100 % of the time. The experienced clinician might face failure of IANB at times and mandibular

anesthesia will be problematic for every practicing dentist regardless of experience [6].

However, IANB failure rate is more frequent among undergraduate dental students and interns which is in somehow due to the lack of experience [23].

The impacts of IANB failure will be reflected by students during their learning/training period, and if not adequately solved in time, their performance will get impaired, which in turn, affects their career professional future.

Competence in the field of local anesthesia is regarded as a key skill of any dentist. Successful pain management can facilitate the treatment for both the patient and the dentist, and it has also been suggested, that patients may choose their dentist based on his or her ability to provide a pain-free therapy [24], [25].

The aims of this study were 1) to assess the rate of IANB failure among dental students, interns, and instructors 2) to report the causes of failure, 3) to investigate the substitutes used in case of IANB failure and awareness of alternative techniques, and finally 4) to assess most common IANB complications.

2. Materials and methods

In the current study the data has been collected using an electronic Google form questionnaire.

Ethical approval was taken from the Scientific Research Committee (3/1-21).

The questionnaires were anonymous containing twenty questions divided into multiple sections. The first section included the participants' demographic questions such as age, gender, academic level and years of experience. The second section included questions about the frequency of using IANB in the dental clinics during the different dental treatments on the lower teeth, the frequency of cases in which the IANB was failed or provided insufficient anesthesia and the most common causes of failure according to their experience. In addition the participants were asked about the number of attempts they usually apply before another action is taken and about the actions taken to overcome the failure. Also they were asked about their awareness and use of different alternative or supplemental anesthetic techniques. Also the most commonly encountered complications of IANB were assessed. (Annex 1 questionnaire form).

The Questionnaire was formulated and conducted among dental students of the higher levels (level 11 and level 12), interns and instructors in Vision Colleges. Then the collected data was subjected to descriptive analysis to retrieve the objectives of the study.

3. Results

In the present study 356 participants were involved; among the total 217 (61%) were females, and 139 (39%) were males. 24.8% of the participants were undergraduate students: 9.6% level 11 and 15.2% level 12, 59% interns and 16% instructors who were distributed among the specialties of surgery, endodontic, paediatric and periodontics dentistry.

The participants distributed between the Jeddah branch 61.5% and the Riyadh branch 38.6% of Vision Colleges.

Regarding the knowledge about inferior alveolar nerve block; 69.1% of the participants considered that they have sufficient knowledge about IANB injection, while 30.9% considered their knowledge about the

injection insufficient. In addition 91.6% of the individuals considered that they were able to administer the injection without supervision and 98.6% stated that they follow the landmarks during administration.

73.9% of the participants mentioned that they use IANB to provide anesthesia for dental procedures of all mandibular teeth. 47.2% of the individuals preferred to use infiltration in the lower anterior teeth, while 20.2% preferred to use incisive nerve block for procedures on anterior teeth (figure 1).

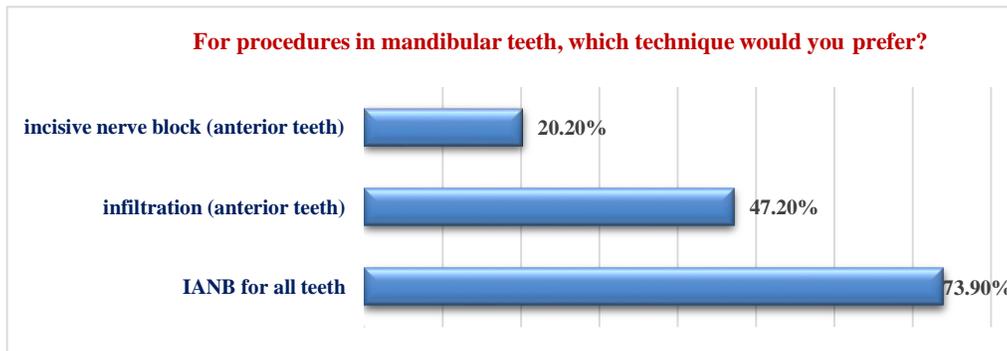


Figure 1: Replies to the question: For procedures in mandibular teeth, which technique would you prefer?

When the participants were asked about aspiration before administration; only 17.4% mentioned that they always apply aspiration and 34.8% sometimes apply aspiration. On the other hand 21.1% rarely apply aspiration and 26.7% don't apply aspiration at all.

Regarding the success of injection only 16.3% of the participants evaluated their selves as very good administrators and most of them stated that they have a failure of anesthesia which happens very often in 6.7% of the responses, often in 8.4%, sometimes in 41.9%, rarely in 34.3% of the responses. Only 8.7% of the respondents claimed that they never face anesthesia failure (figure 2).

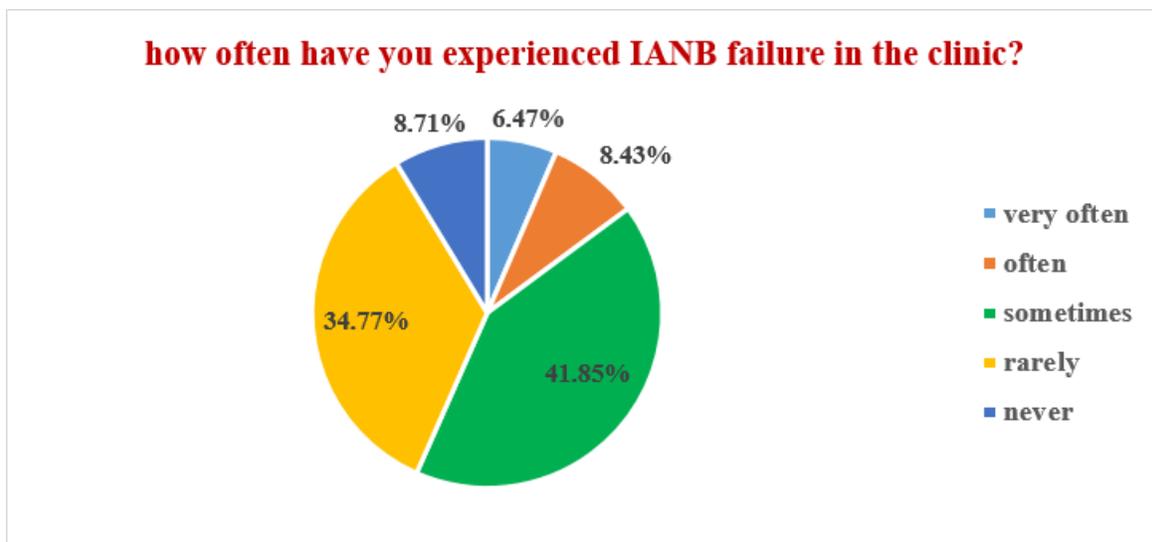


Figure 2: Replies to the question: how often have you experienced IANB failure in the clinic?

The most common causes of failure according to them were unclear landmarks (46.1%), anatomical variations (38.5%) and wrong technique (31.7%) (Figure 3).

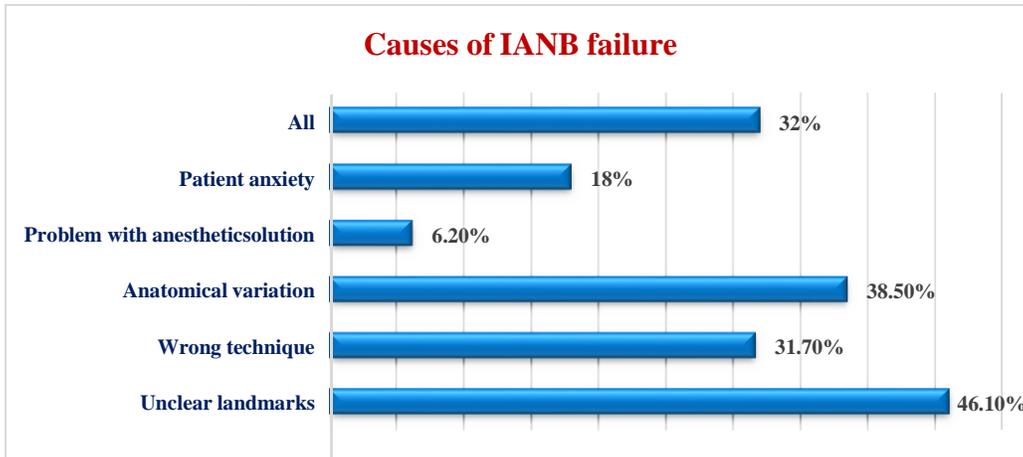


Figure 3: Summary of causes of IANB failure according to the participants.

When the doctors were asked what to do in case of anesthesia failure; most of them would try with another injection technique (39%), call for supervisor (37.6%) or try again with the same injection technique (34.8%). (Figure 4).

In addition 81.5% stated that they would repeat IANB in case of failure about 2-3 times then they would admit the failure of IANB and defer the patient to another appointment or try another technique.

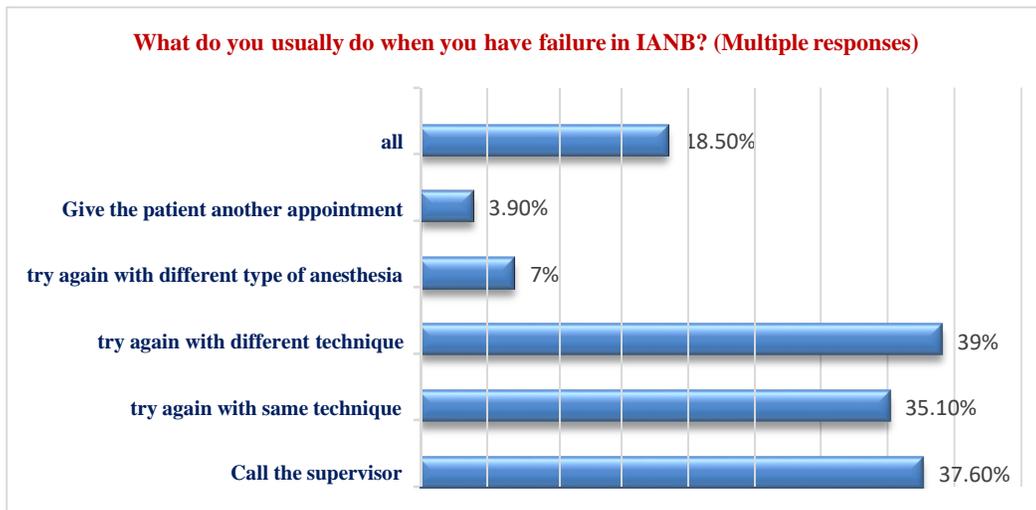


Figure 4: Replies to question: what do you do when you have failure in IANB?

Endodontic procedures were most commonly related to failure of IANB anesthesia (62.1%), followed with oral surgery procedures (21.9%).

The most common supplementary technique used to overcome IANB failure in our sample was intra- ligament anesthesia in 49.4%, while 26.1% use the Gow-Gates technique and 14.6% used intrapulpal anesthesia. Only 9.8% of the participant use the Akinosi/Varzirani injection as a secondary technique (figure 5).

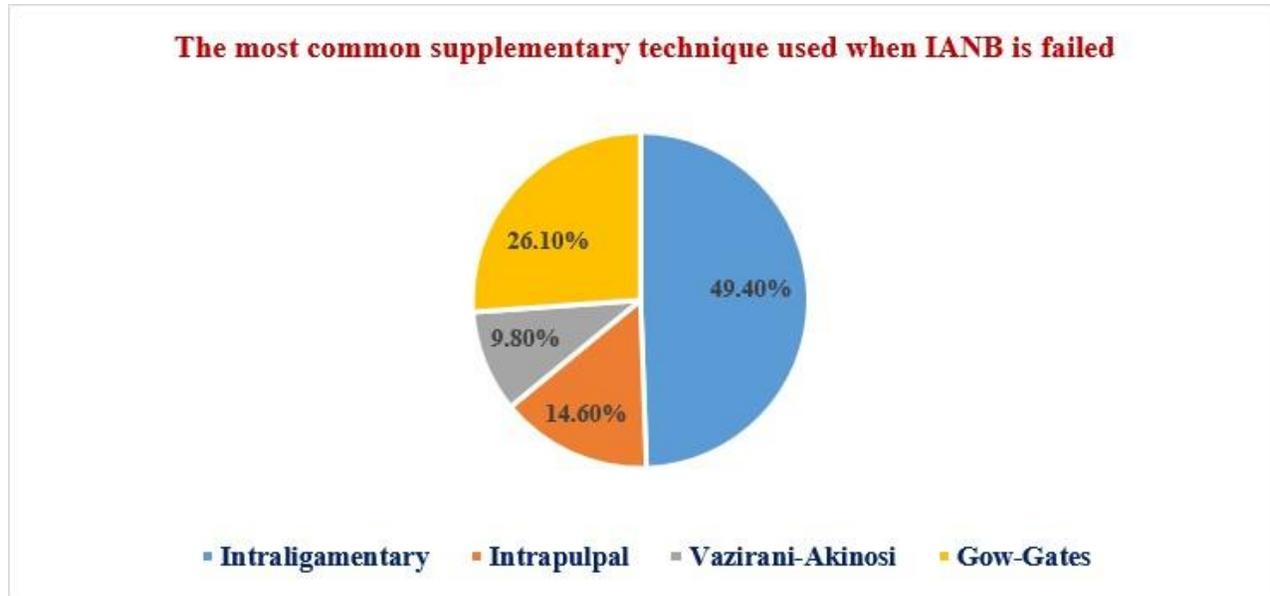


Figure 5: Summary of IANB substitutes in our sample.

Most of the participants wished to have more training on IANB technique in oral surgery department 69.7%.

Regarding the complications of IANB anesthesia; 60.1 % of respondents had never had complications related to IANB. The most common reported complications according to our respondents were facial paralysis (17.1%), trismus (16.3%) and hematoma (10.4%) (figure 6).

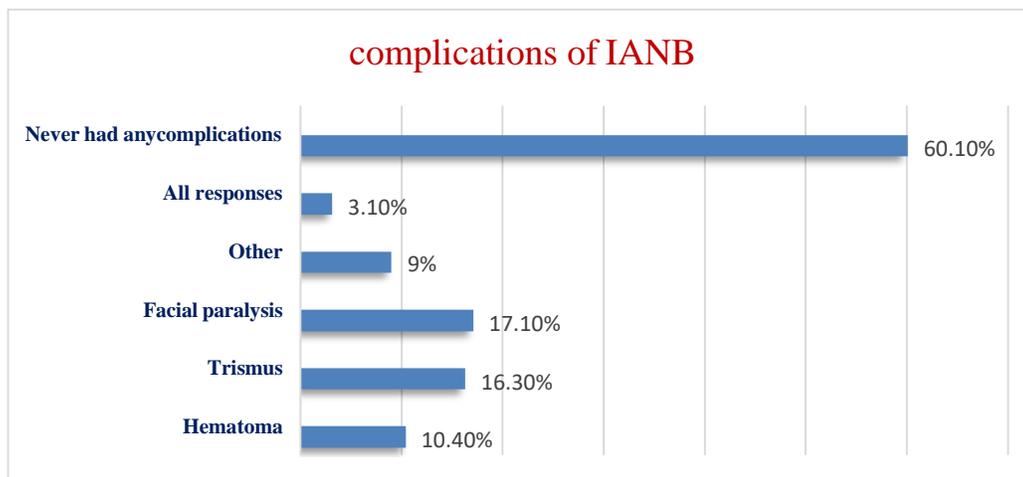


Figure 6: Summary of responses to the question: what are the most common complications you have observed after an IANB?

4. Discussion

IANB injection is one of the basic injection techniques in the dental practice. 73.9% of our participants use IANB to provide anesthesia for dental procedures of all mandibular teeth, which reflect the importance of this technique in our daily dental practice.

Among participants 30.9% said that they have insufficient knowledge about the injection; which was mostly related to undergraduate clinical programme.

A surprising result was that only 17.4% of the participants always apply aspiration although as high rate of positive aspiration as 10-15% has been reported [1]. Which represent the highest frequency of positive aspirations of all intraoral injections [26].

Because the inferior alveolar vessels are located the most posterolaterally among the components of the inferior alveolar neurovascular bundle and located outside of the lingual and the protective shadow cast by the crista endocoronoidea, it is more exposed to needle insertion when IANB is performed [27].

15.1% of the respondents reported very often and often failure of IANB, and 41.9% of them reported failures that sometimes happen which match with the study of [28] in which 14% of the students and interns observed IANB failure very often or often.

Multiple studies reported high failure rate of IANB and according to malamed, the success rate of conventional (IANB) is only 80–85% [3].

The most common causes of failure according to our participants were unclear landmarks (46.1%), anatomical variations (38.5%) and wrong technique (31.7%). In a study of [29] dental interns were monitored during administration of inferior alveolar nerve block, and the most common cause for IANB failure in the mentioned study was attributed to the difficulty in palpating the landmarks (77%).

For successful IANB, extraoral landmarks should be considered. Degree of ramal flaring and height and width of the mandibular ramus as well as intraoral landmarks can affect the success of the injection [30], [31].

For example [32] reported that the IANB failure rates were significantly higher in the retrognathic mandible (14.5%) than in the normal mandible (7.3%) and prognathic mandible (9.5%).

In addition multiple previous studies indicated that Variations of normal anatomy, such as communication among mandibular nerve branches, can cause local anesthesia failure [33- 36].

Endodontic procedures were the most commonly related procedures to failure of IANB anesthesia (62.1%) followed with oral surgery procedures (21.9%), which is similar to [28].

It is agreed that IANB injection alone does not always allow pain-free treatment for mandibular teeth with irreversible pulpitis [13].

Inflammation in teeth with irreversible pulpitis leads to hyperalgesia in patients and negatively affects the success of anesthesia performed during emergency endodontic treatment [37].

Studies reported that the failure ratio of a single IANB block injection in patients with irreversible pulpitis ranges between 30 and 90 % [38], [39].

In case of anesthesia failure; most of participants would try with another injection technique (39%). In addition 81.5% stated that they would repeat IANB in case of failure about 2-3 times then they would admit the failure of IANB and defer the patient to another appointment or try another technique. Multiple references recommended to repeat the IANB injection to overcome IANB failure such as the work of [3], [23] who found that 70% of their respondents repeated a standard IANB injection [23]. On the contrary,

[13] reported a a low success rate of repeat IANB.

Multiple alternative techniques can be used to overcome the failure of IANB:

Gow-Gates Mandibular Nerve Block: which provides anaesthesia to the entire distribution of nerve. This technique is technically more difficult than the conventional blocks, but has a higher success rate and resolves the problem of accessory innervations [14].

Closed-mouth block (Vazirani Akinosi Mandibular Nerve Block): This technique is useful in cases of trismus, provides successful anaesthesia in bifid alveolar nerve and bifid alveolar canals [15], and is a reasonably safe technique that many practitioners perform routinely to achieve mandibular anesthesia [16].

Periodontal Ligament Injection (Intra ligamentary injection): this technique can be used to overcome a failed alveolar nerve block [17]. Also, it was described as the most commonly used method after failure of IANB during the treatment of mandibular posterior teeth with irreversible pulpitis [1].

The most common supplementary technique used to overcome IANB failure in our study was intra- ligament anesthesia in 49.4% of the responds, which agree with [28] study that indicated the intraligamentary injection as the most common used technique after IANB failure (57.1%).

In our study only 26.1% use the Gow-Gate technique,14.6% use intrapulpal anesthesia and 9.8% of the participant use the Akinosi/Varzirani technique (AVT) as a secondary technique. These results were reasonably similar to those of [23] study in which only 14.9% of participants reported using the Gow-Gates technique and 7.5% reported using the Vazirani-Akinosi technique.

In a different study [37] reported that Forty (60.6%) of the respondent practiced the Akinosi/Varzirani technique (AVT) as a secondary technique while only 1 had ever attempted the Gow-Gate technique (GGT) [40].

This difference could be related to the variations in the curriculum applied in the different dentistry colleges in addition to the small size sample in the study of [37].

These results may reflect lacking in clinical training on these alternative technique in our colleges.

Multiple studies concluded that Vazirani-Akinosi nerve block and intraosseous injection had superior effectiveness compared to IANB [38].

And Gow-Gates mandibular conduction anesthesia may increase the success rates in patients with irreversible pulpitis compared with conventional IANB [41].

In a study that compared classical IANB and Gow-gates nerve block for surgical removal of mandibular third molar, the study suggested that the technique of Gow-Gates is superior to IANB but requires skill and greater expertise that one gains with practice [42]. This confirms the importance of promoting the use of these alternative methods in the dental treatments.

The dental practitioners need to be familiar with these alternative techniques and completely understand their advantages, disadvantages, indications, and complications.

59% of respondents had never had complications related to IANB. And the most common reported complications according to our respondents were facial paralysis (16.6%), trismus (15.3%) and hematoma (9.8%). Which are similar to those observed in previous studies [19], [28].

Other post-IANB complications documented in the literature include visual problems, motor problems (such as palpebral ptosis), and diplopia [26], [43].

Paralysis of the lingual nerve, paresthesia, or dysesthesia has also been reported. Infrequent complications include extraocular muscle paralysis and necrosis of the skin over the chin [22].

Recently a case of cerebral air embolism after IANB injection was reported because of the accidental injection of lidocaine with epinephrine into the carotid sheath because of its close anatomical proximity to the pterygomandibular triangle [44]. Which reflect the importance of pre-injection aspiration to avoid unfavourable complications. Intravenous injection should be prevented through accurate aspiration before anesthetic solution injection [28], [15].

5. Conclusion

The results of this study indicate that IANB is the main used technique in obtaining anaesthesia in the lower teeth, and more training of students on this injection is needed and more instructions related anatomical landmarks, anatomical variation, and pre-IANB aspiration should be enhanced.

Also alternatives to IANB, such as the Gow-Gates and Akinosi techniques should be activated and emphasized, theoretically and clinically, in the anesthesia courses of the dental curriculum.

Future studies after curriculum modifications are recommended to reflect the clinical impact of this changes on the students and dentists behaviour regarding IANB failure.

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