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RESEARCH ARTICLE

CURRENT TRENDS IN INFERIOR ALVEOLAR NERVE BLOCK

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ABSTRACT

The inferior alveolar nerve (IAN) block is the most frequently used mandibular injection technique for achieving local anesthesia in mandibular surgical procedure. However, the IAN block does not always result in successful anesthesia.Authors reviewed literature regarding comparison between inferior alveolar nerve block & its various modifications relating to specific local anesthetic delivery systems, degree of pulpal anesthesia, anesthetic efficacy.

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INTRODUCTION

Conventional inferior alveolar nerve block is the most frequently used technique to produce anesthesia for performing restorative and surgical procedures in mandible (Thangavelu, 2012). However the reported incidence of failure is significant i.e. 15-30% (Palti et al., 2011; Blanton, 2003). Several authors have contributed for the improvement of IANA by refining and adopting new techniques to enhance the success rate. Such techniques are Gow Gates technique, Vazirani Akinosi technique and conventional technique using computer controlled injection system (Goldberg, 2008; Aggarwal, 2010; Oztas, 2005). Former technique is associated with delayed onset time, variable buccal nerve anesthesia, increased intraoperative bleeding (Sisk, 1985).

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Some authors also tried changing the approach angle of needle insertion (Boonsiriseth et al., 2013), landmarks for needle insertion (Thangavelu, 2012), the shape of needle for better access (Chakranarayan et al., 2013), rotating the needle during insertion via conventional approach (Malamed, 2004), using acupuncture along with anesthesia,[11] injection into retromolar triangle area,[12] using an anterior approach to conventional technique,[13] altering the temperature or volume of solution injected[14-17] in search of a newer technique that has highest efficacy and negligible complications. Each technique has its own advantages and disadvantages. The present review was undertaken to discuss various alternative techniques for inferior alveolar nerve block in current literature.

MATERIALS AND METHODS

The intention of this paper is to review the literature regarding Comparison between conventional inferior alveolar nerve block and various modifications.

A literature search was conducted in August 2019. The following key words were used in "science direct", "Google search" and "pubmed".

- Comparison between conventional inferior alveolar nerve block and various modifications
- Comparison between different techniques of inferior alveolar nerve block

Only those articles that discussed comparison of conventional inferior alveolar nerve block and newer modalities using various parameters like degree of pulpal anesthesia, anesthetic efficacy were included. All the articles were included irrespective of their study design and level of evidence. Articles that were in English were only considered. Case reports, studies without comparison and those which were repetition of technique were excluded.

Modifications of inferior alveolar nerve block

Dumbar et al. 1996 evaluated the anesthetic efficacy of intraosseous (IO) injection after an inferior alveolar nerve block compared with inferior alveolar nerve block with only gingival penetration (mock IO injection) in 40 subjects at two separate appointments of 1 week apart. The standard inferior alveolar nerve block was given with 27 gauge needle and 1.8ml solution using 2% lidocaine with 1:100,000 epinephrine. Intraosseous injection was performed with stabident system at distal surface of first molar. Mock IO injections were given in similar manner except that no solution was deposited. Anesthetic success was 42% in mock IO injection group and 90% with the inferior alveolar nerve block with intraosseous injection. Immediate anesthesia onset, increase in heart rate and lower pain rating was reported in intraosseous group.

Hannan et al., 1999 compared the degree of pulpal anesthesia with an ultrasound guided inferior alveolar nerve block with the conventional inferior alveolar nerve block in 40 patients who randomly received two nerve block approaches at two separate appointments at least one week apart. 100% successful anesthesia was obtained with both the approaches. They concluded that accuracy in needle placement with ultrasound did not improve the success of inferior alveolar nerve block.

Takasugi et al 2000 said that the conventional technique, in which the needle was approached toward the mandibular foramen, was accompanied by risk of complications such as vascular and neural injury, intravascular injections, and muscular injury with an associated incidence of 2.9 to 22% of positive blood aspiration. After analyzing the anatomical study of pterygomandibular space using CT images, they focused on the space between the medial pterygoid muscle and deep tendon of temporalis muscle near the anterior border of mandibular ramus, then they hypothesized that local anesthesia deposited at this area should diffuse and reach the inferior alveolar nerve (Figure 1). So an anterior injection approach was designed in which the syringe was positioned at the insertion point at the lateral side of the pterygomandibular fold approximately 10mm above the occlusal plane and was placed from the contralateral mandibular first molar. The needle was inserted to a depth of 10mm. After ensuring negative aspiration, 1.8 ml of anesthetic solution was injected. In comparison with conventional technique they concluded that the anterior technique is able to achieve anesthesia of the inferior alveolar nerve with the low risk of inferior alveolar neural and vascular complications. It should be considered as an alternative to theconventional technique.

Stabile et al 2000 evaluated the anesthetic efficacy and heart rate effects after intra osseous injection (IO) of 1.5 % etidocaine (1:200000 epinephrine) after an inferior alveolar nerve block in 48 patients who randomly received 2 combinations of injection at two separate appointments. The combinations were an inferior alveolar nerve block (IANB) with 3% mepivacaine + IO injection with 1.8 ml of 1.5 % etidocaine hydrochloride having 1:200000 epinephrine and an IANB + mock injection (0.1ml of 3% mepivacaine). The IO injection of 1.8ml of 1.5% etidocaine hydrochloride significantly increased anesthetic success when compared with the inferior alveolar nerve block + mock injection. There is transient increase in heart rate in patients receiving IO injection with etidocaine hydrochloride.

Oztas et al., 2005 studied the efficacy of anesthesia and the reaction to pain after treatment when inferior alveolar nerve block was given with traditional syringe compared with periodontal ligament injection (PDL) with wand computerized device in 25 children of 6-10 years of age. Either technique was performed randomly in two separate visits over the primary mandibular second molar. Pain perception was assessed with Eland colour scale. Traditional syringe was found to be more painful when pain was measured immediately after injection. However the pain scores with wand injection were significantly higher at the end of the treatment. When patients were asked regarding the preference of the technique, majority favored PDL injections.

Kanaaet al.,2006 studied the effect of speed of injection on efficacy of inferior alveolar nerve block (IANB) in a randomized double-blind crossover trial. They evaluated the efficacy and discomfort associated with slow (60 seconds) and rapid (15 seconds) inferior alveolar nerve blocks using 2.0 ml of 2% lidocaine with 1:80,000 epinephrine in securing mandibular first molar, premolar and lateral incisor pulp anesthesia in 38 volunteers. Visual analogue scale was used to self -record the injection by volunteers. Based on the data collected, they concluded that slow IANB produced more number of episodes of no sensation during maximal electronic pulp stimulation in first molars, premolars, and lateral incisors than rapid injection and slow IANB was more comfortable than rapid IANB.

Steinkruger et al 2006 conducted a clinical study comparing the degree of pulpal anesthesia after the conventional inferior alveolar nerve block (IANB) injected with needle bevel facing away from the ramus or toward the ramus. As some authors reported that the beveled needles deflect toward the non bevel side during its insertion and the bevel should always be kept away from the ramus for more accurate injections. In their study, 51 patients were taken and injection was given using 27 gauge needle at two separate appointments at least one week apart with either technique. When results of their study was analysed, there was no significant difference between two needle bevel orientation techniques in terms of success rate of IANB. Camarda et al 2007 evaluated the anesthetic efficacy of IANB by increasing the anesthetic volume by using two different drug delivery systems(i.e. using a standardized two cartridge reloading and reinjection technique and a computer controlled system using a technique where by the second

cartridge was reloaded without having to remove the needle from the injection site. Successful anesthesia was evaluated by using explorer over the soft tissue innervated by inferior alveolar and lingual nerve at three and ten minutes after final anesthesia administration. Success rate were 94.3% at 3 minutes and 100% at 10 minutes with two cartridge delivery with traditional syringe and 80% at three minutes and 91.4% at 10 minutes with computer control delivery system. They concluded that the results was quite high and exceeded the accepted success rate of IANB (85%) reported in literature. They recommended that the clinician can therefore exceed the anesthetic volume to enhance the success rate.

Jung IY et al 2008 compared the anesthetic efficacy of buccal infiltrations(BI) in mandibular first molar with that of inferior alveolar nerve block(IANB) to check the pulpal anesthesia for mandibular first molars using 4% articaine with 1:10000 adrenaline at two separate appointments at least one week apart. Anesthetic success was 54% in BI group and 43% in IANB, but the difference was not significant statistically. But they concluded that BI with 4% articane for mandibular first molar can be a useful alternative when compared with IANB as it has faster onset and a similar success rate.

Goldberg et al. 2008compared the pulpal anesthesia obtained with conventional inferior alveolar, Vazirani Akinosi, and Gow Gates technique in asymptomatic vital teeth in 40 patients using 3.6 ml of2 % lidocaine with 1:100,000 epinephrine who received all three techniques at 3 separate appointments. Electric pulp tester was used to check anesthesia at first molar, first premolar and lateral incisor. Success rate achieved after Gow gates was 16-44%, conventional inferior alveolar 25-62% and for Vazirani akinosi technique 13-50%.They concluded that anesthetic success rate was similar between three techniques, but conventional inferior alveolar nerve block has faster onset of anesthesia. Yesilyurt et al 2008 did a comparative study between the computerised device (wand) and conventional syringe to evaluate the pain of needle insertion and injection during inferior alveolar nerve block in 40 patients between 18-30 years of age. Pain rating scale and visual analogue scale was used to determine the intensity of pain. Results showed that Wand was less painful than conventional syringe used for IANB and it was the most preferred choice among the patients.

Aggarwal et al. 2010 evaluated the anesthetic efficacy of Gow gates nerve block, Vazirani Akinosi technique, buccal plus lingual infiltrations and compared these tree techniques with conventional inferior alveolar nerve block in 97 cases using 4% articane with 1:100,000 epinephrine. Treatment was initiated 15 minutes after the anesthesia administration and pain during treatment was recorded using Helf Parker Visual analogue scale. Success rate was 52% for Gow Gates technique, 41% for Vazirani Akinosi technique, 27% for infiltration technique. Conventional technique was successful in 36% of cases. So they concluded that the Gow Gates technique showed higher success rate when compared with conventional inferior alveolar nerve block technique.

Palti et al., 2011 reviewed an alternative technique for inferior alveolar nerve block using various anatomical points for reference, simplifying the procedure and enabling greater success rate. A total of 193 mandibles from dry skulls were used to establish a relationship between the teeth and mandibular foramen.

By using two wires, the first passing through the mesiobuccalgroove and middle point of the mesial slope of the distolingual cusp of the primary secondmolar or permanent first molar (right side), and the second following the oclusal plane (left side), a line can be achieved whose projection coincides with the left mandibular foramen..This study showed correlation in 82.88% ofcases using permanent first molar and in 93.62% ofcases using the primary second molar (Figure 2& 3). This method is very effective for inferior alveolar nerve block, especially in Pediatric Dentistry.

Thangavelu et al., 2012 studied an alternative inferior alveolar nerve block (IANB) that has a higher success rate than other routine techniques. In their technique, Imaginary midpoint between the upper and lower occlusal plane, at anterior border of ramus is selected, 6 to 8mm above this midpoint and 8 to 10mm posterior to the anterior border of ramus is the first site of insertion of needle (Figure 4). The barrel of the syringe is placed at the contralateral side and the needle is inserted. Needle is advanced till it hits the bone. Few drops of the local anesthetic solution are deposited, to anesthetize the long buccal nerve. The barrel of syringe is then adjusted towards midline of mandible to insert needle freely further along the medial side of ramus. 'During injection few drops of Lignocaine solution is being deposited to anesthetize lingual nerve. The needle is advanced further towards the mandibular foramen by following the medial side of ramus as guide. At 21 to 24 mm length of the needle insertion from anterior border of ramus, needle distance with anterior border of ramus was verified. To bring the tip ofneedle closer to bone and IAN the barrel of the syringe is taken back to the contra lateral side. 1-1.5 mL of local anesthetic solution is deposited at this place i.e. pterygomandibular space to anesthetize Inferior alveolar nerve. Their technique proved to be effective in 95% of cases and complications such as positive aspirations, trismus, needle breakage, hematoma and nerve injuries were not encountered.

Aggarwal et al 2012 compared the anaesthetic efficacy of inferior alveolar nerve block(IANB) using 2 % lidocaine with 1 :200000 adrenaline injected at two different volumes i:e 1.8ml and 3.6 ml in 55 patients divided randomly into two groups. Treatment was started after 15 minutes of injection and pain during treatment was assessed by visual analogue scale (VAS) and successful anesthesia was considered when there was no or mild pain. Result showed success rate of 26% and 54% respectively in 1.8ml and 3.6ml group. Authors concluded that increasing the volume of 2% lidocaine with 1:200000 adrenaline improved the success rate significantly. Chakranarayanaa et al., 2013 studied a method of inferior alveolar nerve block by injecting the local anesthetic solution into the pterygomandibular space by arching and changing the approach angle of conventional technique and estimated its efficacy (Figure 5). The needle after the initial insertion was arched and inserted in a way that it approaches the medial surface of the ramus at an angle almost perpendicular to it (Figure 6). The technique was applied over 100 patients for mandibular molar extraction and the anesthetic effects were assessed. A success rate of98% was obtained.

Boonsiriseth et al., 2013 evaluated the efficacy of anesthesia obtained with a novel injection approach for inferior alveolar block compared with the conventional injection approach as described by malamed in 40 patients who randomly received each oftwo injection approaches oflocal anesthesia on either side of the mandible at two separate appointments.

Table showing comparison between different technique of inferior alveolar nerve block

S. No	Year	Author	Comparison between technique	Conclusion
1	1996	Dumbar D et al[17]	Anesthetic efficacy of intraosseous (IO) injection after an inferior alveolar nerve block compared with inferior alveolar nerve block with only gingival penetration (mock IO injection)	Anesthetic success was 42% in mock IO injection group and 90% with the inferior alveolar nerve block with intraosseous injection
2	1999	Hannan et al[18]	Compared degree of pulpal anesthesia with an ultrasound guided inferior alveolar nerve block& the conventional inferior alveolar nerve block	100% successful anesthesia was obtained with both the approaches. Accuracy in needle placement with ultrasound did not improve the success of inferior alveolar nerve block.
3	2000	Takasugi Y et al[19]	Conventional technique compared with anterior injection approach	Anterior technique is able to achieve anesthesia of the inferior alveolar nerve with the low risk of inferior alveolar neural and vascular complications
4	2000	Stabile P et al[20]	Anesthetic efficacy and heart rate effects after intra osseous injection (IO) of 1.5 % etidocaine (1:200000 epinephrine) after an inferior alveolar nerve block in 48 patients who randomly received 2 combinations of injection at two separate appointments	Transient increase in heart rate in patients receiving IO injection with etidocaine hydrochloride
4	2005	Oztas N et al[6]	Efficacy of anesthesia and the reaction to pain after treatment when inferior alveolar nerve block was given with traditional syringe compared with periodontal ligament injection (PDL) with wand computerized device in 25 children of 6-10 years of age	Traditional syringe was found to be more painful when pain was measured immediately after injection. When the patients were asked regarding the preference of the technique, majority favoured PDL injections.
5	2006	Kannan MD et al[21]	The efficacy and discomfort associated with slow (60 seconds) and rapid (15 seconds) inferior alveolar nerve blocks using 2.0 ml of 2% lidocaine with 1:80,000 epinephrine in securing mandibular first molar, premolar and lateral incisor pulp anesthesia	Slow IANB produced more number of episodes of no sensation during maximal electronic pulp stimulation in first molars, premolars, and lateral incisors than rapid injection and slow IANB was more comfortable than rapid IANB
6	2006	Steinkruger G et al[22]	A clinical study comparing the degree of pulpal anesthesia after the conventional inferior alveolar nerve block (IANB) injected with needle bevel facing away from the ramus or toward the ramus.	There was no significant difference between two needle bevel orientation techniques in terms of success rate of IANB.
7	2007	Camarda AJ et al[23]	Evaluated the anesthetic efficacy of IANB by increasing the anesthetic volume by using two different drug delivery systems(i.e. using a standardized two cartridge reloading and reinjection technique and a computer controlled system using a technique where by the second cartridge was reloaded without having to remove the needle from the injection site.	Results was quite high and exceeded the accepted success rate of IANB (85%) reported in literature. Clinician can therefore exceed the anesthetic volume to enhance the success rate.
8	2008	Jung IY et al[24]	Compared the anesthetic efficacy of buccal infiltrations (BI) in mandibular first molar with that of inferior alveolar nerve block (IANB)	BI with 4% articane for mandibular first molar can be a useful alternative when compared with IANB as it has faster onset and a similar success rate.
9	2008	Goldberg S et al[4]	Compared the pulpal anesthesia obtained with conventional inferior alveolar, Vazirani Akinosi, and Gow Gates technique in asymptomatic vital teeth	Anesthetic success rate was similar between three techniques, but conventional inferior alveolar nerve block has faster onset of anesthesia.
10	2008	Yesilyurt C et al[25]	Comparative study between the computerised device (wand) and conventional syringe to evaluate the pain of needle insertion and injection during inferior alveolar nerve block	Wand was less painful than conventional syringe used for IANB and it was the most preferred choice among the patients.
11	2011	Palti DG et al[2]	Reviewed an alternative technique for inferior alveolar nerve block using various anatomical points for reference, simplifying the procedure and enabling greater success rate	Method is very effective for inferior alveolar nerve block, especially in Pediatric Dentistry
12	2012	Thangavelu K et al[1]	Studied an alternative inferior alveolar nerve block (IANB) that has a higher success rate than other routine techniques	Inferior alveolar nerve block is an appropriate alternative nerve block to anesthetize inferior alveolar nerve due to its several advantages

Continue..

13	2013	**Chakranarayana a A et al**[9]	Studied a method of inferior alveolar nerve block by injecting the local anesthetic solution into the pterygomandibular space by arching and changing the approach angle of conventional technique and estimated its efficacy.	A success rate of 98% was obtained
14	2013	Boonsiriseth K et al[27]	Efficacy of anesthesia obtained with a novel injection approach for inferior alveolar block compared with the conventional injection approach	Efficacy of inferior alveolar nerve block by novel injection approach provided adequate anesthesia and caused less pain and greater safety during injection.
15	2013	Mathew A et al[28]	Evaluated the factors responsible for minimal needle deflection during IANB in vitro (in agar agar) which has physical properties similar to that of human tissue	Combination of rotational technique and bibevelled needle tip usage to reduce the amount of needle deflection
16	2013	Lenka S et al[29]	Compared the three techniques of local anesthesia for mandible i.e. inferior alveolar nerve block via direct intra oral approach, Gow Gates nerve block and Vazirani Akinosi nerve block	Gow Gates nerve block anesthesia was a highly successful alternative to conventional inferior alveolar nerve block in terms of complications such as trismus, advantage of single injection, longer duration of anesthesia, lesser pain experienced during injection
17	2013	Vasanthakumar A et al[14]	The effect on pain, onset and duration of action by cooling the lignocaine hydrochloride (with 1:200000 and without adrenaline) on inferior alveolar nerve block compared with lignocaine hydrochloride at room temperature	Cooler anesthesia (with or without adrenaline) showed lesser pain on injection, faster onset and prolonged duration of action compared with LA (with and without adrenaline) at room temperature
18	2013	Fowler S et al[30]	Efficacy of inferior alveolar nerve block using it at two different volumes of 3.6ml and 1.8ml of 2% lidocaine with 1:100000 epinephrine	For patients presenting with irreversible pulpitis, success was not significantly different between a 3.6-mL volume and a 1.8-mL volume of 2% lidocaine with 1:100,000 epinephrine. The success rates (28%–39%) with either volume were not high enough to ensure complete pulpal anesthesia.
19	2013	Ajamah J et al[31]	Conducted a study to evaluate the effect of operators experience over the success of inferior alveolar nerve block	Adequate understanding of the reason for failure should help the clinician to minimize the failure and maximize the success.
20	2013	Kang SH[20]	3 dimentional anatomic relation of mandibular foramen with mandibular anatomic landmarks for inferior alveolar nerve block	Convenient to insert the needle through the first molar area on the contralateral side for inferior alveolar nerve block.
21	2014	Aggarwal V et al[24]	Anesthesia efficacy of 2% lidocaine with two different concentrations of epinephrine (1;80000 and 1:200000)	Success rate was similar with both the concentration of adrenaline in 2% lidocaine.
22	2014	Shabazlar N et al[32]	Compared with intraligamentary (ILA) injection anesthesia to assess the failure rate, pain during injection, additional injection, cardiovascular disturbance (CVD), latency time, unwanted side effects, volume of anesthesic solution, duration of anesthesia in adults patients.	Except for cardiovascular disease there is no evidence that ILA is neither superior nor inferior when compared with IANB
23	2014	Canavan D et al[33]	Measures for delivering effective and painless inferior alveolar nerve block by controlling the anxiety with good verbal communication, preferring the supine and semisupine position as this will help to rapidly deal with vasovagal syncope	Concluded that point of needle insertion should be, about 6-10mm above the occlusal plane
24	2015	Jalali S et al[34]	Effect of Acupuncture over the success of inferior alveolar nerve block (IANB)	Application of acupuncture significantly increases the efficacy of IANB for mandibular molars with symptomatic irreversible pulpitis.
25	2016	Kriangcherdsak et al[35]	Success rates of the first inferior alveolar nerve block administered by dental practitioners	Large percentage of the dental practitioners (85.26%) used the standard method to locate the anatomical landmarks, injecting the local anesthetic at the correct position, with the barrel of the syringe parallel to the occlusal plane of the mandibular teeth. Further, 68.42% of the dental practitioners injected the local anesthetic on the right side by using the left index finger for retraction
26	2018	Sovatdy S et al[36]	Surgical removal of bilateral mandibular third molars with two different IANBI techniques. One side was injected using Quicksleeper®, and the other side was injected using a conventional IANBI	CAIOI is an advantageous anesthetic technique. It can be used as an alternative to conventional IANBI for mandibular third molar surgery.
27	2019	Gajendragadkar K et al[26]	Group A was receiving IANB via CCLAD and group B receiving IANB using a conventional cartridge syringe	Significant difference was observed in the pain perception of the patients during CCLAD. The patient comfort was grossly equal for both techniques

In novel approach a 30 mm long dental needle was used with stopper at 20mm from the tip of the needle (Figure 7). The barrel of the syringe was placed on the occlusal surface of the posterior teeth at the same operation site. The needle insertion point was the same point as for the conventional injection approach (height of injection, anteroposterior site of injection). The needle was slowly advanced into the soft tissue until the stopper contacts the mucosa. Aspiration was performed before slowly depositing local anesthetic solution and in amount of 1.7ml of solution injected. They concluded that the efficacy of inferior alveolar nerve block by novel injection approach provided adequate anesthesia and caused less pain and greater safety during injection. Mathew et al., 2013 evaluated the factors responsible for minimal needle deflection during IANB in vitro (in agar agar) which has physical properties similar to that of human tissue.

Study was conducted to assess the factors like needle gauge, tip design, insertion technique, insertion angle and tissue thickness and the amount of needle deflection during IANB. It was performed over 14 in vitro test models (2.5 x 2 x 2 cm) of agar agar mounted over dental surveyor for accurate needle insertion upto 25mm of depth and radiographic analysis was done to measure the deflection. This study reported that the deflection of needle was directly proportional to the thickness of tissue, bibevelled needle tip design showed less deflection compared with conventional needle design, rotational insertion technique had least needle deflection when compared with other techniques (linear, only single rotation) directly proportional relation of the needle gauge and the amount of needle deflection, angle of insertion has minimal effect on amount of deflection.

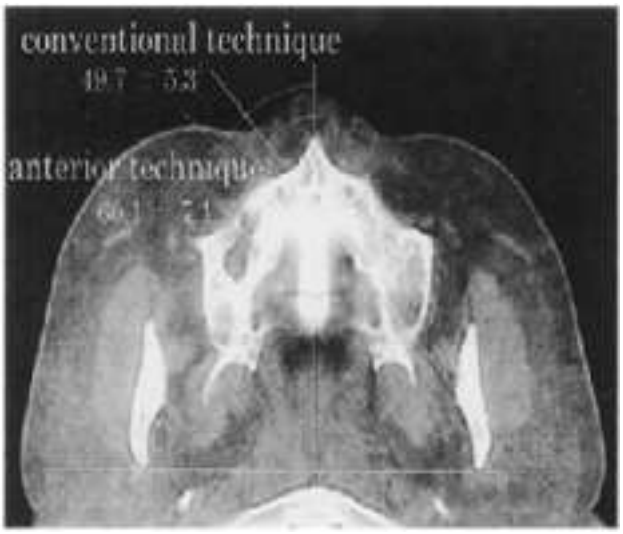

Figure 1- CT images of pterygomandibular space approach

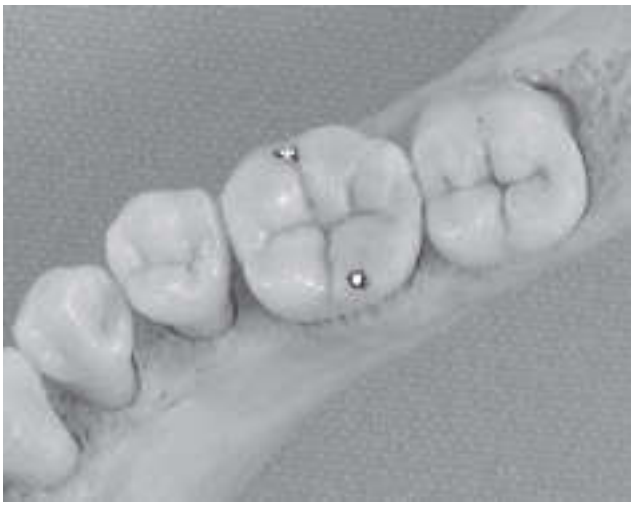

Figure 2. Occlusal surface of the mandibular permanent first molar Mesiobuccal groove (*) and middle point of the mesial slope of the distolingual cusp (·).

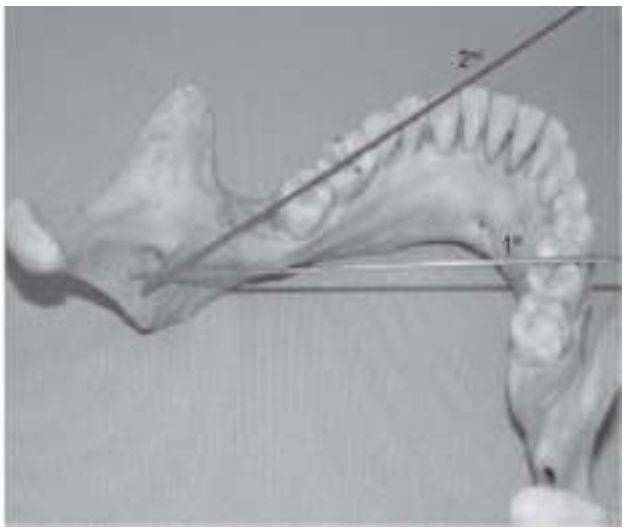

Figure 3. The wire passing from the mesiobuccal groove and middle point of the slope of the distobuccal cusp (or distolingual angle line) of the mandibular first molar permanent, and the second wire passing from the left side occlusal plane

Figure 4. Midpoint and initial site of needle insertion

Figure 5. In vitro assessment of arching of the needle

Figure 6. Administration of inferior alveolar nerve block using the arched needle technique

Figure 7. Novel injection approach

Figure 8. Image of the computer-assisted intraosseous injection with Quicksleeper

So author recommended the combination of rotational technique and bibevelled needle tip usage to reduce the amount of needle deflection.

Lenka et al., 2013 compared the three techniques of local anesthesia for mandible i.e. inferior alveolar nerve block via direct intra oral approach, Gow Gates nerve block and Vazirani Akinosi nerve block in 120 patients using 2% lidocaine with 1:80,000 adrenaline. Anesthetic efficacy was evaluated using pin prick test, aspiration test, pain during injection, depth and frequency of anesthesia, and onset and duration of anesthsia. Results showed greater incidence of pain and higher incidence of positive aspiration in conventional technique. Gow Gates technique showed delayed onset of action and longer duration of anesthesia Vazirani Akinosi technique did not showed any added advantage over the former two techniques. Highest incidence of successful anesthesia was recorded with Gow Gates technique (92.5%), followed by Akinosi technique (90%) and conventional inferior inferior alveolar nerve block (72.5%). Author concluded that Gow Gates nerve block anesthesia was a highly successful alternative to conventional inferior alveolar nerve block in terms of complications such as trismus, advantage of single injection, longer duration of anesthesia, lesser pain experienced during injection.

Vasanthakumar et al., 2013 studied the effect on pain, onset and duration of action by cooling the lignocain hydrochloride (with 1:200000 and without adrenaline) on inferior alveolar nerve block compared with lignocaine hydrochloride at room temperature.100 patients were divided into 4 groups of 25 patients each. Group I and Group II: local anesthesia with and without adrenaline (at room temperature) .Group III and Group IV: local anesthesia with and without adrenaline (refrigerated). Heft parker visual analogue scale and electric pulp stimulator were used to assess the discomfort experienced during injection and pulpal anesthesia respectively. The result showed that onset of anesthesia was fastest for Group III and slowest for Group II. Pain at injection site was least for Group III followed by Group IV. So they concluded that cooler anesthesia (with or without adrenaline)showed lesser pain on injection, faster onset and prolonged duration of action compared with LA (with and without adrenaline) at room temperature and also said that cooling LA without adrenaline was very useful clinically in patients for whom plain LA was required as it prolongs the duration of action. Fowler et al., 2013 evaluated the efficacy of inferior alveolar nerve block using it at two different volumes of 3.6ml and 1.8ml of 2% lidocaine with 1:100000 epinephrine in 129 and 190 patients respectively. Successful anesthesia was determined as the ability to access and instrument the tooth without pain using Helf parker visual analogue scale (VAS).Results showed no statistically significant difference between 3.6ml and 1.8ml volume of 2% lidocaine with 1:100000 epinephrine when used in patients of irreversible pulpitis. Ajamnah et al., 2013 conducted a study to evaluate the effect of operators experience over the success of inferior alveolar nerve block in 300 patients who received IANB by 6 different operators of different specialities. The operator who had highest experience (19 years) showed the highest success rate and lowest were recorded in first year resident who had experience of 2 years. They concluded that adequate understanding of the reason for failure should help the clinician to minimize the failure and maximize the success. Kang et al., 2013 analysed the 3 dimentional anatomic relation of mandibular foramen with mandibular anatomic landmarks for inferior alveolar nerve block in Korean patients. Computer tomographic images were compared between two groups one of growth group (8-16) and other of adult group (18-25).Their findings indicated that the, mandibular foramen moves towards posterior region with continued mandibular growth, the distance from gonion to mandibular foramen increases with age, mandible opens greatly posteriorly at the mandibular foramen region, the mean distance between the anterior border of ramus and mandibular foramen was 22.9mm. Based on their measurements they concluded it would be convenient to insert the needle through the first molar area on the contralateral side for inferior alveolar nerve block.

Aggarwal et al., 2014 evaluated the anaesthesia efficacy of 2% lidocaine with two different concentrations of epinephrine (1;80000 and 1:200000)in 62 patients out of which 31 patients received 2% lidocaine with 1:80000 and 32 patient received 2% lidocaine with 1:200000 for IANB. Heft parker visual analogue scale was used to record the pain during treatment. The result showed no statistical difference in pain experienced during deposition of solution and the success rate was similar with both the concentration of adrenaline in 2% lidocaine. Shabazfar et al., 2014 conducted a meta-analysis from 1979-2012 in which inferior alveolar nerve block was compared with intraligamentary (ILA) injection anesthesia to assess the failure rate, pain during injection, additional injection , cardiovascular disturbance (CVD), latency time, unwanted side effects, volume of anesthesic solution, duration of anesthesia in adults patients. They included seven studies. Results showed that IANB had higher incidence of CVD and is of longer duration than ILA. Pain on injection was less in cases of ILA. No significant difference was detected in terms of failure rates as well as for additional injection. So they concluded that except for CVD there is no evidence that ILA is neither superior nor inferior when compared with IANB. Canavan et al., 2014 discussed the measures for delivering effective and painless inferior alveolar nerve block by controlling the anxiety with good verbal communication, preferring the supine and semisupine position as this will help to rapidly deal with vasovagal syncope, using 25 gauge long needle as the narrow gauge needle will increase the chances of needle breakage and makes aspiration difficult, needle after 2-3 times use over the same patient should be discarded, barbed needle should be checked beforehand, slow rate of injectioni.e.1ml/min and rapid injection leads to immediate and long term pain, proper identification of landmarks. The point of needle insertion should be, about 6-10mm above the occlusal plane. Author

also discussed the reason for failure of IANB and management of complications occurring postinjection. Jalali et al., 2015 studied the effect of Acupuncture over the success of inferior alveolar nerve block (IANB) in 40 patients who were divided into acupuncture and control groups. A disposable needle (length 25 mm, diameter 0.25mm) was inserted 1-1.5mm deep at Hegu (L14)acupoint and after 15 minutes patient presented with a specific sensation around needle insertion (called De qisensation) then IANB was administered. In control group practitioner mimicked the application of acupuncture and needle was fixed with band aid. After 15 minutes IANB was given.Pain during treatment was assessed by VAS. Result showed 60% success rate in acupuncture group and 20% success rate in control group. Author's conclusion was that application of acupuncture significantly increases the efficacy of IANB for mandibular molars with symptomatic irreversible pulpitis.

Kriangcherdsak et al., 2016 conducted a study on success rates ofthe first inferior alveolar nerve block administered by dental practitioners. Volunteer dental practitioners at Mahidol University who had never performed an INAB carried out 106 INAB procedures. The practitioners were divided into 12 groups with their advisors by randomized control trials and recorded the success rate via pain visual analog scale (VAS) scores. They concluded that large percentage of the dental practitioners (85.26%) used the standard method to locate the anatomical landmarks, injecting the local anesthetic at the correct position, with the barrel of the syringe parallel to the occlusal plane ofthe mandibular teeth. Further, 68.42% ofthe dental practitioners injected the local anesthetic on the right side by using the left index finger for retraction. Theonset time was approximately 0-5 mins for nearly half of the dental practitioners (47.37% for subjective onset and 43.16% for objective onset), while the duration of the IANB was approximately 240-300 minutes (36.84%) after the initiation of numbness. Moreover, the VAS pain scores were 2.5 ± 1.85 and 2.1 ± 1.8 while injecting and delivering local anesthesia, respectively. The only recorded factor that affected the success ofthe local anesthetic was the administering practitioner. This reinforces the notion that local anesthesia administration is a technique-sensitive procedure. Sovatdy et al in 2018 conducted a clinical, single-blind, randomized, split-mouth, controlled trial including 25 patients (10 males and 15 females, mean age 21 years). The patients underwent surgical removal ofbilateral mandibular third molars with two different IANBI techniques. One side was injected using Quicksleeper® (Figure 8), and the other side was injected using a conventional IANBI. Both techniques used one cartridge (1.7 ml) of 1:100,000 epinephrine 4% articaine and supplementary injection was used if necessary. This study showed that CAIOI has faster onset and shorter duration of action than IANBI ($P < 0.05$). The pain was similar in both techniques. In the CAIOI group, one-third of the cases could be completed without additional anesthesia. The remaining two-thirds required minimal supplementary volume of anesthesia. The success rates were 68% for CAIOI and 72% for IANBI, respectively. They concluded that CAIOI is an advantageous anesthetic technique. It can be used as an alternative to conventional IANBI for mandibular third molar surgery. Gajendragadkar 2019 conducted a prospective clinical studyin pursuance of making inferior alveolar nerve block more comfortable via computer-controlled local anesthetic delivery. Sixty-four adult patients requiring bilateral IANB were selected and divided into two groups: group A (50 patients receiving IANB via CCLAD) and group B (50 patients receiving IANB using a conventional cartridge syringe). Pain perception and patient comfort were assessed using the visual analog scale and the 5-point semantic scale, respectively. The pain perception was compared between the two groups using the Mann-Whitney U-test, and the P value was 0.003. The patient comfort was also compared using the same test, and the P value was 0.484. They concluded that significant difference was observed in the pain perception ofthe patients during CCLAD. The patient comfort was grossly equal for both techniques.

Conclusion

Although many techniques for inferior alveolar nerve block have been described in the literature, most dentists still use the conventional block approach. Selecting the mostsuitable technique needs the dentist to be knowledgeable and fully aware of the various steps involved. Similarly, the advantages and disadvantages of each approach need to be recognized and taken into account, as indeed do the indications related to their implementation.

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