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Citation for final published version:

Olley, Ryan C. , Renton, Tara F. and Frost, Peter M. 2020. Intraligamentary local anaesthesia for posterior mandibular extractions. *Dental Update* 47 (3) , pp. 213-216. 10.12968/denu.2020.47.3.213

Publishers page: <http://dx.doi.org/10.12968/denu.2020.47.3.213>

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## Title

Intraligamentary-Local-Anaesthesia for posterior mandibular extractions

## Abstract

This article reviews research and author experience behind Intraligamentary (ILA) and Infiltration (IFA) Local Anaesthesia with Inferior Alveolar Nerve Block (IANB). In particular, the use of ILA with 4% Articaine is discussed as an effective anaesthetic technique to replace both IANB and IFA for the purpose of tooth extraction in the posterior mandible. ILA also avoids the possible complications associated with IANB. Other advantages and some shortfalls of the ILA technique are described in relation to Primary Dental Care. The technique for achieving ILA is described.

## Clinical significance

The ILA technique with articaine is a simple, swift and effective alternative to IANB and IFA for extraction of posterior teeth in the mandible in Primary Dental Care. ILA has fewer potential debilitating complications than IANB and is likely more effective than IFA.

## Objectives statement

The reader should appreciate the contribution of ILA, IFA and IANB in providing anaesthesia for tooth extractions and the use in particular of ILA.

## Introduction (1)

The Intraligamentary Local Anaesthetic (ILA) or 'Periodontal Anaesthetic' technique has been described as a misnomer, as it enters the cancellous bone through natural perforations and is, in effect, an intra-osseous, as opposed to Periodontal, Local Anaesthetic. In addition to the similar Infiltration Local Anaesthetic (IFA) or 'Supraperiosteal Injection' technique, the ILA is not commonly taught or used in dental schools for extraction of mandibular posterior

teeth. The 'go to' method for anaesthesia of posterior teeth in the mandible has often been the Inferior Alveolar Nerve Block (IANB). A recent paper in Dental Update briefly mentions ILA as a useful anaesthetic technique for tooth extraction, that might replace IANB<sup>1</sup>. In this review, we discuss in detail research behind ILA and compare this with IANB and IFA. We also discuss the anaesthetic and technique for ILA for the purpose of extraction of posterior teeth in the mandible, with relevance to Primary Dental Care.

#### Extractions in the posterior mandible following ILA and IANB (2)

The use of ILA was described in France in the early 20<sup>th</sup> century as a novel and effective method for achieving local anaesthesia in dentistry, but the technique did not become universally adopted due to inadequacy of instruments available at the time<sup>2</sup>. Nowadays, modern instruments reduce pressure, pain and reversible changes to the soft tissues on injection and the technique has limited side effects when practiced *lege artis* by an experienced operator<sup>2</sup>.

A meta-analysis of the literature from 1979-2012 compared ILA and IANB techniques for achieving anaesthesia in the mandible<sup>3</sup>. Outcome criteria used included failure rates of both techniques, pain during injection, additional second injections, cardiovascular disturbances (CVD), and differences in method. The latter included unwanted side effects, latency time, amount of anaesthetic agent and the duration of anaesthesia. There was large heterogeneity in methodology and reporting between studies and no clear advantage of one technique over the other. Indeed, studies involving pulpal testing of healthy teeth show that there are few differences in failure of anaesthesia between ILA and IANB techniques<sup>3</sup>.

However, more cardiovascular disturbances are reported in studies using IANB<sup>3</sup>. In one study, there were significantly more risk of tachycardia, nausea, dizziness, agitation and tremor and a general feeling of unwell (albeit transient) in patients, following IANB in contrast to ILA<sup>4</sup>. This was especially true for 45.9% of the patients with risk factors (most of whom had CVD)<sup>4</sup>. The meta-analysis therefore brought into question the use of IANB for routine

dental treatments and recommended more research<sup>3</sup>. In addition, although the risk is very low, due to its method of application and risk of nerve contact, inferior alveolar nerve damage is more common following IANB<sup>1</sup>. Furthermore, contact and damage of lingual and alveolar inferior nerves can result in loss of taste of the anterior two-thirds of the tongue. Impairment of buccal nerves could also result in loss of sensation to the ipsilateral side of the lower lip and soft tissue of cheek. However, it should be noted that no reports of permanent paraesthesia complications were found in the meta analysis<sup>3</sup>. The reported risk of nerve injuries from IANB remains very low and reportedly ranges between 1:160,571 and 1:4,156,848<sup>5</sup>.

There are limited studies investigating ILA for extraction of mandibular molar teeth and fewer comparing ILA with IANB. Furthermore, studies are heterogeneous in methodology and definitions of failure<sup>3</sup>. A recent prospective randomised study involved extraction of 301 mandibular posterior teeth in 266 patients using ILA or IANB with articaine<sup>6</sup>. The study recommended ILA over IANB due to lower pain of injection, shorter latency time (i.e. quicker onset of anaesthesia), shorter duration of local numbness and requiring lesser amounts of anaesthetic solution<sup>6</sup>. There was, however, similar anaesthetic quality during extractions between both ILA and IANB techniques<sup>6</sup>. In contrast, another study reports ILA (with prilocaine) to be more painful than IANB (with prilocaine) and results in more pain during extraction of teeth, albeit with no difference in patient preference between ILA and IANB techniques<sup>7</sup>. This is in contrast to the aforementioned study<sup>6</sup> where the reported lower pain of injection (following ILA in contrast to IANB) is likely related to the pressure of application, which was limited to 120N<sup>6</sup>. In this regard, ILA pressure syringe systems can result in less painful anaesthesia than IANB. Conversely, other work in private dental practice using 2% lidocaine (1:100,000 adrenaline) demonstrates that IANB is even more painful than ILA and IFA (even following topical anaesthetic application) and despite more pressure recorded in application using ILA<sup>8</sup>. Overall, outcomes to several studies on ILA and IANB are varied, but show limited differences in patient preference between IANB

and ILA. The effectiveness of ILA therefore appears promising. In addition, work investigating the effectiveness of pulpal anaesthesia following IANB have shown the need for supplemental ILA in order to prolong anaesthesia<sup>9</sup>. Considering the efficacy of ILA and possible risks of IANB, ILA would appear a safer and effective technique over IANB.

There are limited clear accounts of the deleterious effects of ILA in adults. The risk of bacteraemia has been reported in children following ILA (up to 97%) leading to a suggestion to avoid in infective endocarditis patients<sup>10</sup>. However, in adults, there is a lack of research. Review papers recommend ILA may be avoided if significant inflammation is present at injection sites in order to reduce the risk of bacteraemia<sup>11</sup>. Other work conducted in monkeys also suggests a risk of tooth elongation and damage to periodontal ligament following ILA, although the histological effects are reversed within a week<sup>12</sup>. This is perhaps an advantage rather than contraindication for exodontia.

#### IFA and IANB for posterior mandibular dental extractions (2)

To the author's knowledge, studies comparing IFA and ILA for the purposes of extraction of posterior mandibular teeth are missing. However, work has investigated buccal and lingual IFA using 4% articaine (1:100,000 adrenaline) in adult patients undergoing mandibular first and second molar extraction versus IANB using 2% lignocaine (1:80,000 adrenaline). It showed that there are insignificant differences in pain perception during extractions between IFA and IANB techniques<sup>13</sup>. However, another recent prospective randomised study in private dental practice in Germany showed that IFA using 4% articaine and a pressure syringe system was not suitable for anaesthesia in the posterior mandible for tooth extractions, as anaesthesia was achieved in only 35% of cases, in contrast to anaesthesia in all cases using IANB and 4% articaine<sup>14</sup>. Another randomised study of 133 patients requiring extractions of posterior mandibular teeth following buccal IFA, showed that 4% articaine provided more effective anaesthesia and less pain than 2% lidocaine, but due

to limited success rates, the article recommended that IFA could not be recommended over IANB<sup>15</sup>.

Another recent study in Dental Update, involving 112 patients in hospital in south London, showed that sufficient anaesthesia was achieved for mandibular molar tooth extraction in only 57% of patients using 4% articaine with buccal and lingual IFA<sup>16</sup>. The remaining patients required top up anaesthesia using IANB or additional IFA<sup>16</sup>. Similarly, studies demonstrate only 56% effectiveness of pulpal anaesthesia in mandibular first molars following IANB with 2% lidocaine (1:80,000 adrenaline), which can be increased to 92% by supplementation using buccal IFA with 2% lidocaine (1:80,000 adrenaline)<sup>17</sup>.

Based on the aforementioned studies, IFA appears a possible, albeit sub optimally effective, method of achieving anaesthesia for posterior mandibular tooth extractions. Like IANB, IFA often requires further IANB or additional IFA injections. This may relate to the position of delivery of anaesthetic using IFA. Anaesthetic delivery with IFA is not directly to the nerve through a block, or directly to the tooth periodontal ligament through an ILA injection.

#### Articaine (2)

Articaine is a commonly used local anaesthetic for extraction of teeth using IFA and ILA. For the purpose of achieving pulpal anaesthesia of mandibular first molars using the IFA anaesthetic technique, prospective randomised double blind trials demonstrate the success of 1.8mL of 4% articaine in almost two thirds of cases, whilst 1.8mL of 2% lidocaine (each with 1:100,000 adrenaline) in only around a third of cases<sup>18</sup>. Conversely, another randomised study investigating anaesthesia for achieving pulpectomy showed little difference between 2% lidocaine and 4% articaine each given by ILA, but this study was conducted in children<sup>19</sup>. However, in the author's experience, articaine has been used alone for many years by ILA to provide successful anaesthesia for extraction of posterior mandibular teeth in adult patients.

In regard to articaine concentration, retrospective studies suggest neurotoxicity at 4% (when used as an IANB) compared with other anaesthetics at lower concentrations<sup>20</sup>. Nonetheless, this has been suggested as operator and technique dependant and influenced by reporter bias<sup>20</sup>. Articaine has relatively low toxicity compared with other anaesthetics at similar concentrations<sup>20</sup>.

In addition, little difference has been demonstrated in terms of the efficiency of either 1:200,000 or 1:100,000 adrenaline for achieving pulpal anaesthesia<sup>21</sup>. However, in a prospective study of 2731 patients in dental practices, more sympathomimetic side effects were reported in articaine with 1:100,000 than 1:200,000 adrenaline<sup>4</sup>.

#### Technique for ILA with 4% articaine for posterior mandibular tooth extractions (2)

Based on the above-mentioned work and author experience, IFA and IANB often rely on supplementation injections for the purposes of posterior tooth extractions in the mandible. In addition, there are significant, albeit low, risks using IANB as stated. The authors recently successfully extracted almost 300 consecutive mandibular posterior teeth in Primary Dental Care over 16 years using 4% articaine and ILA alone. ILA offers a method of direct anaesthesia to the tooth to be extracted and may be adopted as the primary method for achieving anaesthesia for non-surgical posterior mandibular tooth extraction procedures.

Based on the author's experience from Primary Dental Care, up to 1.8mL (approximately 80% of a 2.2mL cartridge) of 4% Articaine Hydrochloride (with 1:200,000 adrenaline) (Septanest, 1:200,000, Septodont<sup>®</sup>) may be given gently into the periodontal ligament of the tooth to be extracted. An intraligamentary syringe with pen grip (Septodont<sup>®</sup>) using a short 30-gauge needle (Septodont<sup>®</sup>) can be used, or alternatively a conventional anesthetic syringe. If the latter, it is important to use gentle pressure using a skillful technique to avoid forcible injection<sup>2</sup> as mentioned previously. The needle bevel must face toward the tooth root. The 1.8mL is spread over two sites buccal and two sites lingual per tooth until blanching of the mucosa appears circumferentially. Figures 1 and 2 show the

position of needle into the periodontal ligament diagrammatically and radio-graphically respectively.

The onset of anaesthesia is achieved within minutes (usually up to 5 minutes). The duration of anaesthesia for purposes of extraction is around 30 minutes and in the authors experience, few additional top ups are required. This is likely because anaesthetic delivery occurs immediately adjacent to the tooth to be extracted.

ILA offers advantages in that small doses are required for extractions, up to 1.8mL. The authors also find ILA a useful technique for patients with a severe gag response or who suffer trismus. However, ILA may not be suitable for procedures of longer duration. These would require repeat ILA anaesthesia involving multiple tissue injections. Another albeit small disadvantage of ILA is that anaesthetic solution may more readily leak into the oral cavity with an unpleasant taste. High volume suction is recommended.

Other suggested problems specific to the use of articaine ILA relate to the risk of osteonecrosis and periodontal damage or paraesthesia. Although periodontal damage is demonstrated in monkey<sup>12</sup>, there is limited clinical evidence for these other complications. In addition, the break down in periodontal ligament by ILA is an advantage for extractions.

It has also been suggested that written consent be obtained before administering any anaesthetic<sup>20</sup> perhaps more so for IANB. It is important for risks to be explained. Nonetheless, it is also suggested that if clinicians took written consent for every anaesthetic administered, they would be overwhelmed by written consent for almost any procedure in dentistry<sup>5</sup>.

#### Conclusion (1)

IANB carries more 'potential' risk than IFA and ILA. ILA, like IFA, offers safer alternatives to IANB for patients with CVD risks, bleeding diatheses or patient's taking anti-coagulants<sup>3</sup>. Likewise, the risk of direct nerve damage and paraesthesia is mitigated.



For the purpose of extraction of posterior mandibular teeth in adults, the effectiveness of IANB shows mixed or similar results to ILA and sometimes with need for supplemental ILA following IANB. Similarly, IFA studies also show mixed and often poor results in achieving adequate anaesthesia for posterior mandibular extractions and often require supplemental IFA or IANB anaesthetic.

Based on this review, ILA offers a relatively safe alternative to IANB and more efficient substitute to IFA, for extraction of posterior teeth in the mandible in dental practice. 4% articaine is an effective and relatively safe anaesthetic for use with the ILA technique.

#### Conflicts of interest (1)

There are no conflicts of interest.

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Figures (1)

Figure 1 Diagram showing buccal position of the needle into the periodontal ligament for ILA in a mandibular premolar tooth

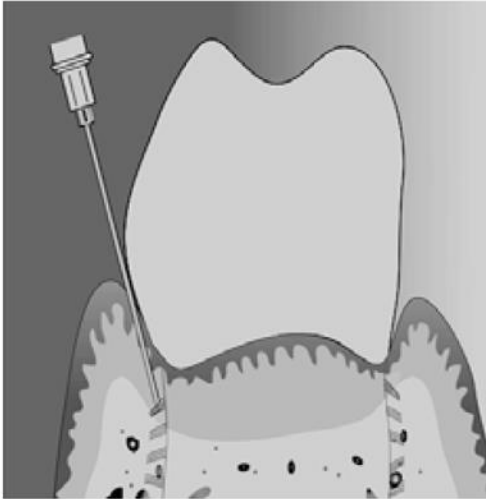


Figure 2 Radiograph (a) and photograph (b) showing the buccal-mesial position of the needle into the periodontal ligament, for ILA, in a mandibular molar tooth to be extracted

