Intraosseous Injection: A Review

Priyanka Sukla,

Intern, Institute of Dental Sciences, Siksha 'O' Anusandhan (Deemed to be University) Bhubaneswar 751003, Odisha, India.

Abstract

The purpose of this article is to detailedly study the intraosseous (IO) injection in dentistry. Successful treatment of patients relies on the effective manner of delivering local anaesthesia. The conventional aspirating syringe is the widely used method of administration of local anaesthesia. Problems with administration include delays between injection and effect, the long duration and post-operation numbness of patients. But newer methods have been developed that can aid in alleviating pain among which intraosseous injection is one. This article also focuses on uses, techniques, advantages, disadvantages, and site of administration of injection and duration.

Keywords*: Intraosseous anaesthesia; Techniques; Advantages and Disadvantages*

Introduction

Most of the dental treatments rely on effective management of pain. An inevitable side of dentistry is unsuccessful local anaesthesia. Several elements can contribute, which may be related to either the patient or the dentist. Factors related to the patient may be anatomical, pathological, or psychological. Whenever the conventional method of aspirating syringe fails, the advanced method of intraosseous injection can be applied.[1]

The intraosseous injection is a specialized method that enables the deposition of a local anaesthetic solution exactly into the cancellous bone close to the tooth which has to be anaesthetized. Due to the thickness of the cortical plate, the infiltration injections with lidocaine solution are not convincing for anaesthesia of the molar teeth of the mandible and hence clinicians do not endeavour infiltration in the posterior mandible. Overcoming this problem, the intraosseous injection allows direct access to the bone which is cancellous.[2] Hussein et al compared these two injection techniques, using 1.8mL of 2%lidocaine with 1:100,000 epinephrine, in the lateral incisor of the maxilla. The two techniques were indistinguishable except the intraosseous technique which had a shorter duration of anaesthesia as well as a quick onset. Many studies have been issued on intraosseous technique along with an effective rate of anaesthesia of pulp of 41-96% which has been based on the pathology, the tooth of concern, treatment, and method of assessment. Three devices are currently within easy reach. They are the Stabident system, X-tip system, and the Intraflow hydroxytryptophan anaesthesia. The intraosseous injection can be operated by utilizing the conventional or specialized instrument. When a vasoconstrictor-containing solution is used, intraosseous injection becomes more efficient.[3,4]

The specialized instrument comprises a suitable perforator and needle. The best intraarticular area is recognized by the help of a radiograph for anaesthetic injection. If it has not anaesthetized the gingiva then in the area of perforator a small volume (0.1ml) of anaesthetic solution is infiltrated. Within the attached gingiva the area to be perforated is present 2mm below the gingival margin of nearby teeth in a vertical plane intersecting interdental papilla. Well-fixed to a dental handpiece, the perforator is pushed on through the buccal cortex till a distinctive drop is experienced into the cancellous area of bone. The perforator is pulled out and the small 6mm 30 gauze needle is pushed out and the small spot in the bone and slowly about 0.2-0.5ml is injected.[5]

Reasons For Failure Of Anaesthesia

There can be different reasons for which local

anaesthesia may fail to work. Variations in the positions of nerves, as well as foramina, can lead to failure of anaesthesia in the conventional method. In dentistry, the important foramina do not have a constant location for regional block anaesthesia among patients. Furthermore, other causes for failing of anaesthesia can be the thickness of the bone, inflammation of the pulp, and pathological changes relayed to soft or hard tissues.[6]

Nerve Supply

There can be innervations from more than one nerve trunk which teeth may encounter. Failure of anaesthesia following infiltration injection and block techniques can be due to accessory nerve. Upper molar teeth are supplied by greater palatine nerves therefore an infiltration is not likely to attain transference buccally at upper first molar teeth. In the very same manner, maxillary anterior teeth are supplied by nasopalatine teeth. The long buccal nerve supply rarely supplies lower molar pulp and a long buccal block or mandibular infiltration may be needful for absolute anaesthesia in these cases. Pulpal supply of mandibular teeth may be contributed by the lingual nerve but it can be usually restrained by the lingual nerve block along with the inferior alveolar nerve block.[7]

Pathological Causes For Unsuccessful Anaesthesia

There can be numerous factors which may include anatomical alterations due to surgery or any trauma. Trismus can be another crucial factor which is the most common factor in dentistry. The solution is such a case can be buccal infiltration in the upper jaw with closed month. The palatal tissues inpatient with trismus can be anaesthetized by the use of intraosseous anaesthesia with help of advanced needle towards the palate via mesial and distal gingival papillae buccally.[8]

Bone As Barrier For Diffusion

The significant factor for the diffusion of anaesthesia is the thick cortical plate of the mandibular alveolar process that prevents infiltration in grown-up patients with the exclusion of the midline of the mandible.

Inflammation Of Pulp

A very commonly noticed fact is that tooth with inflamed pulp may be difficult to numb. The reason behind this is the low pH in an inflammatory area that influences the working of the local anaesthetic solution by reducing the concentration of unionized fraction that spreads via nerve sheaths. Likewise, inflammatory areas have an enhanced supply of blood as of vasodilatation which might rise anaesthetic 'washout'.Local anaesthesia in high anaesthetic is not practicable.[9]

Techniques

The intraosseous system which has been purposeful clinically are first, the Stabident system(Fairfax Dental Inc., Miami, FL) and secondly, the X-tip system (Dentsply, York, PA-the X-tip system newly has been procured by Dentsply International). Other systems have been advanced-the Intraflow (Pro-Dex Inc., CA) as well as the Comfort Control Syringe (Dentsply International).[10]

Stabident System

This system consists of a slow-speed handpiece driven perforator, a solid 27-gauze wire with a bevelled finish which when operated, through the cortical plate produces a small hole. The delivery of the anaesthetic solution to the bone, which is cancellous is via the 27-gauze ultra-short injector needle put into the hole produced by the perforator. Worthwhile benefits are given by the Stabident method. This permits a reduction in time amidst the anaesthetic injection and accomplishment of anaesthesia. Local anaesthesia requirement is reduced as one cartridge is generally needed.[11]

X-Tip System

A newly discovered system namely the X-tip was set in motion in the year 1999.Dr. Arthur(Kit) Weathers from Griffin innovated the technique of intraosseous injection with the X-tip. Dr Weathers invented a simple and beneficial approach to penetrate bone while simultaneously, giving dentists opportunity and proficiency to effortlessly re-enter the penetrated site after which the clinician can inject anaesthesia straight into the cancellous bone.

The system of X-tip is packed in a sterile packet. In the packet, there is a vial that has the X-tip material. The X-tip is made up of 9mm 27-gauze hollow perforator that is positioned inside a 7mm23-gauze cannula which is called a guide sleeve. So, the perforator overhangs 2mm

beyond the guide sleeve. This part has a 15mm extended universal latch-type fitting for a slow-speed handpiece. The perforator as well as a cannula, both are enveloped with a protective red cap. Also, an ultrashort needle of 27-gauze(8mm long) is present in this system.[12]

For use of X-tip, according to this technique, the first step is to take a radiograph of the interdental area which is to be perforated for the dentist to visualize and to verify sufficient interproximal bone is present between teeth thereby not rupturing the periodontal ligament. Various risk areas are also present which has to be taken care such as the mental foramen region, an impacted third molar area present horizontally, or a low-lying maxillary sinus area. Again due to the presence of mainly cortical bone in the anterior region i.e. in between the central incisors, IO anaesthesia will not be functioning properly. In such a case, clinicians have to give topical anaesthesia, and then after 0.3-0.4 ml of local anaesthesia has to be injected at the site selected to perforate in the buccal vestibule.[13]

The soft tissue site where perforation has to be done should lie in the attached gingiva,2mm coronally towards the mucogingival line between teeth. In the mandible, it is suggested to go distal to the tooth which has to be worked on for perforation because of the course of nerves present. At the same time, in the maxilla because of greater porosity in the bone it is of less importance. As there is a lack of attached gingiva in cases of periodontal diseases, this method of X-tip is unfit to be in use.

After fitting of perforator along with the guide sleeve to the slow-speed handpiece, one can start up the perforation process. It is achieved by a striking motion and this motion should be conducted no longer than 2s to prevent heating of the bone which may induce the necrosis of that region. During the perforation of the cortical bone, the operator can feel the piercing into the bone. The guide sleeve has to be gripped against gingiva with the help of a pair of cotton pliers while the perforator and slow speed are withdrawn. After this, an ultrashort needle (27-gauze) can be instituted via the guide sleeve. One-third of the cartridge should be put into the region. Slowly but surely the injection has to be given for 30 seconds. In the motive to attain hard tissue anaesthesia of duration for nearly 20 minutes, local anaesthesia with vasoconstrictor has to be used(suggested vasoconstrictor recommendation of epinephrine 1:200,000). The dentist employs a cotton plier to the pull-out guide sleeve and after which anaesthesia will work instantly.[14]

IntraFlow Anaesthesia

This is a technique that primarily focuses on the proper placement of the injection. For Intraflow, choice of the site, preparation of the site, and proper perforation are much-required considerations. For its successful execution, the answer is proper placement so that the anaesthetic solution won't flow within medullary areas. Generally, it is advisable to insert the solution distally to the tooth needed to be anaesthetized. For the determination of the desired site in this, the operator is needed to take a pre-operative radiograph.

The required area of perforation is cancellous bone, which is present adjoining the middle-third of the root to alveolar crest and also apically. The site of choice can be outlined along a line that has to bisect the papillae interdentally, present coronal to the mucogingival junction of the desired tooth distally.[8]

Comfort Control Syringe

The Comfort Control syringe is an electronically operated system for the delivery of local anaesthesia. It has 5 contrasting injection rates that are pre-set in the system for its utility. Using a two-stage delivery rate, the injection begins at an extremely slow rate to counter the initial pain usually associated with an injection. A digital panel shows the rate, elapsed time, and amount of anaesthetic inserted. This approach can make injections easier for dental professionals and make them comfortable for the patients.[8-11]

Advantages Of Intraosseous Injection

The IO injection benefits and eases the work of dental professionals. The Stabident system lessens time in achieving the anaesthesia after injecting the solution. Hardly,3-3 ½ minutes are needed for accomplishing anaesthesia when the solution is injected for 30 seconds even when topical anaesthesia and infiltration of the membrane are given for 60 seconds. In simple terms, we can conclude it minimizes the interval between administration of solution and tooth preparation.[11]

In cases where the patient has to undergo restoration, the IO injection benefits the patient for bilateral work of restoration in the mandibular arch. Moreover, lips and tongue remain unanaesthetized making the technique appreciable. The Stabident method uses local anaesthetic lesser when compared to traditional methods of delivery. The method is admired due to its painless technique of injection. Fastness is an important advantage of the procedure done.

Another advantage is without general injection in all the sites, anterior maxillary anaesthesia is feasible. In such cases, palatally no anaesthesia is required. To attain easy anaesthesia, the X-tip is an effortless and fruitful technique. It can be a piece of vital equipment to keep in reserve in clinics, which can be utilized particularly in the instance where there is no effect of block or infiltration anaesthesia when the tooth is treated.[12]

The plus point of interflow anaesthesia is its use when one has to select a different site for perforation and there is the proximity of roots. The fine target areas are the retromolar pad areas and edentulous areas. In places where the bone is thick or dense like in the buccal shelf area near the molars of the mandible, the approach of the technique can be done lingually too.

The Interflow system enables the introduction inside the penetration site, the injection site as well as removal in one step. There is no requirement for relocating the site of perforation. It is efficient for areas that are hard to imagine as such in the case of the first molar and at times the second molar region. It can be helpful when attached gingiva has finite bands or there is horizontal less loss of bone in the area of penetration. While the use of IO injection there is the immediate onset of anaesthesia so there is no time required to wait for its onset which is needed in instances of conventional methods.[1,13]

Disadvantages Of Intraosseous Injection

There are some disadvantages to the IO method. The perforator which is metallic segregates from the shank which is made up of plastic. The chances of such kind of segregation of metal perforator from the plastic shank often arise when the perforation is intricated and probably because of the extreme heating of the metal leading to the softening of the plastic hub. The Stabident system can't be used in the apical region of alveolar mucosa as it is infeasible to discover the hole to distribute the solution evenly. Another drawback can be leakage of the solution via the guide sleeve within the mouth. It happens particularly when the needle is not placed properly in the guide sleeve up to the hub. Post-operative pain can be also one of the disadvantages. The Intraflow anaesthesia equipment needs a high-price establishment and maintenance cost. Moreover, sometimes the device may cause leakage of anaesthetic solution.[14,15]

Selection of The Site

The Stabident as well as the X-tip system allows the clinician to look out the site of selection for perforation in the attached gingiva. This permits the penetration to be done via the thick cortical bone and has to be halfway amidst the adjacent roots of teeth. As the guide sleeve stays in the same place, the X-tip method can be favourably placed in apically in alveolar mucosa. When the interproximal area is absent, X-tip can help obtain pulpal anaesthesia. When a site has to be anaesthetized for the best results, one has to go to the distal side of the tooth. But an exception to this, it can be one of the cases such as in mandibular and maxillary 2nd molar cases in which one has to go to the mesial side of the tooth.[15]

Conclusion

The dental professionals encounter a failure of local anaesthesia at times. The causes behind the failure of the anaesthesia explained here can aid to master the skills and control the situation while facing any tough or demanding case. The equipment used in the intraosseous systems forms the basis for a route towards the experimentation and research work in dentistry. The present-day technique of the IO system is proficient and the duration of its action is lesser when compared with the conventional methods. Patients with less fear and pain can receive better treatment as lips and tongue numbness doesn't occur. Patient satisfaction and preference are more for intraosseous injection.

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