

Translated from French

Restorative and aesthetic dentistry and intraosseous anesthesia: clinical applications (implementation of the Quicksleeper S4 ®)

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"The good dentist is the one that does not harm and the good patient is the one who does not move during dental treatment." To meet these concerns, anesthesia still occupies a central position in dentistry. Painless, efficient and simple to perform, intraosseous anesthesia seems to succeed in fulfilling both the patient's and practitioner's expectations, in difficult cases but also, and perhaps especially, in the daily practice of restorative dentistry.

Introduction

Long neglected in medicine, pain management is today a priority for many health providers. Furthermore, to meet the patients' expectations, any dental surgeon can now provide himself with the means to achieve a painless primary anesthesia without postoperative complications. Apart from "needle phobia", patients do fear anesthesia, essentially for two reasons: on the one hand, the fear of pain during anesthesia administration and on the other hand, soft tissue numbness for several hours after a treatment that often lasted about 10 minutes. With this in mind, for already ten years, dentistry has seen a rise in popularity of various alternative anesthetic techniques. Intraosseous anesthesia remains indisputably one of the most well-known and most interesting techniques in terms of effectiveness (1). Carried out with the appropriate armamentarium, this technique provides constant results whatever the nature of the treatment to achieve, and this, without postoperative complications. Its use can thus extend well beyond the only treatment of difficult cases (pulpitis, infectious zones, mandibular posterior sectors, etc.) and can become the usual and routine anesthesia method for the dental practice (2). Several commercial firms offer a specific armamentarium for this method (Stabident ®, X - Tip ® Dentsply, Cyberjet ®, Anesto ® WH). Each of these systems has its own technical features with its pros and cons. After a reminder of the fundamental principles of intraosseous anesthesia (IOA), this article aims to demonstrate particularly the benefits offered by using the Quicksleeper S4 ® (Dental Hi Tec) as a primary technique, in daily clinical cases of restorative and cosmetic dentistry.

Principles

Although described as early as 1907 (3, 4), intraosseous anesthesia, also known as intradiploïc, is a method still widely unknown and therefore not very widely used in dentistry. Many operative procedures describe the addition of a series of anesthetic techniques that are supplementing each other, that eventually lead to successful anesthesia. Ultimately, the majority of these protocols use PDL, intraseptal, or even intra pulpal

injections, certainly effective, but with drawbacks (needle torsion, anesthetic leakage, failure, risk of papillary necrosis, postoperative periodontitis, impossibility of using a 1: 100, 000 vasoconstrictor, contraindication in periodontal disease, pain, etc.) that cannot be neglected (5, 6).

The effectiveness of IOA is based on the injection of the anesthetic solution directly in the interdental trabecular bone. The diffusion of this solution then depends on surrounding physiological factors (physical factors such as bone density, chemical factors like pH). Anesthesia onset is immediate and its duration varies according to the quantity injected and the vasoconstrictor that was used. However, the action of the IOA is somewhat different depending on whether it concerns the mandible which has a centrifugal unidirectional vascularization or the maxillary which has a multi directional and centripetal vascularization (Fig. 1). As a general rule, half a cartridge will allow anesthesia for the two teeth adjacent to the injection point, while a full cartridge will numb up to 6 teeth, without soft tissue anesthesia. With the Quicksleeper S4, because of the deep and vertical penetration of the needle (of at least 10 mm into the cancellous bone), anesthetics are called 'osteocentral'. The diffusion of the anesthetic is even wider and closer to the apical area.

The first step thus consists in anesthetizing the attached gingiva; for this purpose, it is advisable to place the bevel of the needle perfectly flat on the gingival surface (Fig. 2.1 special DHT needle®, 30/100, 16 mm, Dental Hi Tec). The double-bevel design of the DHT® needle allows a painless penetration of the mucous membrane (Fig. 2.2). Then it is necessary to carefully control the depth of the needle penetration, in order to avoid any contact with the underlying periosteum (which is highly innervated). The pen-grip of the Quicksleeper S4 handpiece enables to obtain the necessary control without difficulty. The drop by drop injection is triggered by activating the wireless pedal and is electronically controlled (Fig. 3). The sensitivities felt during this step are equal to zero or very low (mainly due to the acidic pH of the anesthetic solution).

The second step is to perforate the cortical plate through the discontinuous rotation of the needle (to avoid heating of the cortical bone). The same needle is used for the first two steps. In toothed quadrants, for restorative dentistry (Fig. 4), the perforation points pass through the top of the papilla. The needle is inclined at a 30-45 ° angle compared to the long axis of the tooth and driven until bone contact. The needle rotation is then activated. It is worth noting that in pedodontics, due to low bone density, penetration of the needle can be performed by hand using alternate low amplitude rotational movements (with DHT needle 30/100-9 mm-Green). Because of the lack of innervation of the cortical plate, the patient does not feel any pain during this stage. However, the vibrations and noise generated by the needle rotation motor (located in the body of the handpiece) can prove to be impressive for a patient who has never received this type of anesthesia. So it would be appropriate to inform him of this detail in order to avoid any startle reflex.

The third step, after a visual and tactile perception of 'steps' of needle penetration during the crossing of cortical bone and trabeculae in the cancellous bone, consists in the slow and gradual (electronically controlled) injection of the anesthetic solution.

The amount injected and the concentration of the vasoconstrictor are determined on the basis of the working time anticipated, which can vary from 60 to 75 minutes. Individual variations can however be noticed. The relatively low duration of this type of injection can also constitute a limit to the use of this technique (complex surgical cases for example). However, restorative dentistry, generating painful acts (excavation of decayed tissue, cavity preparation) are usually limited to the first stages of the procedure, which ensures operating comfortably with the use of just one cartridge. The small dose of anesthetic solution needed to complete the treatment is also a major advantage in terms of reduction of the risks associated with the toxicity of the anesthetic formulations.

Furthermore, this technique allows the use of vasoconstrictors in all circumstances, which considerably reinforces the effects of the anesthetic molecule (synergistic action of epinephrine with articaine) and reduces the injected doses. When the 16 mm needle is inserted by least 75% of its length, the risks of tissue necrosis are nonexistent because of the wide distribution of the anesthetic solution in the spongy bone. Currently, the most effective choice is epinephrine, a molecule known for its action on the heart muscle; also, when performing intraosseous anesthesia with a vasoconstrictor and particularly if it is highly concentrated (1/80, 000 or 1/100, 000), the patient may experience a short and inconsequential tachycardia and tachypnea (7, 8). However, it seems desirable to warn the patient of this possible inconvenience, naturally very anxiety-generating.

Clinical applications in restorative and cosmetic dentistry

Posterior maxillary area (Fig. 5 and 6)

The posterior maxilla, in the premolar area particularly, is undoubtedly the ideal region for "learning the ropes of the trade" with osteocentral anesthesia. Access is easy; bone is usually of low density. The diffusion of the anesthetic solution reaches one to two teeth distally and two to three teeth mesially from the injection point (for 1 cartridge of articaine with 1: 100 000 epinephrine).

Posterior mandibular area (Fig. 7 and 8)

Mandibular anesthetics are reputedly the most difficult because bone density is higher than in the maxilla. Osteocentral anesthesia is particularly appropriate here, and the practitioner will appreciate the effectiveness of the technique whereas the patient will not, or hardly, experience any postoperative discomfort (especially discomfort arising from the inferior alveolar nerve block injections at the mandibular foramen). For many patients, this advantage goes far beyond just comfort, and it ensures them to be able to resume all everyday activities as soon as they leave the dental office, which is, according to many of them, far from being insignificant.

Incisor and canine areas (Fig. 9-11)

For the front maxillary and mandibular teeth osteocentral injections can be performed in any chosen proximal space. However, for a procedure involving the six anterior teeth, locating the injection point between the central incisors provides pulpal and periodontal anesthesia from canine to canine. It should be noted, however, that the effectiveness and duration of the anesthesia will gradually decline from the central incisor to the canine. Dental treatment should thus be primarily initiated on the canines and continued tooth by tooth to the incisors (Fig. 9).

Furthermore, conservative treatment of the anterior sector requires in addition a few specificities related to the anatomy of anterior teeth. In the case of particularly scalloped gingival contour, the use of ligatures and clamps is often necessary to properly adjust the rubber dam on the crowns of the teeth (Fig. 10 & 11). However, these devices, by squeezing the marginal gingiva, generate pain. Traditional supra periosteal techniques anesthetize the buccal periodontium only. In contrast, a single osteocentral injection between the central incisors will fully numb the periodontium, on both buccal and palatal aspects.

Discussion and conclusion

Painless and efficient, intraosseous anesthesia could thus become the undisputed solution to meet both the patient's expectations and those of the practitioner. A few points however deserve to be clarified:

-Mastering the specific techniques for each intraosseous injection and for each individual system (Quicksleeper S4[®] included) is correlated with a learning curve. From personal experience, several weeks of daily and intensive use were required to feel completely at ease. Among the different systems we personally tested (X-Tip[®], Quicksleeper S4[®], and Anesto[®]), Quicksleeper was more effective, more versatile, and more ergonomic. «Osteocentral» injections allow immediate, deep, extended anesthesia and without risk of necrosis.

- Intraosseous anesthetics may be used for all types of clinical situations, and their benefits extend well beyond the only difficult cases (pulpitis on mandibular molar, for example). Conversely, a very constant repetition of the specific technical gesture is without any doubt one of the keys to success. However, supra periosteal and nerve block injections cannot be rejected so far. For the second and third maxillary molars for example, we believe that supra periosteal anesthesia remains the simplest and the fastest technique, especially as the discomfort associated with soft tissue anesthesia is very low in these areas. Moreover, inserting the Quicksleeper S4[®] hand piece vertically is almost impossible there.

Similarly, if the practitioner wishes to obtain a long lasting anesthesia (beyond an hour, for complex surgical cases for example), the nerve block techniques are more effective even though they require additional injections. Extending the duration of intraosseous anesthesia is of course also possible. For that purpose, the use of a guide sleeve left in place in the bone for the duration of the procedure (X - Tip[®]) is a clear ergonomic advantage over the Quicksleeper S4[®]. With Quicksleeper S4[®], changing the needle (which is sometimes blocked) or the empty cartridge, although fairly simple in theory, is more tedious than with a traditional syringe. Moreover, it is not always easy to find the location of the first intraosseous perforation and it is sometimes necessary to practice a second hole.

-The Quicksleeper S4 requires a careful and regular maintenance (greasing of the rotary containers once a week). This investment of time adds to the initial investment (about 3,500 €) and consumables (DHT[®] specific needles are a little more expensive than conventional needles).

On the other hand, a special mention should be given to the positive impact generated by the osteocentral technique on patients. Children do not feel the 'shot' anymore, and the risk of post-operative lip biting disappears. Once the effect of surprise linked to the first experience is over, most of young or older adults would not want, from our experience, to return to classical techniques, essentially for postoperative comfort brought by intraosseous injections. Better, new patients come to the dental office, specifically requesting this type of anesthesia.

Quicksleeper S4[®] is therefore a particularly efficient tool for dentists; from many points of view, it is a tangible progress in daily practice. The abolition of pain sensation is a fundamental objective to reach in our practice; Quicksleeper S4[®] appears as an extremely effective way to achieve this goal.

Fig. 1: differential diffusion of anesthetic according to the location of the injection point: unidirectional, centrifugal in the mandible and multidirectional and centripetal in the maxillary (document Dental Hi-Tec). The procedure of the osteocentral anesthesia is always similar. To inject into the trabecular bone, the practitioner passes through two tissues: the mucosa and the cortical plate.

Fig. 2: the first stage of the injection is a gingival anesthesia: a tangential and slight penetration of the specific needle allows a preliminary anesthesia of the mucosa (2.1); compared with a conventional needle,

the specific design (with a double bevel) of the DHT needle allows a pain free penetration (2.2) (documentation Dental Hi-Tec)

Fig. 3: Detailed Quicksleeper S4[®] (documentation Dental Hi-Tec)

1. Wireless and battery-free pedal
2. Electronic control box
3. Ergonomics of the optimized handpiece
4. Visualization by a lights indicating the quantity injected
5. Autoclavable cartridge container
- 6 Automatic injection system avoiding the needle obstruction during the perforation of the cortical plate
7. Lip protectors
8. The flexible cable improves the handiness of the hand piece.

Fig. 4: in zones with teeth, the perforation points are always on a vertical line from the top of the papilla, 3-5 mm below the collar line; for the maxilla, and 2-3 mm above this line in the mandible. the needle is inclined at 30 to 45 ° and driven until the bone contact (4.1); the rotating needle is then pushed to allow the penetration of the cortical plate and the trabeculae of cancellous bone; the electronically controlled injection of the anesthetic solution can then begin; this technique is called 'osteocentral' because it is delivered closer to the apex and extends beyond just the two adjacent teeth (4-2) (Documentation Dental Hi-Tec)

Fig 5: composite and onlay. Pre-op radiogram (5.1). An onlay has to be made on tooth #15, and a direct composite filling will be done on tooth #14. The intraosseous anesthesia is performed between teeth #15 and 16. Note the distal positioning of the lip retractor, thus preventing any risk of lip injury when the needle is rotating (5.2a and 5.2b). The rubber dam is then placed (5.3). A cartridge with 1:100 000 epinephrine will provide effective anesthesia from teeth # 13 to 17 and for the palatal gingiva as well. This is an important point to keep in mind: it allows the placement of the rubber dam very far distally, with no gingival pain (where the clamp is placed), with no need for any supplemental injection on the palatal aspect. The 45 minutes anesthesia duration allows to complete the composite filling on tooth #14 and to prepare the onlay cavity on tooth #15 (5.4). The onlay is placed (5.5, 5.6, and 5.7): for this, a simple gingival anesthesia is necessary.

Fig 6: conservative care by quadrants, with minimal dose of anesthetic solution (osteocentral technique). Preparation for two inlays on teeth # 24 and 25, direct composite fillings on teeth # 23 and 22 (6.1a and 6.1b). Anesthesia was carried out with one cartridge with epinephrine 1:100 000 between teeth # 24 and 25. 45 to 60 minutes of working times is available for the practitioner to terminate the potential painful procedures, namely cavity preparation ((6.2). As usually, inserting the inlays required no anesthesia (6.3. Laboratoire Grégoire Martin, CH La tour de Peilz).

Fig 7: conservative care for mandibular molars : only one osteocentral injection was made in the interdental septum between teeth # 36 and 37 (7.1 and 7.2), with a cartridge with 1:100 000 epinephrine, providing an immediate and efficient anesthesia from teeth # 37 to 34, including the buccal and lingual gingiva. Thanks to this, the rubber dam (7.3) is placed with no pain (on the clamp location, and when the dam is eased interdentally with dental floss). 45 to 60 minutes of effective anesthesia allowed the easy preparation for teeth # 37 (composite) and 36 (onlay) (7.5). During the second clinic session, and although a composite base has been placed on tooth # 37 (for pulpal isolation) some patients demand a full comfort. In these situations, an osteocentral injection is carried out exactly like during the first appointment. Then, half a cartridge will be enough. It is frequently possible to find the hole created by the previous drilling, so that there is no need for needle rotation (7.5 and 7.6).

Fig 8: multiple and bilateral care: as there are none or minimal effects on soft tissues, we can treat simultaneously both posterior mandibular quadrants. Here teeth # 36, 34, 46 are vital, and have been prepared for bonded indirect restorations (overlays/onlays), while tooth # 44 was prepared for a ceramo metal crown. Two osteocentral anesthetics were carried out in the inter radicular space of teeth # 36 and 46, providing pulpal analgesia, and buccal and lingual gingival anesthesia as well. This allows a pain free preparation and impression. Note that, one hour after the treatment began, we can see, after removing the rubber dam, the persistent bleaching of the lingual gingiva, showing that anesthesia is still effective at that moment.

Fig 9: direct composite restorations on lower incisors. Just one injection between the central incisors anesthetizes the whole incisive and canine group, including the buccal and lingual gingiva (9.1a and 9.1b). Four composite restorations were placed, from teeth # 32 to 42 (9.2). It is advisable to begin the treatment on the lateral incisors, as anesthesia is the shortest as teeth are in a more distal position (9.3).

Fig 10: direct composite restorations on teeth # 11, 21, 22 (10.1). Only one osteocentral injection between the central incisors anesthetizes teeth as well as buccal and palatal gingiva (10.2). The scalloped gingival contour which is usual on the anterior teeth frequently implies using ligatures in order to give access to the teeth necks. The full gingival anesthesia provides then a comfort which is greatly appreciated by the patient.

Fig. 11: bonding of two ceramic laminates on teeth # 11 and 21. Here again the requirements related to bonding (cord retractors, rubber dam, clamps, floss) imposed an anesthesia of the buccal and palatal mucosa. With just one osteocentral injection between teeth # 11 and 21, we got one hour of comfort during the procedure. (Ceramist: Samuel Schwab, Dental, CH-Lausanne)

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Disclosure

The authors have no commercial interest with Dental Hi-Tec France. Dental Hi-Tec France provided them with a Quicksleeper S4[®] for a test for a limited period, during which the authors have personally bought all the consumables.