Transcortical anesthesia: Experimental Approach and Importance in Odontology

INTRODUCTION
Anesthesia is an essential part of our activity, but unfortunately, there are frequent failures: anatomical causes, inflammation, inappropriate technique, etc. There are multiple criteria for good anesthesia, it should work instantly, be effective, easy to use, and not hinder the patient’s activities.

Transcortical anesthesia aims to meet these criteria. An experimental study was conducted in order to visualize diffusion of a solution using macroscopic, radiological and histological procedures.

DESCRIPTION OF THE TECHNIQUE
Firstly, the gums need to be disinfected with chlorhexidine followed by pre-surgical radiography so that bone quality and space available can be verified. Gingival anesthesia is performed with the bevel flattened and parallel to the gingiva. The cortical bone is not innervated, so perforation is completely painless. The perforation is done at a 90° angle to the cortical bone, in a vertical line to the septum 2-3 mm from the base of the dental neck in the mandibula, and 3-10 mm from the base of the dental neck in the maxilla.

The perforation in the maxilla can be distal or mesial, and preferably distal in the mandibula. A distal incision reduces the amount of anesthetic to be injected. The injection is made at the top of the ridge for isolated teeth. The injection must be slow and controlled, 60 seconds per millilitre.

ADVANTAGES
- Immediate: No time needed for diffusion through periosteum.
- Suppression of soft tissue anesthesia: mental nerve anesthesia can occur but it is not as deep and does not last as long, 1 hour 15 minutes on average.
- Suppression of palatal and lingual anesthesias: it diffuses through Volkmann's intercommunicating channels.
- Less anesthetic needs to be used.
- Anesthetics are eliminated more rapidly: the bone marrow is richly vascularised, the absorption is faster, the patient no longer suffers hours of discomfort from the anesthesia.
- Duration of anesthesia: on average 30 to 60 minutes, depending on the quantity injected and the vasoconstrictor used.
- Possibility of anesthetizing an inflamed area.
- Use with children: reduction of quantities injected, absence of post-surgical pain and especially no soft tissue anesthesia, therefore no risk of biting oneself.
- Use of concentrated vasoconstrictors: the quantity of adrenaline in ¼ of a cartridge of lidocaine at 1/80,000 is almost half of the quantity of a cartridge of articaine at 1/200,000, which is the anesthetic generally used for infiltration anesthesia.
The amount of anesthetic is divided by 8.

**DISADVANTAGES**

- Thick cortical bone: in 4% of cases, perforation will be impossible.
- Difficulty in finding the perforation point. It is necessary to keep good support points.
- Increased cardiac rhythm: the increase varies; it requires a few minutes to return to normal.
- Post-op follow-up: subgingival haematoma can occur but they are minimal. It is possible to have pain upon palpation, especially with a thick cortical bone, as the volume of bone chips produced is more significant. There can also be gingival inflammation, and a sensation of hyperocclusion.
- Anatomical considerations: the mental foramen, maxillary sinus, abnormal bone growth, insufficient interradicular spacing, horizontal impacted wisdom tooth.
- Periodontal disease: the perforation will be made more apically, it will be necessary to search for a bone contact.
- Complications: they are rare and often due to faulty handling, they can include lingual perforations, needle breakage, etc.

**EXPERIMENTAL STUDY**

**Objective of the experiment**

An experimental study was conducted, consisting of a macroscopic, radiological and histological study. The purpose was to see the diffusion of a solution with regard to the quantity injected.

**Equipment and methods**

A Micropaque based solution was used, consisting of barium sulphate with added methylene blue. Injections were administered using the Quicksleeper system.

**Results**

**Macroscopic study (Figures 1, 2 and 3)**

Injection of 1/4 to 1/2 a carpule allowed diffusion to:
- the lingula mandibulae
- the median sagittal plane
- the lingual and vestibular bone canal
- the mental foramen

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Figure 1: Diffusion in the mental foramen

Figure 2: Diffusion in the lingula mandibulae, the median sagittal plane and the lingual bone canal. The blue colour of the cortical bone should be noted.

Figure 3: Diffusion in the vestibular bone canal
Radiographic study

The radiopacities obtained vary: radiopacity was highly visible on some X-rays because the solution seemed to be concentrated whereas it was less visible on others.

A more significant radiopacity was observed at the site of injection, on thicker cortical bones and in the dental canal area (Figure 4).

Histological study of calcified tissue

The total EDV scatter analysis revealed the presence of barium sulphate due to its spectral recognition (Figure 5). The presence of barium sulphate was confirmed by an MEB analysis, which showed the presence of barium sulphate in the inferior alveolar nerve (Figure 6).
The use of samples preserved in formalin implies the absence of blood circulation.

Furthermore, only hemi-mandibula were used, which did not permit visualization of the diffusion in the contralateral hemi-mandibular.

The injections were limited to ¼ or ½ of a carpule. If the doses had been increased, it would have no effect on the diffusion as the solution escaped via extremities and exit points. This is confirmed in clinical practice, as generally ¼ - ½ of a carpule is sufficient for anesthesia of 1 to 4 teeth. 1 carpule is needed for anesthesia of 8 teeth.

The blue colouring of the cortical bone clearly shows the principle of diffusion through the intercommunicating channels of the spongy bone.

Diffusion in the lingual bone canal shows that lingual and palatal anesthesias are not necessary, thanks to this principle of diffusion. A more localized and difficult diffusion can be observed on thicker cortical bones which explains the pain experienced on injection. The histological study confirmed the presence of barium sulphate in and around the alveolar nerve which would explain mental nerve anesthesia in some cases.

DISCUSSION

The solution used was more viscous than an anesthetic solution, therefore, its diffusion was slower in space and time.

Analysis under optical microscope confirmed these results: Barium sulphate in and around the inferior alveolar nerve (Figure 7). It is also found on the alveolar dental ligament, around the dental root (Figure 8).

CONCLUSION

Transcortical anesthesia is a technique that allows use of vasoconstrictors without any risk of necrosis.

It enables effective and instantaneous anesthesia. The experimental studies clearly demonstrate the low quantities of anesthetic to be used. The histological study confirms the diffusion of anesthetics in the inferior alveolar nerve. Other studies need to be conducted in order to discover the influencing factors that determine the presence or absence of mental nerve anesthesia, which would enable its suppression or maintenance if required.