ARTIGO

COMPARISON OF LATENCY AND DURATION OF INFERIOR ALVEOLAR NERVE BLOCK DELIVERED BY CARPULE SYRINGE OR MORPHEUS® DEVICE

COMPARAÇÃO DE LATÊNCIA E DURAÇÃO DO BLOQUEIO DO NERVO ALVEOLAR INFERIOR APLICADO POR SERINGA CARPULE OU DISpositivo MORPHEUS®

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ABSTRACT: The present study aimed to compare latency and duration of inferior alveolar nerve block delivered by the carpule syringe or the Morpheus® computerized system. This study was a split-mouth, double-blind, randomized clinical trial with 31 volunteers. The inferior alveolar nerve block was performed with carpule syringe and Morpheus® device. The teeth had latency times and duration of anesthesia measured using the pulp electric tester. All data were tabulated and sent for statistical analysis with a level of significance set at 5%. The latency time were the same for most cases. The duration of the anesthetic effect was higher for the carpule technique. The success rate for the carpule technique was 80.65%. For the technique with Morpheus®, the percentage of success was 83.87%. There were no significant differences in pain after injection. Most of the volunteers preferred the anesthetic technique with Morpheus® (64.52%), while 35.48% preferred the carpule syringe. The techniques with carpule and Morpheus® presented same time of latency and anesthetic duration, as well as similar success rate. Pain experienced during the execution of the two techniques was the same. As for the preference for the injection devices, the majority opted for Morpheus® system.

KEYWORDS: Pain, Local Anesthesia, Inferior Alveolar Nerve, Nerve Block.

RESUMO: O presente estudo teve como objetivo comparar a latência e a duração do bloqueio do nervo alveolar inferior realizado pela seringa carpule ou pelo sistema computadorizado Morpheus®. Este estudo foi um ensaio clínico randomizado, duplo-cego, de boca dividida, com 31 voluntários. O bloqueio do nervo alveolar inferior foi realizado com seringa carpule e dispositivo Morpheus®. Os dentes tiveram tempos de latência e duração da anestesia medidos através do testador elétrico pulpar. Todos os dados foram
tabulados e enviados para análise estatística com nível de significância de 5%. O tempo de latência foi o mesmo para a maioria dos casos. A duração do efeito anestésico foi maior para a técnica carpule. A taxa de sucesso da técnica carpule foi de 80,65%. Para a técnica com Morpheus® o percentual de sucesso foi de 83,87%. Não houve diferenças significativas na dor após a injeção. A maioria dos voluntários preferiu a técnica anestésica com Morpheus® (64,52%), enquanto 35,48% preferiram a seringa carpule. As técnicas com carpule e Morpheus® apresentaram mesmo tempo de latência e duração anestésica, bem como taxa de sucesso semelhante. A dor sentida durante a execução das duas técnicas foi a mesma. Quanto à preferência pelos dispositivos de injeção, a maioria optou pelo sistema Morpheus®.

PALAVRAS-CHAVE: Dor, Anestesia Local, Nervo Alveolar Inferior, Bloqueio Nervoso.

1. Introduction

The fear of pain is considered one of the main motives due to which patients avoid to be submitted to dental procedures [1-7]. Since their introduction, anesthetics are pointed out as causative of pain sensation and anxiety [8]. Therefore, the success of their application plays a crucial role in the patients’ behavior [9]. During the utilization of local anesthetics, the fast increase of hydraulic pressure exerted by the anesthetic substance on the tissues, which compresses the peripheral nerves present over there, is considered one of the main factors that are causative of discomfort to patient [10]. Besides, the pain perception could be related also to tissue puncture, the applied anesthetic flow rate, injection localization, drug temperature, tactile control of needle penetration, and the experience level of the applier professional [11,12]. Although the intention is to look for the regulation of pressure and volume
by means of slow release of the anesthetic agent, the manual calibration is not perfect. According to Asarch, et al. [8], it is difficult the obtainment of adequate pressure and volume of injections, as the quantity of resistance and the need of pressure are variable, depending on every individual.

Because of that, the creation of electronically controlled anesthetic injection systems has become necessary. Through them, the drug release on the tissues is controlled and, consequently, the pain provoked can be decreased. In Brazil, such technology started to be commercialized in 2005, with the apparatus Morpheus®. Through it, the slow administration of the anesthetic agent (by drip) could provide painless needle introduction and lower volume satisfactory anesthesia in already consolidated techniques as, for instance, the blockage of inferior alveolar nerve (BIAN) [10].

In this context, the influence of solutions properties and characteristics on the efficacy of anesthetic techniques, as well as that of factors involved during the application of local anesthesia (as, for instance, the injection speed) have been studied by some authors [13-15]. According to Kanaa, et al. [13], the slow injection during the inferior alveolar nerve blockage produces significantly more episodes of “pulp response absence” than the quick injection, which emphasizes the clinical relevance in the results obtained through this technique. This way, the knowledge about the properties of anesthetic substances as, for instance, their time for action onset (latency) or diffusion duration and depth help to assure a more effective and minimally traumatic treatment [15]. In Dentistry, lidocaine is the anesthetic solution considered as “standard”, to which all other remaining substances are compared. Among its characteristics, stand out the pulp anesthesia of up to 60 minutes; soft tissues anesthesia of 3 to 5 hours and action onset (latency) of 2 to 3 minutes [16].

There are few reports in the literature respecting computerized
systems of injection, in particular from the Morpheus® apparatus. However, there are already recent evidences about their efficacy on the pain perception level [17,18]. This way, the possibility to obtain a better utilization from anesthetic solutions through an electronically controlled injection system could promote not only higher efficacy in the performance of dental procedures, but also higher treatment adherence by the patients, as it could allow lower pain sensibility during the anesthesia application.

The present study aimed to compare latency and duration of inferior alveolar nerve block delivered by the carpule syringe or the Morpheus® computerized system.

**2. Materials and Methods**

2.1 Ethical Support and the Investigation Characterization

The investigation has been submitted to the appreciation and approval by the Investigation Review Board for studies involving human beings of the Federal University of Sergipe - CAAE: 79846817.9.0000.5546 and has been approved by the Brazilian Register of Clinical Trials (BReCT) through the registration code RBR-4zzc3p.

The population was composed by patients that looked for dental attendance at the Dentistry Department of the Federal University of Sergipe, for dental restorations at elements 37 and 47, of average depth (between 3 - 4 mm of dental pulp) of type class I. Considering an expected difference between the averages of anesthetic duration to the order of 20%, with standard deviation of approximately 30%, the sample calculation has revealed a necessity of 31 volunteers to a test power of 95% with significance level of 5% (t-BioEstat Test 5.0). Patients with hypersensitivity to drugs utilized in the study, those with some systemic alteration preventing their
participation in the study, those with dental procedures fear, pregnant and/or nursing patients, those with history of drugs dependence or abusive consumption of alcohol have been excluded. The volunteers were approached individually to participate in the investigation. After explained the study importance and how the attendances would be done, those accepting to participate in the investigation signed the respective informed consent form (ICF), according to Resolution nº 466/12 of CONEP/MS.

This work was a double-blind and randomized clinical trial of split-mouth type. The split-mouth standard has resulted in two groups (Technique A and Technique B) and has attributed the anesthetic techniques and laterality in the mandible in a way that all volunteers could receive both techniques. The information about randomization was deposited in an opaque and sealed envelope; and such information was known only by investigator 1 (operator). The “Technique A” corresponded to conventional anesthesia, executed by means of carpule syringe (control group); the “Technique B”, to anesthesia executed by means of Morpheus® apparatus (experimental group).

2.2 Anesthetic Techniques

For the execution of anesthesia, the following has been utilized: topic anesthetic benzocaine 20% (Benzotop® DFL Ind. Com. S.A., Rio de Janeiro, RJ), lidocaine 2% with epinephrine 1:100.000 (Alphacaine® with epinephrine 1:100.000 - DFL Ind. Com. S.A., Rio de Janeiro, RJ) and a 27G long needle (Unoject® DFL Ind. Com. S.A., Rio de Janeiro, RJ). For injection of the anesthetic solution, carpule syringe with aspiration (Quinelato, Rio Claro, SP) and the injector with controlled velocity Morpheus® (Meibach, Registered at Ministry of Health under nº 80164510001) have both been
The application of topical anesthetic was done in the retromolar region, in the medial area of the pterygomandibular raphe (benzocaine gel 20% for 2 min), with the purpose of minimize the pain provoked by the needle puncture. Then, 1.2 ml of lidocaine solution 2% were injected with epinephrine 1:100.000 for execution of the inferior alveolar nerve blockage, following the protocol defined by Malamed [16]. After the mucous perforation, small volumes of anesthetic have been injected, according to the speed proposed for every device (carpule syringe - 1 ml/min; Morpheus® System – 0.9 ml/min through drip). The technique was executed by a single operator (investigator 1), duly calibrated and trained for the utilization of both, carpule syringe and the Morpheus® electronic system.

2.3 Analysis by the Pulp-Tester

The second inferior molars were submitted to electric stimulation by the Digital Microcontrolled Pulp Tester (Pulp Tester Digital Microcontrolado®, MIDIART Informática Ltda.). Previously to administration of anesthetic solution, the basal threshold of electric stimulation was determined for every volunteer. For execution of the experiment, the electrode was placed in the middle third of the vestibular face of units 37 and 47, in order to avoid alterations in the responses inferred by the thickness of dental enamel, which exerts resistance to the passage of electrical current. Then, the volunteer was responsible for the assurance of the apparatus metallic structure to close the circuit. The apparatus starts in minimal voltage (grade 0), being then gradually increased up to the volunteer denoting sensibility, defining so the basal threshold.
For the anesthetic evaluation, the following parameters have been utilized:

- Time of latency – period after the injection and starting of anesthetic action, which was measured in intervals of 2 minutes. The absence of sensitivity to electrical stimulation has confirmed the time of latency and it was noted in a clinical record. In case the patient was still sensitive after 10 minutes, anesthetic failure was considered.

- Duration of anesthetic effect - period between the starting of anesthetic action up to return to basal stimulation threshold. After the obtainment of anesthetic effect, the molar teeth were evaluated every 10 minutes up to basal stimulation threshold was achieved.

2.4 Study Clinical Protocol

This study has been developed in two sessions, with minimal interval of two weeks between them. In every session, an injection device has been utilized, according to previous randomization of the devices and dental elements application order in every volunteer. After defined the basal threshold, the volunteer was submitted to the inferior alveolar nerve blockage, executed by investigator 1. The evaluation of anesthetic parameter was executed by investigator 2, blind to utilized device. The volunteer has used a blindfold similar to a “mask to sleep”, in order to avoid the recognition of utilized injection system, and has also utilized a noises muffler, in order to avoid any interference on the blinding quality, as the Morpheus® system emits a sound that characterizes itself.

For the evaluation of latency times and anesthesia duration, a chronometer and a pulp-tester device have been utilized. After the application of every anesthetic device, the volunteer received an Analogic Visual Scale, with the purpose to classify the pain sensation.
experimented during the procedure. The measures have been further checked by means of a digital pachymeter.

For the execution of the temporary restorer treatment, the glass ionomer cement (Maxxion R® FGM, Joinville-SC, Brasil) was the utilized material. The restorer procedure has not exceeded the time of 10 minutes, because every 10 minutes new electrical tests were executed up to return to basal threshold value of electrical stimulation. This way, the time of duration of pulp anesthesia has been checked. Finished the experiment, the volunteer was forwarded to the Restorative Dentistry clinic to give continuity to definitive treatment.

2.5 Statistical Treatment

The numerical variables were analyzed by Shapiro-Wilk tests to verify the normality. For distribution of genders and age, percentual analysis and t-test have been applied. For the evaluation of anesthetic success and failure the chi-square test has been applied. The anesthesia duration and the pain measure by means of VAS were compared by the Mann-Whitney test. The significance level of all tests was considered 5%, and they were executed utilizing the statistical packs BioEstat 5.0 (Instituto Mamirauá, Belém, PA, Brasil) and GraphPad Prism 7.0 (software GraphPad, La Jolla, CA, EUA).

3. Results

Thirty-one (31) volunteers have been observed, being 16 (51.6%) of male sex and 15 (48.4%) of female. The average age (standard deviation) was of 25.9 (±4.7) years. There were no statistically significant differences (t-test for independent variables, p=.159) between the ages of men and
women. No volunteer has presented adverse effects to use of local anesthesia. The latency time for both techniques was, in the majority, 2 minutes; except in one case for both, of 4 minutes. The data about the duration of anesthetic effect could be observed at Figure 1. The percentage of success for the technique with the carpule was 80.65%, and the failure percentage was 19.35%. For the technique with the Morpheus®, the success percentage was 83.87% and the failure percentage was 16.13%. There was no significant statistical difference ($x^2$, $p=0.739$) between the techniques. The post-anesthesia pain evaluation is presented at Figure 2.

Respecting to the preference for the utilized anesthetic technique, 64.52% of subjects stated to prefer the anesthetic technique using Morpheus®. While 35.48% of the sample preferred the conventional anesthetic technique.

4. Discussion

The application of local anesthesia is an important prerequisite to promote a pain decrease during dental treatment [19]. Extensively utilized in procedures considered uncomfortable, painful, or even in cases in which the patient does not tolerate the pain, the success of local anesthesia would have as advantage to decrease the patient anxiety, becoming him/her more comfortable and receptive to proposed treatment [12,20,21]. However, in practical terms, it not always happens, as psychological factors play an essential role for the pain perception and patient’s behavior [12,22]. Among the existing techniques, the inferior alveolar nerve blockage is the one more commonly utilized, as it allows higher depth and anesthesia diffusion. However, it is a technique that still presents considerable percentual of failure and report of discomfort [16,23,24]. So, to try to promote a minimally traumatic anesthesia by
means of controlled release of local anesthetics, the electronic systems of injection have been developed [10].

In this study, the time of latency and the duration of blockage of the inferior alveolar nerve have been evaluated through 2 devices, as the knowledge about anesthetic properties could help to promote higher pain control during trans and post-surgery [15]. The time of latency was 2 minutes as for the carpule syringe as for the Morpheus® apparatus. Despite the prevention by the electronic system, of a slow injection of the anesthetic solution and, considering it, the expectation of a quicker starting action, in this study, the time measure has been developed in intervals of 2 minutes. So, it was not possible to perceive differences between both devices. In the same way, the duration of the anesthetic effect did not present significant differences, as a result also of the interval between the measures, which were executed in intervals of 10 minutes. Notwithstanding, it is important to emphasize that the establishment of intervals for the referred measures has become necessary to, face constant stimulations, avoid damages to dental pulp [25,26].

In the same way as in our study, Tortamano, et al. [27] have compared the times of latency and duration of pulp anesthesia utilizing lidocaine 2% with epinephrine 1:100.000. In that work, the average times of latency and duration were 8.7 and 61.8 minutes, respectively. The difference found for the latency time could be justified by the volume of utilized doses (1.8 ml in the work of Tortamano, et al. [27], as well as by the measure interval advocated (1 minute). Peñarrocha-Oltra, et al. [28] have also compared a conventional technique to an alternative one (intraosseous technique); however, lidocaine 2% was utilized only for the first technique. The duration of anesthetic effect was between 1 - 3 hours, while the average latency time was 8.52 minutes; a result that is similar to that found by Tortamano, et al. [27]. Lasemi, et al. [29] have compared
articaine 4% in different concentrations of epinephrine (1:100,000 e 1:200,000). Despite the utilization of a different anesthetic salt, the time of latency was similar to that found in our study; however, the duration of anesthetic effect was 4 hours for both epinephrine concentrations. Differently, Kriangcherdsak, et al. [20] have presented time of latency between 0 - 5 minutes and duration of anesthetic effect between 240 - 300 minutes. In that study, the main objective was to evaluate the rate of success of BIAN; for this reason, the evaluation of anesthesia parameters was not detailed in the methodology. In 2017, Kämmerer, et al. [30] presented average times of latency of 10.55 and 10.9 minutes for articaine 2% and 4%, respectively. Despite to present methodological similarities to our study, the local anesthetic utilized was articaine and the interval for evaluation of the time of latency was of 1 minute, which could justify the differences found respecting to our study.

Besides the times of latency and duration, the rate of success and failure of the technique for every device have also been evaluated. The success observed for the technique with the carpule was 80.65% and the failure was 19.35%. For the technique with the Morpheus® device, the success percentage was 83.87% and the failure percentage was 16.13%. There was no statistically significant difference ($\chi^2$, p=0.739) between both techniques. The results found in this study are similar to those in the studies of Melo, et al. [31], Kriangcherdsak, et al. [20], Peñarrocha-Oltra, et al. [28] in which the rate of failure for the technique with the carpule was approximately between 15 to 20%, as anticipated in the literature [16].

Respecting to pain perception by means of VAS, the results have shown that this parameter presented lower values with the Morpheus® apparatus, despite the non-occurrence of significant differences between the devices. This result agrees with the study of Araújo, et al. [17], in which the same computerized system and carpule syringe were utilized in the blockage of
the inferior alveolar nerve. In the same way, Kämmerer, et al. [30] have not observed significant differences in the pain to injection between articaine 2% and 4% in the BIAN. Despite the advantages also observed in the electronic systems, once executed in a slow and controlled manner, the injection with carpule is able to produce an anesthesia with pain perception similar to that of computerized devices, which justifies the results found in the literature and this study [13,17].

At the end of the investigation, the volunteers were questioned about the preference for the devices. A proportion of 64.52% of them stated to prefer the anesthetic technique with the use of Morpheus®, while 35.48% of the sample preferred the technique with carpule syringe. In the study of Aragão, et al. [18], 76.7% opted for Morpheus®. In Melo, et al. [31], 83.3% of volunteers preferred the technique executed by the same system. On the other hand, in Araújo, et al. [17] there was no difference respecting to satisfaction of volunteers between the devices. As observed in the studies with lower pain with the use of Morpheus®, it was expectable a higher preference for this device. However, as the time with the execution of the technique with the electronic system is higher, there was considerable predilection for the technique with carpule in our study [17].

The study limitations are related to the necessity of a method, in which it is possible to evaluate the times of latency of anesthetic duration in a continuous way; however, without the occurrence of damages to dental pulp. The utilization of an interval of measures has difficulted the definition of these parameters and the comparison between the injection systems. Then, it is suggested the execution of new studies that could utilize new parameters of evaluation, as well as new work methodologies.
5. Conclusion

The techniques with carpule and Morpheus® presented the same time of latency and anesthetic duration. The percentage of success for the technique with the carpule was 80.65% and the one of failure was 19.35%. For the Morpheus® technique, the percentage of success was 83.87% and that of failure was 16.13%. Significant differences in the pain after injection measured by VAS were not found. Besides, the majority of volunteers (64.52%) has chosen the Morpheus® system.
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Figure 1 – Pulpal anesthesia duration (minutes) for the two anesthetic methods. Center bar represents median, maximum, and minimum values. Mann-Whitney test, $p=0.697$.

Figure 2 – VAS as a function of the degree of pain experienced during the execution of the two anesthetic methods. Center bar represents median, maximum, and minimum values. Mann-Whitney test, $p=0.390$. 

Source: The authors.