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Comparative study of the effectiveness of three anesthetic solutions in mandibularintraosseous anesthesia-clinical study

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Abstract:
Background:*The aim of the study was to compare the efficacy (duration and area of analgesia) in intraosseous anesthesia after infiltration of three different anesthetic solutions.*
Material and Methods: *The object of the study were 36 clinically healthy patients with carious lesions on vital mandibular first or second molars, divided into 3 groups: 1st group-intraosseous infiltration of 0.9 mL 3% Mepivacaine (n = 12); 2nd group-0.9 mL 4% Articaine with 1: 200,000 Epinephrine (n = 12); 3rd group- 0.9 mL of 4% Articaine with 1: 100,000 Epinephrine (n = 12). All patients were anesthetized using the Quicksleeper system by following the manifacturer's protocol for performing mandibular intraosseous anesthesia. Pulp anesthesia of first and second molars, premolars and canines were evaluated with the Logipex 5 at 5 min intervals after placement of intraosseous anesthesia. 100 µA was accepted to be the criterion for successful anesthesia. The area of analgesia was determined by the number of teeth that have reached pulp analgesia (100 µA).*
Results: *For the 1st group pulp anesthesia was registered only for the first molar at 2±0.2 min, with an average duration of anesthesia of 25±1 min. In the 2nd group at 2±0.2 min anesthesia was registered for the first molar and second premolar with an average duration of 40±3 min and 30± 3 min, respectively. Anesthesia was registered for the second molar at 5±0.5 min with a duration of 25±1 min, while at 10±2 min, the second premolar was anesthetized for about 20±3 min. In 3rd group successful anesthesia was registered at 2±0.2 min, for all four teeth, with statistically significant longer average duration compared to the group of lower adrenaline concentration.*
Conclusion: *The average duration and area of analgesia in intraosseous anesthesia depends on both the active ingredient of the anesthetic solution required and the involvement of the vasoconstrictor.*
Key words: *intraosseous anesthesia, Quicksleeper, duration of anesthesia*

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I. Introduction

Intraosseous anaesthesia (IO) is a technique whereby the anaesthetic solution is injected into the cancellous alveolar bone where it can readily diffuse to anesthetize the sensory nerves of teeth. This technique of anaesthesia was introduced in dentistry over four decades ago and was primarily performed with a round bur, endodontic reamer, buetelrock drill to slow-speed 27-gauge perforator drills with guide sleeves [1]. Nowadays there is a wide variety of devices for IO, which allows easier administration of anesthetic into the cancellous bone such as the computer assisted system Quicksleeper(Dental Hi Tec, Cholet Cedex, France).

Using this computer-controlled IO system involves a three-step procedure, including anaesthesia of the mucosa, computerised rotation of the needle distal to the tooth in question to penetrate the cancellous bone, and computerised injection of the anaesthetic solution [2].

The advantages of this anaesthesia include use of smaller dosages of the anaesthetic solution and reduced soft tissue anaesthesia compared to conventional regional block and infiltration techniques, and rapid onset of profound pulpal anaesthesia [3-5].

The aim of the study was to compare the efficacy (onset, duration and area of analgesia) of primary intraosseous anaesthesia after infiltration of three different anaesthetic solutions (0.9 mL 3% Mepivacaine, 0.9 mL 4%

Articaine with 1: 200,000 Epinephrine, 0.9 mL of 4% Articaine with 1: 100,000 Epinephrine)with Quicksleeper system.

II. Material and Methods

The study was approved by the Ethical Committee of Medical University of Plovdiv (№ 6/10.11.2016). Written informed consent was obtained from every subject.

Patientsselection:

− healthypatients, 18-64 yearsoldwithnocommondiseases (allergies, diabetes, cardiovasculardiseases, etc.);
− patientsdiagnosedwithcariouslesionsonfirst, and/orsecondlowermolars;
−patients with vitallowerfirstandsecondmolars, premolarsandcanines (evaluatedbyelectricalpulptest);
−patientswithnoregisterednon-cariouslesionsonlowermolars, premolarsandcanines;
− patientswithnoregisteredpulpstonesonlowermolars, premolarsandcanines (evaluatedbyradiograph);
−patientwithnoanamnesticdataoftreatmentwithanaesthesiaon lower distal teeth, forthepast 2 weeks;
− patientswithnodataoforal soft tissue infection;
− patientswithnoperiodontaldiseasesбез клинично установени белези за пародонтално заболяване.

Following these criterion, 36 healthy patients were selected and divided into 3 groups:

- 1st group-intraosseous infiltration of 0.9 mL 3% Mepivacaine (n = 12);
- 2nd group-0.9 mL 4% Articaine with 1: 200,000 Epinephrine (n = 12);
- 3rd group- 0.9 mL of 4% Articaine with 1: 100,000 Epinephrine (n = 12).

Intraosseous anesthesia was performed by computer assisted system Quicksleeper(figure 1) in the following protocole:

Figure № 1. Computer assisted system Quicksleeper.

- infiltrative anesthesia of soft tissue - 0.3 mL anesthetic was infiltrated at15 ° angle at the perforation point (figure 2);

Figure № 2. Infiltrative anesthesia.

- perforation of compact bone - target point is 2 mm apical from the intersection of the horizontal (line passing through margogingivalis) and vertical line (line dividing interdental septum) (figure 3);

Figure № 3. Intraosseous anesthesia.

- infiltration of anesthetic into cancellous bone - 0.9 mL of anesthetic was infiltrated for 92s.
Intraosseous anaesthesia wasperformed exclusively distally of first molar/ mesially of second molar.

To evaluate the effectiveness of intraosseous anesthesia, indicators for changes in the dental pulp sensitivity threshold were used. This study was conducted exclusively on first and second molars, premolars and canines. Baseline values of patient's pain threshold were previously measured and recorded. To confirm the adequate participation of each patient during the diagnostic test, the pain threshold measurements of the examined teeth were preceded by an electroodontodiagnosis (EOD) of a contralateral intact (vital) tooth. A value of 100 μA (two positive results) was accepted as the criterion of pulpal anesthesia, which in endodontics is an indicator of the lack of dental pulp sensitivity.

Collected EOD values allow to obtain information on the time of beginning and end of intraosseous anesthesia, and the area of anesthesia. The sensitivity threshold of dental pulp on the examined teeth was determined, using Logipex 5 (Oviron Electronics, Bulgaria). The study was conducted on clean and isolated tooth surfaces at 2, 5, 10, 15, 20 min, etc. in a 5 min interval after placement of the IA (two measurements for each tooth for the corresponding time interval). The zone of analgesia was determined by the number of teeth that reached pulpal analgesia (100 μA). treated caries lesion All the treated carious were finished with temporary filling.
Patientswithno two consecutive positive results registered (100μA) in the first 10 minutes, were excluded from this study

Statistical analysis
Statistical analysis was performed by Statistica 4.5 (StatSoft, Inc. Microsoft, USA), SPSS 11.5 (Inc, Chicago, IL, USA) Excel 7.0 VB for applications and PraphPad Prism 3.0 (PraphPad, Soft, USA). Data was processed with detailed and comparative statistical analysis.

III. Result

In table 1 are presented the average age of the patients and the number of performed IO in each group.

Table № 1. Patient's average ageand number of performed IO.

Group	n	Average age	Performed IO	
			Left	Right
1st group	12	28 years	7	5
2nd group	12	27 years	4	8
3rd group	12	25 years	6	6

In 3 fromall 36 casesofintraosseousanaesthesia, noanaesthetic effect was obtained, because of difficulties in the technical execution. Thosepatientswereexcludedfromthestudy, forthere were no registered two consecutive positive results registered (100μA) in the first 10 minutes.

For the 1st group pulp anesthesia was registered only for the first molar at 2±0.2 min, with an average duration of anesthesia of 25±1 min (figure 4). In the 2nd group at 2±0.2 min anesthesia was registered for the first molar and second premolar with an average duration of 40±3 min and 30± 3 min, respectively. Anesthesia was registered for the second molar at 5±0.5 min with a duration of 25±1 min, while at 10±2 min, the second premolar was anesthetized for about 20±3 min (figure 5). In 3rd group successful anesthesia was registered at 2±0.2 min, for all four teeth, with statistically significant longer average duration compared to the group of lower adrenaline concentration (figure 6). Innoneofthe 3

groupscanineanaesthesiawasregistered.

Figure №4. Changes in the pain threshold of lower molars, premolars and canine after intraosseous infiltration of 0,9 mL 3% Mepivacaine hydrochloride

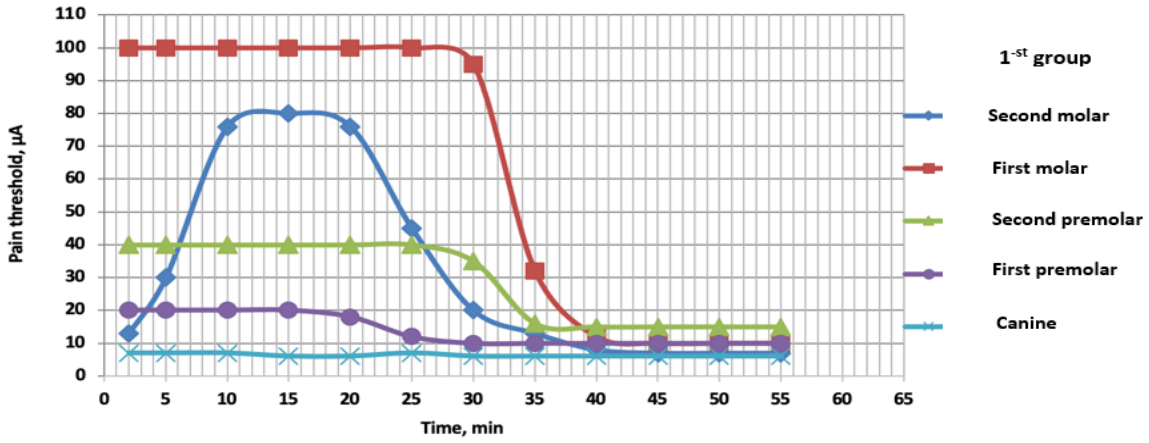

Figure № 5. Changes in the pain threshold of lower molars, premolars and canine after intraosseous infiltration of 0,9 mL 4% Articaine hydrochloride/1:200 000 Adrenaline

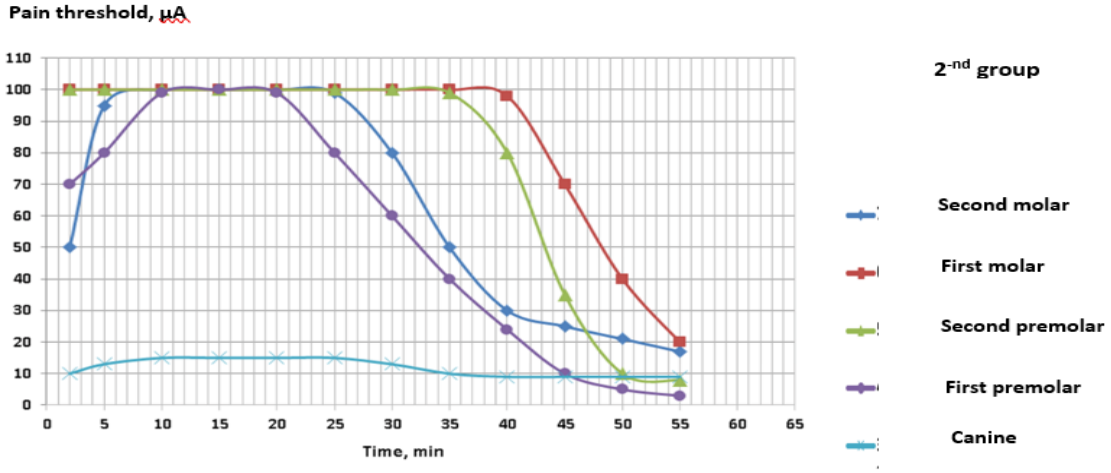

Figure № 6. Changes in the pain threshold of lower molars, premolars and canine after intraosseous infiltration of 0,9 mL 4% Articaine hydrochloride/1:100 000 Adrenaline.

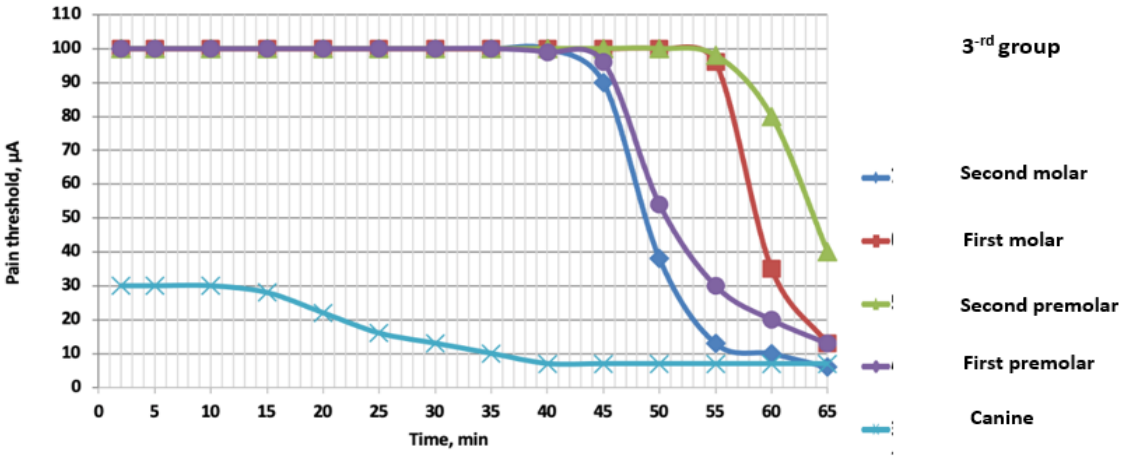

Table 2 representsdataonstart, averagedurationandareaofanaesthesiaforthethreeanaestheticsolutions.

Table№ 2. Beginning, averagedurationand areaofanaesthesiaforthethree groups.

Group	Number of patients	Onset/duration of IO					Area of analgesia
		2nd molar	1st molar	2nd premolar	1st premolar	Canine	
1st group	10	absenceof anesthesia	(7±1) min/ (25±1) min	absence of anesthesia	absence of anesthesia	absence of anesthesia	1 tooth
2nd group	11	(5±0,5) min/ (25±1) min	(2±0,2) min/ (40±3) min	(2±0,2) min/ (30±3) min	(10±2) min/ (20±3) min	absence of anesthesia	4 teeth
3rd group	12	(2±0,2) min/ (40±3) min	(2±0,2) min/ (55±6) min	(2±0,2) min/ (56±3) min	(2±0,2) min/ (47±3) min	absence of anesthesia	4 teeth

There was a statistically significant difference ($p < 0.05$) both in duration of anesthesia of the eponymous teeth from different groups, and in the number of teeth (area of anesthesia) that reached complete pulpal anesthesia, between the group without vasoconstrictor and the groups with different concentrations of vasoconstrictor.

IV. Discussion

At first, IO was administered as a supplemental anaesthetic technique to IANB particularly in cases of symptomatic irreversible pulpitis with success rate of 71–98%.[6, 7]. Study results demonstrate that pulpal analgesia after supplemental IO has a duration of as long as 60 min when used with local anaestheticcontaining vasoconstrictor and approximately 15 to 30 min when used without a vasoconstrictor[8].

Nowadays the progress of instrumentation, which allows slow and painless delivery of local anaesthetic solution into cancellous bone has led to the development of IO as a primary method of analgesia in dentistry [7, 9].

Gallatin et al. found that onset of pulpal anaesthesia (no response to pulp testing) occurred within 2 min when using the X-tip as a primary injection in mandibular first molars. Previous studies of the intraosseous Stabident system also have shown immediate onset[6].

Pereira et al conducted a comparative study on the duration of IO after infiltration of 0.9 mL Articaine with 1: 100,000 and 1: 200,000 Adrenaline in treatment of irreversible pulpitis of the mandibular molars and found that both anaesthetics provide effective pulpal anaesthesiaduring endodontic treatment[10].

V. Conclusion

The average duration and area of analgesia in intraosseous anesthesia depends on both the active ingredient of the anesthetic solution required and the involvement of the vasoconstrictor.

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