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# Conscious Sedations in Out-Patient Dentistry in Children of Preschool Age

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## Abstract

**Aim:** To improve the quality of dental treatment in children by using combined anaesthesia technique including local anaesthesia and conscious sedation, and to as less the effectiveness of conscious sedation for younger children undergoing dental treatment.

**Materials and Methods:** The study included 514 children. Some children were treated under medical conscious sedation (3 different drugs were injected). The reference group was treated without use of anesthetic. Heart rate, noninvasive blood pressure, breathing rate, SpO2, and parameters of microcirculation were monitored with the help of computer capillaroscopy. The study was conducted at four time points.

**Results:** All children in this study were treated with various psychophysiological and dental results. The results were statistically processed. Regularities were revealed.

**Conclusion:** Children undergoing dental treatment without MCS are affected by stress. The degree of stress in surgical patients was noted to be significantly higher. The absence of physiological parameters changes in children treated without MSC is not a proof of the absence of stress. The dose of 0.15 mg per kg is optimal for the comfortable level of MSC. The increase of midazolam dose is not associated with further reduction of stress. The obtained data is true for both age categories.

***Keywords:*** *Conscious Sedation; Pediatric Dentistry; Stress Level; Behavioral Correction; Microcirculation; Computer Capillaroscopy*

In recent decades the intensity and prevalence of caries and its complications have been increasing among children in Russia, in large measure among children of early and preschool age. Most children of the younger age group (1 - 6 years) are afraid of dental treatment. An important role in this situation is played by the negative experience of communicating with dentists in the past. There are especially many cases of refusal of treatment among these children. Unfortunately, in most cases, only two treatment options are offered to this group of children. The first is treatment under general anesthesia, the second is treatment against the will of children with retention.

The issues of comfortable treatment in dentistry are given a special place in the work of international and European communities of dentists and anesthesiologists. For example, at the EFAAD Congress in Padua (2014) sedation with preserved consciousness (CS) was recognized as the main method of relieving vegetative reactions and anxiety states in patients in dentistry. Thus, in the last 10 years the European community has changed its view on treatment under general anesthesia, which led to a decrease in the number of cases of treatment under general anesthesia in dentistry and an increase in the frequency of conscious sedation (CS). In the UK, in the publication "Questionable decision" (authors are the Minister of Health and Chief dentist of the UK) it was stated that it is unacceptable to carry out general anesthesia for dental treatment on an outpatient basis.

In pediatric dentistry the use of conscious sedation is even more relevant. This technique requires the dentist's patience, attention, sufficient time to work. This often leads to an automatic refusal to work under sedation and recommendations for treatment under general anesthesia.

## Aim

To improve the quality of treatment of children in outpatient dentistry by using conscious sedation.

## Materials and Methods

The study included 514 children aged 1 to 6 years who received therapeutic or surgical treatment in an outpatient department (Figure 1). For inclusion in the study, it was mandatory for the patient to have one of the following criteria: negative dental experience, "hospital fear", age and characteristical features, the intended use of local anesthesia during dental treatment (Table 1). All children on a physical state belonged to the I-II class on ASA. It was planned to treat patients included in the study under combined anesthesia (conscious sedation plus local anesthesia) or only conscious sedation. The decision on the need for local anesthesia was taken by the dentist depending on the degree of damage to the teeth. Conscious sedation was performed by intramuscular injection of drugs "Midazolam" (208 patients), "Relanium" (225 patients) and "Sibazon" (39 patients) (in combination with tavegil and atropine). 42 children formed a reference group, which was treated without the use of anesthetic. In the reference group, treatment was carried out without the use of anesthetic. Before surgical and therapeutic treatment local anesthesia was performed: application on the mucous membrane, infiltration or conduction. Local anesthetics (articaine 4% and mepivacaine 3%) were used. The amount of local anesthetic was determined by the patient's age, volume and complexity of treatment.

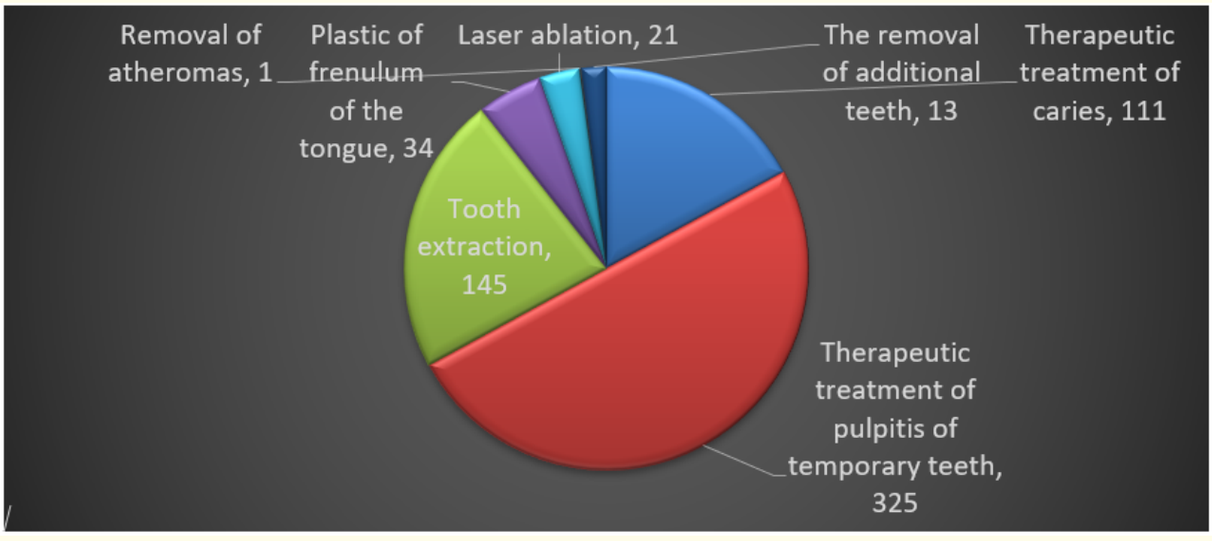


***Figure 1***

| Criteria | In total | | 1-3 | | 3-6 | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Negative experience | 271 | 43,4 | 108 | 17,3 | 163 | 26,1 |
| Hospital fear | 135 | 21,6 | 49 | 7,8 | 86 | 13,8 |
| Character features | 165 | 26,4 | 70 | 11,2 | 95 | 15,2 |
| Age features | 173 | 27,7 | 173 | 27,7 | 0 | 0 |
| Intended use of local anesthesia | 406 | 65,1 | 162 | 25,9 | 244 | 39,1 |

***Table 1***

Within each group treatment of children aged 1 to 3 years and 3 to 6 years were separately analyzed. Intramuscular injection was preceded by local anesthesia of the skin of the upper quadrant of the buttock with "EMLA" cream.

Doses of drugs at the rate of 0.1 mg/kg, 0.15 mg/kg and 0.2 mg/kg were used for the study. As a result, three subgroups which corresponded to doses of the drug were formed within each age group.

To assess the psychological status of children during the examination FIS-scale, parent questionnaires and anamnesis data (presence of negative dental experience or "hospital fear") were used.

The condition of the children was assessed at four stages of the study: 1) before the conscious sedation; 2) before the beginning of dental treatment (after the sedation); 3) after the end of dental treatment; 4) before the end of the visit to the dental institution (2.5 - 3 hours after treatment). Blood pressure, heart rate, respiratory rate and $SpO_2$ were monitored at the stages and the dynamics of microcirculation parameters: the density of the capillary network, the size of the arterial, venous and transitional departments of the capillary, linear and volumetric blood flow rates, perfusion balance - were recorded.

Monitoring the microcirculation of patients was conducted at the eponychium of the nail bed of the fingers (the study is non-invasive and painless) with the help of computer capillaroscope (Figure 2). The quality of treatment under conscious sedation was assessed by questionnaires of doctors and dentists. In questionnaires for parents noted: the level of comfort of treatment in medical sedation, the adequacy of the child's behavior in the near future after treatment and the child's willingness to continue to visit the dentist. The analysis was carried out using statistical package Statistica StatSoft 8.0.

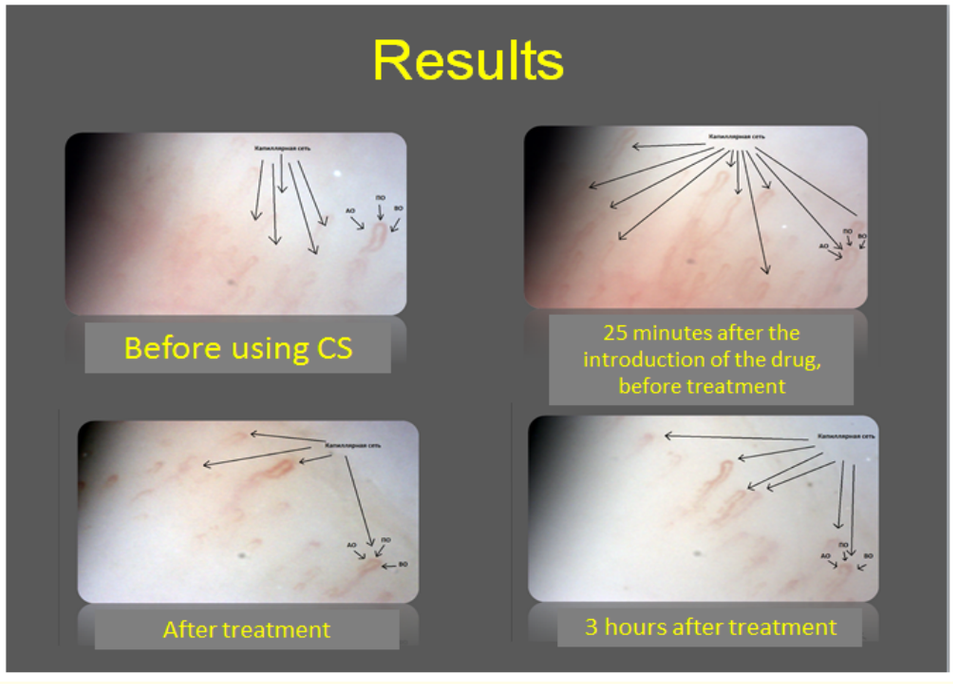


***Figure 2***

## Results and Discussion

The study compared the results of treatment under conscious sedation and without it, the results obtained in different age groups. Comparison of efficacy of sedation drugs in outpatient department was carried out. The influence on the efficiency and patient's psychosomatic status of different doses of drugs was investigated. So, during the assessment of the results of treatment under sedation with "Midazolam" it was noted that the dose 0.15 mg/kg is the optimal treatment option in terms of stored consciousness (the ability to cooperate with the child in 99% of cases, the maximum number of treated teeth is 6, intact marginal integrity of fillings in 97.2% of cases, complications of treatment do not exist, the side effects of the drug are up to 1.5%). The obtained data are valid for both age groups (Table 2).

| Dose | 0,1 mg/kg | | 0,15 mg/kg | | 0,2 mg/kg | |
|---|---|---|---|---|---|---|
| Age group | 1 - 3 years | 3 - 6 years | 1 - 3 years | 3-6 years | 1 - 3 years | 3 - 6 years |
| Number of patients | 26 | 35 | 36 | 43 | 28 | 40 |
| The degree of sedation Ramsay/Bis | II/73-80 | II/73 - 80 | II/60 - 73 | II/60 - 73 | II-III/60 - 73 | II-III/60 - 73 |
| Comfortable time of treatment (minutes) | ≤ 30 | ≤ 30 | ≤40 | ≤40 | ≤ 40 | ≤ 40 |
| Number of teeth treated per visit | 1 - 2 | 2 - 4 | 2 - 6 | 2 - 4 | 2 | 1 - 4 |
| Possibility of contact with the child | 20 | 34 | 35 | 42 | 12 | 28 |
| Preservation edge fit seals after 12 months (%) | 80,7 | 94,8 | 97,2 | 97,7 | 92,8 | 97,5 |
| Complications of treatment | - | 0 | - | 0 | - | 0 |
| Hallucinations and double vision | 0 | 0 | 0 | 0 | 12 | 28 |
| Disinhibition and hyperactivity | 0 | 1 | 1 | 0 | 4 | 16 |

***Table 2***

During sedation with "Relanium" the following results were obtained: none of the doses of the drug does not provide adequate treatment in conscious sedation (the ability to cooperate with the child is up to 40%, the maximum number of treated teeth during one visit is 2, preserved marginal fit seals in 80.2% of cases, complications of treatment - 10 - 12% depending on the dose of the drug, the side effects of the drug up to 80%). It was also noted that with increasing the dose of the drug, the number of side effects increases dramatically and the time of the child's stay in the postoperative ward extends several times. The data obtained are valid for both age groups (Table 3).

| Dose | 0,1 mg/kg | | 0,15 mg/kg | | 0,2 mg/kg | |
|---|---|---|---|---|---|---|
| Age group | 1 - 3 years | 3 - 6 years | 1 - 3 years | 3 - 6 years | 1 - 3 years | 3 - 6 years |
| Number of patients | 33 | 38 | 40 | 29 | 36 | 49 |
| The degree of sedation Ramsay/Bis | I/78 - 79 | I - II/78 - 80 | II/75 - 78 | II/75 - 78 | II - III/73 - 77 | II - III/72 - 77 |
| Comfortable time of treatment (minutes) | - | ≤ 15 | ≤ 20 | ≤ 20 | ≤ 35 | ≤ 30 |
| Number of teeth treated per visit | 1 | 1 | 1 | 1 | ≤ 2 | ≤ 2 |
| Possibility of contact with the child | 5 | 6 | 10 | 5 | 7 | 7 |
| Preservation edge fit seals after 12 months (%) | 80,1 | 82,3 | 81,5 | 79,0 | 70,4 | 71,5 |
| Complications of treatment | 0 | 0 | 1 | 2 | 1 | 1 |
| Hallucinations and double vision | 0 | 0 | 4 | 4 | 8 | 5 |
| Disinhibition and hyperactivity | 2 | 2 | 5 | 3 | 2 | 1 |

***Table 3***

The results obtained during sedation with "Sibazon" are similar to the results of sedation with "Relanium" with the number of side effects and complications increasing approximately twice (Table 4).

| Dose | 0,1 mg/kg | | 0,15 mg/kg | | 0,2 mg/kg | |
|---|---|---|---|---|---|---|
| Age group | 1 - 3 years | 3 - 6 years | 1 - 3 years | 3 - 6 years | 1 - 3 years | 3 - 6 years |
| Number of patients | 7 | 2 | 4 | 14 | 6 | 6 |
| The degree of sedation Ramsay/Bis | I - II/76 - 80 | I/79 - 82 | II/75 - 82 | I/78 - 79 | II - III/73 - 78 | II/74 - 77 |
| Comfortable time of treatment (minutes) | - | ≤ 20 | ≤ 20 | ≤ 20 | ≤20 | ≤20 |
| Number of teeth treated per visit | 1 | 1 | 1 | 1 | 2 | ≤2 |
| Possibility of contact with the child | 2 | 10 | 1 | 10 | 1 | 4 |
| Preservation edge fit seals after 12 months (%) | 85,2 | 50,0 | 75,0 | 90,5 | 84,7 | 86,8 |
| Complications of treatment | 2 | 0 | 0 | 1 | 1 | 0 |
| Hallucinations and double vision | 4 | 0 | - | 0 | 3 | 1 |
| Disinhibition and hyperactivity | 1 | 2 | 4 | 6 | 5 | 6 |

***Table 4***

A comparative analysis of the effect of three drugs on the dynamics of physiological parameters in children under 3 years showed that blood pressure, heart rate and respiratory rate react differently to the use of these drugs in equivalent doses. For example, systolic blood pressure between the first and second measurements was more variable during using "Midazolam" than when using "Relanium" and "Sibazon". More detailed dynamics of physiological indicators depending on the used preparation is presented in figure 3-6 and in tables 5 and 6. BIS values varied significantly depending on the drug used. Thus differences concerned all dose levels. Comparative analysis of drugs by Ramsay showed mixed results, which depended on the dose of drugs.

| The estimated parameter | Measurement | Meaning p | | |
|---|---|---|---|---|
| | | 0,1 mg/kg | 0,15 mg/kg | 0,2 mg/kg |
| Systolic blood pressure | I<br>II | 0,003 | 0,53 | 0,003 |
| | II<br>III | 0,66 | 0,08 | 0,21 |
| | III<br>IV | < 0,0001 | 0,03 | 0,006 |
| | I<br>IV | 0,45 | 0,51 | 0,0003 |
| Diastolic blood pressure | I<br>II | 0,10 | 0,20 | 0,004 |
| | II<br>III | 0,56 | 0,16 | 0,06 |
| | III<br>IV | 0,006 | 0,53 | 0,21 |
| | I<br>IV | 0,74 | 0,65 | 0,57 |
| Heart rate | I<br>II | 0,002 | 0,18 | 0,0001 |
| | II<br>III | 0,16 | 0,65 | 0,28 |
| | III<br>IV | 0,0004 | 0,25 | 0,01 |
| | I<br>IV | 0,64 | 0,08 | 0,04 |
| The frequency of respiratory movements | I<br>II | 0,003 | 0,002 | <0,0001 |
| | II<br>III | 0,002 | 0,36 | 0,09 |
| | III<br>IV | 0,003 | 0,0003 | 0,0007 |
| | I<br>IV | 0,002 | 0,84 | 0,14 |
| BIS | | 0,03 | < 0,0001 | < 0,0001 |
| RAMSAY | | 0,001 | 0,73 | 0,50 |

***Table 5:*** *Comparative analysis of the dynamics of physiological parameters at the age of 1 - 3 years with the use of Midazolam, Relanium or Sibazon in equivalent doses.*

| The estimated parameter | Measurement | Meaning p | | |
|---|---|---|---|---|
| | | 0,1 mg/kg | 0,15 mg/kg | 0,2 mg/kg |
| Systolic blood pressure | I II | 0,73 | < 0,0001 | 0,84 |
| | II III | 0,007 | 0,03 | 0,03 |
| | III IV | 0,0003 | 0,0001 | 0,0003 |
| | I IV | 0,62 | 0,001 | 0,06 |
| Diastolic blood pressure | I II | 0,90 | 0,07 | 0,78 |
| | II III | 0,02 | 0,21 | 0,34 |
| | III IV | 0,06 | 0,34 | 0,95 |
| | I IV | 0,27 | 0,76 | 0,89 |
| Heart rate | I II | 0,11 | < 0,0001 | 0,007 |
| | II III | 0,01 | 0,0001 | 0,19 |
| | III IV | 0,003 | 0,0005 | 0,13 |
| | I IV | 0,29 | < 0,0001 | 0,004 |
| The frequency of respiratory movements | I II | < 0,0001 | < 0,0001 | 0,58 |
| | II III | 0,97 | 0,05 | < 0,0001 |
| | III IV | 0,66 | 0,12 | < 0,0001 |
| | I IV | 0,0005 | < 0,0001 | 0,004 |
| BIS | | 0,0006 | <0,0001 | < 0,0001 |
| RAMSAY | | 0,01 | 0,004 | 0,27 |

***Table 6:*** *Comparative analysis of the dynamics of physiological parameters at the age of 3 - 6 years with the use of Midazolam, Relanium or Sibazon in equivalent doses.*

In our article, the results obtained in the treatment of patients of the reference group are given in comparison with the results obtained in the treatment of conscious sedation with Midazolam. The Midazolam group and the reference group had statistically significant differences in systolic blood pressure dynamics, heart rate ($p < 0.05$), as well as a tendency to statistically significant differences in saturation dynamics ($p = 0.06$). In the Midazolam group, saturation increased from measurement I to measurement IV, while in the reference group it decreased. The heart rate in the Midazolam group changed slightly, while in the reference group there was an increase in the heart rate. Systolic blood pressure decreased in the Midazolam group, and in the reference group it tended to increase. Other physiological indicators did not have statistically significant differences between the two groups in terms of dynamics between measurements I and IV ($p > 0.05$). The difference in the parameters of microcirculation obtained when working with the reference group and the group treated under

sedation is presented in table 7. Table 7 shows that there are statistically significant differences between the Midazolam and the reference group with respect to the dynamics of the network density, the size of the capillary transition section ($p < 0.05$). In the reference group, the network density was significantly reduced, while in the Midazolam group statistically significant dynamics were not revealed. The size of the transition section of the capillary in the Midazolam group tended to increase, whereas in the reference group it decreased. Dynamics of other parameters of computer capillaroscopy in the two compared groups had no statistically significant differences ($p > 0.05$) [1-7].

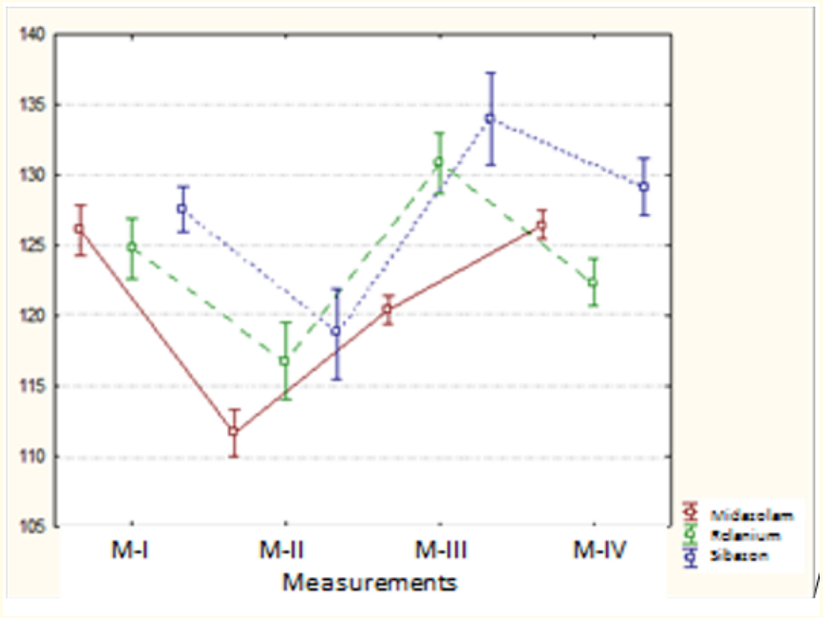


***Figure 3:*** *Dynamics of systolic blood pressure.*

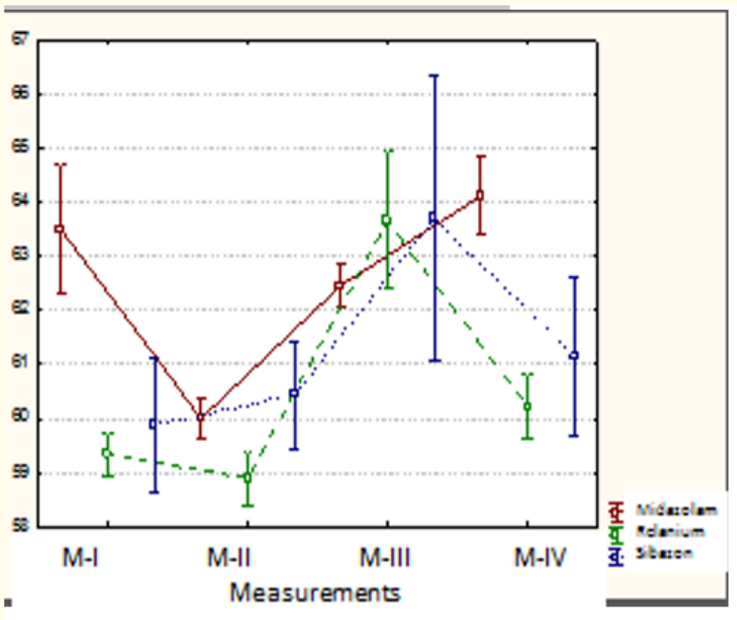


***Figure 4:*** *Dynamics of diastolic blood pressure.*

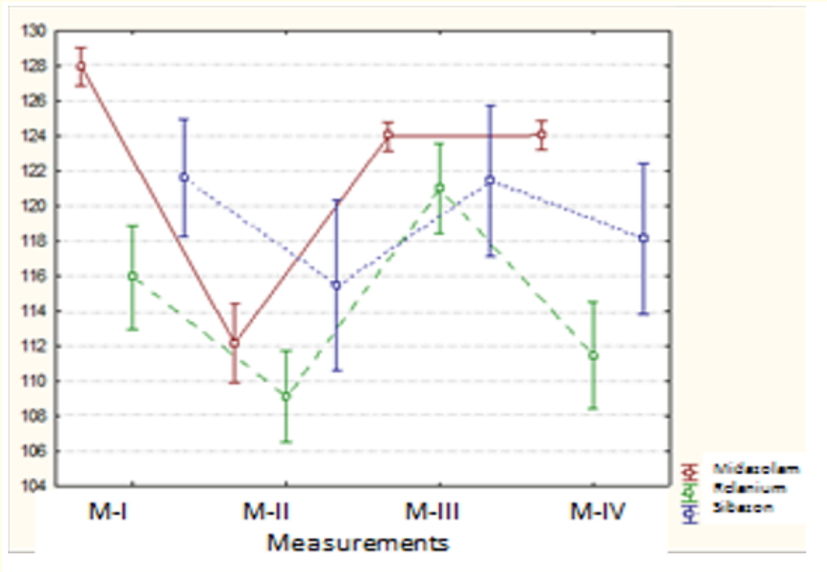


***Figure 5:*** *Heart rate dynamics.*

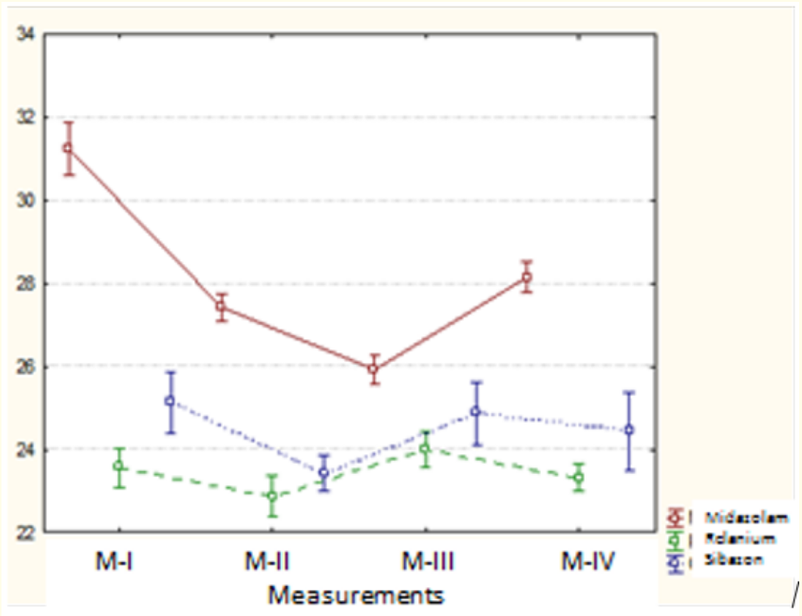


***Figure 6:*** *The dynamics of the frequency of the respiratory movements.*

## Conclusion

"Midazolam" at a dose of 0.15 mg/kg is the most effective drug for conscious sedation for the treatment of children in an outpatient department. "Relanium" at a dose of 0.15 mg/kg for conscious sedation can be applied in children of age group 3 - 6 years in the absence of experience of dental treatment. The timely use of medical sedation in the rehabilitation of the oral cavity for children of younger age group improves the quality of treatment, and allows to provide dental treatment without the use of anesthetic in the future.

| The estimated parameter | Group | Parameter meaning | | Meaning p |
|---|---|---|---|---|
| | | I measurement | IV measurement | |
| Network density (%) | Midazolam (n = 23) | 0,10 ± 0,19 | 0,10 ± 0,20 | 0,009 |
| | Reference (n = 10) | 0,22 ± 0,13 | 0,03 ± 0,01 | |
| The size of the aortic section of the capillary (micrometers) | Midazolam (n = 23) | 8,09 ± 4,11 | 8,90 ± 2,63 | 0,68 |
| | Reference (n = 10) | 8,99 ± 7,07 | 9,19 ± 3,85 | |
| The size of the transition section of the capillary (micrometers) | Midazolam (n = 23) | 10,76 ± 3,41 | 14,3 ± 7,3 | 0,02 |
| | Reference (n = 10) | 16,11 ± 7,19 | 11,4 ± 4,9 | |
| The size of the venous section of the capillary (micrometers) | Midazolam (n = 23) | 11,07 ± 5,47 | 11,9 ± 3,6 | 0,74 |
| | Reference (n = 10) | 13,79 ± 8,15 | 12,8 ± 7,03 | |
| Linear velocity of arterial section (micrometers/second) | Midazolam (n = 23) | 353,0 ± 135,7 | 397,7 ± 85,6 | 0,37 |
| | Reference (n = 10) | 435,3 ± 182,9 | 529,0 ± 274,4 | |
| Linear velocity of venous section (micrometers/second) | Midazolam (n = 23) | 339,1 ± 105,6 | 381,0 ± 117,9 | 0,56 |
| | Reference (n = 10) | 453,3 ± 142,5 | 435,7 ± 174,9 | |
| Perfusion balance (cubic micrometers/second) | Midazolam (n = 23) | -20972 ± 46315 | -22599 ± 30979 | 0,53 |
| | Reference (n = 10) | -82300 ± 115039 | -29925 ± 48259 | |

***Table 7***

Children undergoing dental treatment without the use of monitored conscious sedation experience stress, which is expressed in a decrease in the density of the capillary network and the size of the transition section of the capillary according to computer capillaroscopy. Moreover, it is noted that the degree of stress in surgical patients in this situation is much higher (according to computer capillaroscopy in surgical patients, a decrease in perfusion balance, an increase in the size of the venous capillary and an increase in linear velocity in it). The absence of changes in physiological parameters in children undergoing treatment without anesthesia is not a confirmation of the absence of stress.

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