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TREATMENT AND DIAGNOSTIC ALGORITHM FOR PREVENTION OF DENTAL IMPLANTATION COMPLICATIONS IN PATIENTS WITH HYPERTENSION DISEASE

Nazarova Sh. X.
Nazarov Z. Z.
Pulatova B. J.
Djahangirova D. A.
Tashkent State Dental Institute

Abstract
The cause of the development of dental diseases in a person at any age is the loss of teeth in the dentition, leading to a number of pathological conditions in the maxillofacial area According to the theory of implantology, what is special is the fact that with long-term arterial hypertension, reduced immunity that accompanies Covid-19 and constantly regular use of antihypertensive, anticoagulant medications, the phenomenon of “rarefaction” or “discharge” is formed, which manifests itself in a decrease in the total surface of the exchange vessels. All patients (87 people) were divided into 3 comparison groups depending on nosology, preoperative examination and choice of treatment method. During the study time, dynamic changes in DI stability indicators, regardless of bone density, showed a noticeable increase. This confirms the results obtained regarding the dynamic growth of implant stability in jaws with bone density.

Keywords: Dental implantation, hypertension, prevention of complications, treatment algorithm, osseointegration, osteoporosis, secondary adentia.

Introduction

Relevance of the topic. The cause of the development of dental diseases in a person at any age is the loss of teeth in the dentition, leading to a number of pathological conditions in the maxillofacial area (MFA).

The number of dental implants implanted by dentists is increasing at lightning speed, and the indications for their use have been expanded.

Currently, the section of implantology is marked by a significant level of solved problems in the field of secondary adentia using dental implants. However, the timing of the start of implantation in patients who have suffered coronavirus infection, as well as dentures after implant surgery, remains controversial.

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The need to reduce the recovery time of patients before and after implantation of dental implants (DI) seems global and deserves attention. One of the promising areas is the improvement of methods for direct implantation after tooth extraction directly into the alveolus, which is clearly the most relevant and economically proven improvement in dental care.

However, the major disadvantages of these methods are poor adaptation and insufficient stability of installed implants in the tooth alveolus, as well as low osseointegration into the bone.

According to the theory of implantology, what is special is the fact that with long-term arterial hypertension, reduced immunity that accompanies Covid-19 and constantly regular use of antihypertensive, anticoagulant medications, the phenomenon of "rarefaction" or "discharge" is formed, which manifests itself in a decrease in the total surface of the exchange vessels.

To date, no criteria have been developed for the possibility of expanding the indications for implantation.

Today, concomitant somatic pathology in patients requiring dental implantation speaks for the relevance of this problem and its practical significance in general.

Purpose of the study: RTo develop a treatment and diagnostic algorithm and tactics for preoperative preparation of patients with secondary adentia with concomitant hypertension in the process of planning for dental implantation.

Materials and methods of research.

During the study, we examined and treated 87 patients in the period from 2018-2022. at the Department of Surgical Dentistry and Implantology, TSSI

The characteristics of the patients in terms of age and gender are presented in Table 1, there were 53 men and 34 women, 96 di (Osteem system and Impro intraosseous system) were placed.

The patients were distributed according to age and gender as indicated in Table 1.

Table 1 Characteristics of patients in terms of age and gender

Gender sign		Age aspect (years)			Sum
		30-34	45-49	50-55	
Men	Abs	7	35	eleven	53
	%	9.2%	39.1%	12.6%	61%
Women	Abs	5	13	16	34
	%	4.6%	16.1%	18.4%	39%
Total	Abs	eleven	49	27	87
	%	13.8%	55.2%	31%	**100%**

All examined patients were divided into three groups. All patients (87 people) were divided into 3 comparison groups depending on nosology, preoperative examination and choice of treatment method.

- group 1 - observation group, it consisted of 33 patients with secondary adentia with a history of mild to moderate hypertension. This category of patients was prescribed the vitamin complex CALCIVIT "Swiss energy" to restore calcium-phosphorus metabolism, stimulating osteomodeling and metabolism in bone tissue, as well as normalizing blood hemostasis;
- group 2 - comparison group, it consisted of 33 patients with secondary adentia, with hypertension of I and II degrees, only the traditional regimen was carried out, without preliminary preparation;
- group 3 - comparison group, control group, consisted of 21 patients without pathology;

The position of installed dental implants in the upper and lower jaws was distributed as presented in Table 2.

Table 2 Position of implants installed in the jaw

Place position	Distal section	Front Department	Left side of the distal part	Total number
Upper jaw	83	78	80	244
Lower jaw	77	88	85	247
TOTAL	160	166	165	491

In the study plan, for the purpose of conducting the surgical stage, patients with hypertension of I and II degrees who had previously suffered a coronavirus infection were admitted and patients with severe underlying disease were not included.

Plan npostoperativeperiodobservations:

1. 1 day after completion of the operation;
2. after a week of establishment in the bone;
3. monthly period;
4. from 3-6 months.

General characteristics of research methods

During the preoperative examination of patients, general clinical tests were used: anamnestic collection, visual examination of St.localis in the area of proposed implantation, measurement of blood pressure and heart rate), radiological: 3D X-ray, orthopantomography (panoramic zonography) and computed tomography, functional: ultrasound Doppler flowmetry, ECG and laboratory examination methods (CBC, blood biochemistry).

CLINICAL EXAMINATION METHODS.

The anamnestic collection implied the determination of concomitant organ-system pathology, namely the identification of hypertension and Covid-19, the general condition at the moment, the temporal duration and duration of the main diseases.

Questions were asked about the frequency of visits to the dentist, how long the teeth were removed, for what reason the extraction was performed, whether the patient suffered from occupational hazards, when and for what reason they expressed a desire to undergo implantation surgery.

In the preoperative period, at the very beginning, they were asked what complaints the patient currently has, namely discomfort when chewing, when talking, in business life, communicating with people, colleagues, which occurs due to the absence of teeth, as well as pathological signs - bleeding of the periodontal papillae , mobility of teeth present in the dentition, pain when chewing food, pain in the presence of mechanical, chemical and temperature stimuli.

The primary examination was based on determining the relationship of the dentition, the normal or pathological form of the bite, ascertaining carious cavities and dental plaques; in the area of the proposed intervention, the extent of the dentition defect, the magnitude of the interalveolar height, the height and width of the bone tissue were examined.

Particular attention was required when analyzing the frenulum and muscle cords, the color and humidity of the oral mucosa, the size of the vestibule arch, and the relationship between the free and attached mucosa.

ULTRASOUND DOPPLER FLOWMETRY

Through the tissues of the jaws and alveolar processes of the jaws, the blood flow of the microcirculatory bed was analyzed using sensors up to 20-25 MHz, which penetrated the visualized wave up to 8 mm.

The spectrogram is analyzed quantitatively and qualitatively. The qualitative characteristics of a Dopplerogram of normal structure vary depending on the type and

size of the vessel and its lumen. Dopplerogram pattern: in the case of a large artery, a sharp-peaked line of the curve is displayed during systolic heart contractions and the most straightened curve in the case of diastolic blood flow velocity. In clinical situations of mixed blood flow, a wave-like colored spectrum pattern appears with the absence of sharp peaks. The entire spectrum of colors is presented, from orange to white, depending on the likelihood of vasoconstriction.

In our work, we used the Gosling index (PI), which determined the elasticity of blood vessels.

VS-VD VM

Vs – max.V systolic;

VM –averagenV along the max.V curve;

V.D.end diastol. V

The assessment of Doppler curves is based on the analysis of the maximum current value in the vessels at the moment of systole (Vs), the size of the diastole blood flow velocity (VD).

To obtain statistical data, we used the place bordering the attached and free mucous membrane as a point of localization of sensors for the fact of changes in tissue microcirculation in the projection of the proposed implantation. [2,7,9].

If a patient has chronic ischemic heart disease, as well as arterial hypertension, the use of sedation and premedication is considered an immediate indication. In this regard, for the sensory-vegetative, psycho-emotional and motor components of the pain reaction and as a medicinal effect, we used anesthesia in a combination of sedative premedication and local anesthesia.

Analysis of jaw tissue density using tomograms

Based on the obtained MSCT data, dental implants were virtually installed in patients. (Fig.1).

Fig. 1. Positioning in hole 2.7 CI.

In the virtual positioning zone of the DI, 12 points served as a tactic for determining bone tissue density (Fig. 2).

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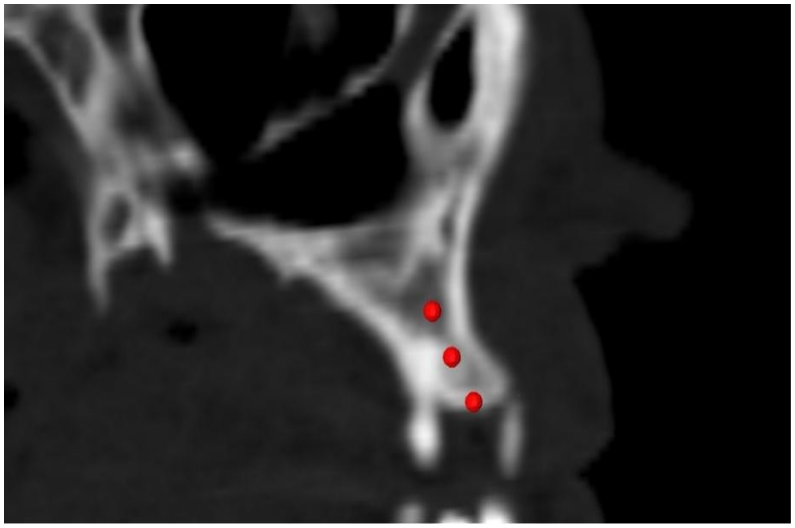

Fig.2. MSCT upperjaw (transverse). Computer program VSG Amira (Germany). Determination of bone density around the DI using measurement points placed along the alveolar ridge of the upper jaw in the area of planned implantation.

Jaw bone density analysis

In 1972, Godfrey Hounsfield and Allan Cormack, using CT, introduced a new method for calculating R-density. Our study used the study of pdensity of the jaw bone using the above methodon a scale of digital values expressed inconventional units.The method is basedon determining the difference in the attenuation of X-ray radiation on tissues of different densities [10].

Many classifications are based on the principles of internal structure.According to the Hounsfield scale, the range of conventional units is distributed as follows: D1 -> 1250 units; D2 - from 850 to 1250 units; D3 - from 350 to 850 units; D4 - <350 units, this classification is based on the principle of assessing the density of the bone tissue of the jaws, distinguishing 4 possible groups: D1, D2, D3, D4 (Fig. 3,4,5,6).

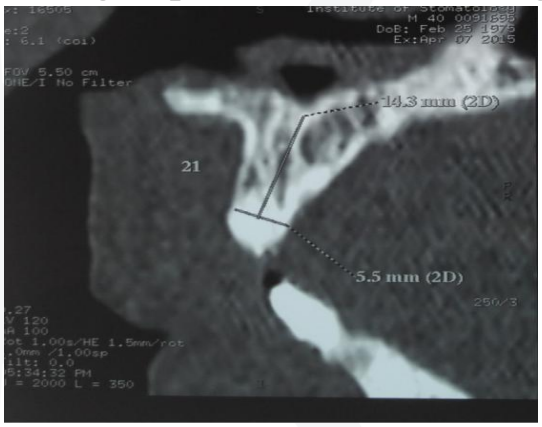

Fig. 3. On CT scan in the area of missing 21 teeth, bone tissue density according to classification. C. Mish D1 – dense compact bone.

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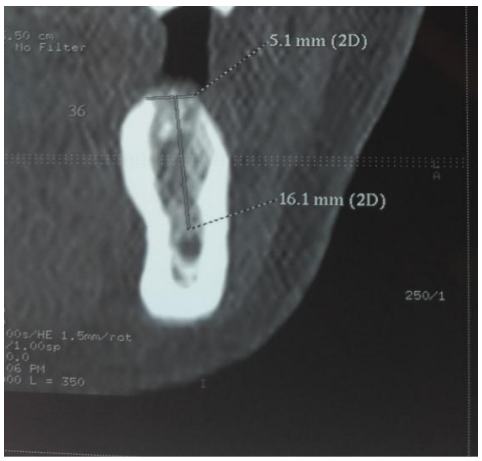

Fig.4. On a CT scan in projection 36, the bone tissue density is D2 (the cortical layer is very pronounced).

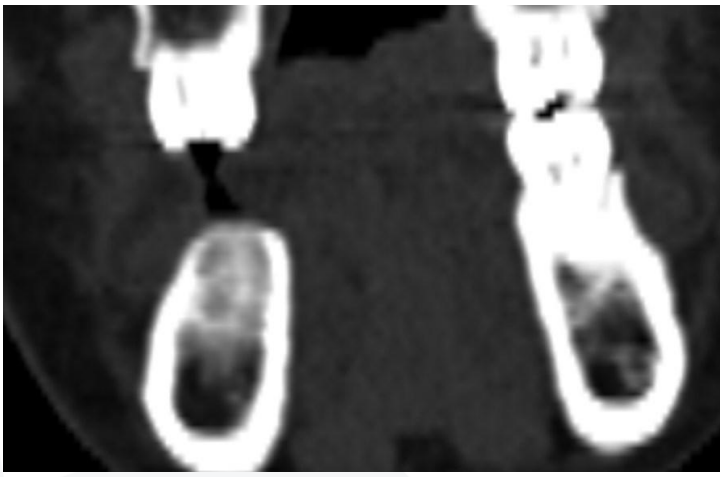

Fig.5.CT scan at the site of the 36th tooth; D3 – compact porous fabric, looseness in the spongy layer

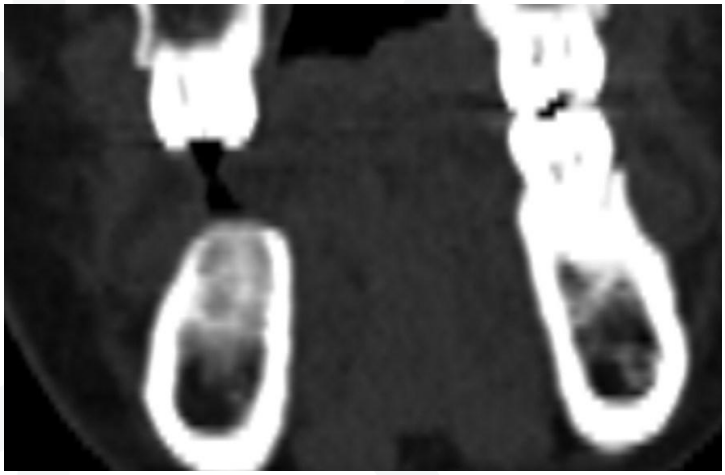

Fig.6. CT scan in projection 36 bone density is D4, loose spongy substance.

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Statistical Data Analysis

Statistical data analysis was performed using the Statistica 6.0 program (StatSoft®, USA). The results of clinical and anamnestic data and examination of patients were compiled into a database, including information on 100 patients in the form of continuous, categorical and binary variables. Age is given as mean and standard deviation M±0.

Independent groups were compared in the standard way, i.e. Mann-Whitney U test. Pearson's test (%2) was performed to test the statistical significance of differences in values in the compared groups. The differences were significant at p<0.05.

Research results and discussion:

Analysis of the clinical picture of the examined patients before and after dental implantation surgery

In the present study, all patients were divided into four groups, which made it possible to select the most dense bone zones (according to S. Mish classification - D 2: density No. 2, No. 3) for the installation of dental implants.

In Table 3, the data presented indicate that 71 CIs were established for all 47 patients.

Table 3. X-characteristics of the study groups according to the number of implanted implants and bone tissue density.

	1a	1b	2a	2b	3
Number of people	10 people	10 people	10 people	10 people	7 people
Col. DI	15	eleven	20	eleven	eleven
D1	1	2	2	1	0
D2	7	5	7	4	5
D3	5	3	8	6	5
D4	4	2	3	2	7

Analyzing Table 2, we see that with immediate loading of the implants, the state of the implanted bed and the general well-being of the patients looked unsightly in comparison with the well-being of patients in groups IA, IIA.

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In the group of patients with delayed loading, the pain symptom was detected only in 5 people in group 1a and in 2 people in group 2a. In addition, 21 individuals from groups IB and IIB experienced hyperemia and swelling of the mucous membrane at the location of the DI. In groups 1a and 2a, when applying suture material, hyperemia and swelling were clinically detected 15

When installing implants with immediate loading, a week later the local status and general condition of the patients remained the least satisfactory compared to these parameters in groups 1a and 2a (Table 4). After 14 days, there is a clear trace of relief of adverse clinical symptoms for patients in groups IB, IIB, as well as their complete absence in groups IA, IIA.

Table 4 Average CI stability indicators

Density bone tissue	n	Stability of implants according to (ISQ), observation periods		
		At the time of implantation tions	After 3 months at n/h	After 6 months on the military unit
No.1	3	76.6 ±0.5	76.5±0.5	-
No. 2	7	68.2±3.15	67.1±3.16	70.3±1.76
No. 3	8	64.5±3.67	67.9±1.93	68.0±2.0
No. 4	4	50.4±1.1	-	68.5±2.5

Significance relative to baseline $p < 0.05$

Consequently, the parameters “ISQ Stability” CI in the examined patients with bone density Nos. D1-D2 changed slightly over the observation time and had initially high data. Monitoring the increase in “CI stability” in the bones of the upper and lower jaws with measured bone density No. 3 and No. 4 was noted to be higher than in bone tissue with density No. 1 and No. 2.

Research Results

Measurement of hemodynamic parameters

The implementation of this research work included the need for constant monitoring of hemodynamic parameters (A/D and heart rate), its preparation and postoperative observation, due to the fact that the main subjects were patients with somatic cardiovascular pathology.

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After implantation (after 30 minutes), blood pressure values were in the range: in the control group, Systole = 120±5 mmHg, diastole = 71±4 mmHg; heart rate was 70±4 beats/min.

In cases of hypertension - stage I, systole was 126±5 mmHg, diastole. was 87±4 mmHg, (p>0.05), heart rate - 75±7 beats/min, P>0.05. In situations of hypertension - II degree: systole. Approximately determined was 132±3 mmHg, diastole in the range of 89±4 mmHg, heart rate 81±3, level of significance (P) > 0.05 (Table 5).

Table 5. Average hemodynamic parameters before premedication, (M±m, P)

Исследуемые группы	**Артериальное давление, мм.рт.ст**		**Частота сер сокращений**
Артериальная гипертензия	**Систолическое**	**Диастолическое**	
I	142±3; P<0,05	91±3; P < 0,05	89±5, P >
II	149±4; p < 0,05	99±5; P < 0,05	95±3, P >
III	*	*	*
Стенокардия			
I	128±3; P > 0,05	84±4; P > 0,05	88±3, P >
II	137±4; P~0,05	89±3; P~0,05	92±4, P >
III	*	*	*
IV	*	*	*
Контрольная группа	124±5	82±3	79±7

P - level of significance compared to the control group

Considering the fact that diseases of the cardiovascular system, in the compensation stage, are relative contraindications (A. NormanCranin, 1993) to the use of dental implantation, we, in the framework of this study, tried to justify the possibility of its use in patients with arterial hypertension and chronic ischemic heart disease.

Thus, we were faced with the following tasks: the most complete rehabilitation of the patients who applied, and, at the same time, minimizing the risk of complications at any stage of the treatment.

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Analysis of mineral metabolism indicators

To substantiate the successful installation of DI in patients with edentia, PCR (phosphorus-calcium metabolism) was studied, which included the levels of Ca ionized, inorganic P and alkaline phosphatase activity. The results of mineral metabolism indicators are compiled in the table6.

Table 6 Data on mineral metabolism values in individuals undergoing dental implantation (n=87)

Index	results	Laboratory norm
Total calcium (mmol/l)	2.39±0.11	2.15-2.58
Ca (mmol/l)	1.26±0.05	1.12-1.32
P (mmol/l)	1.09±0.17	0.86-1.45
ALP (IU/l)	179±44	98-280

The total content of Sav in the preoperative period of patients who needed dental implantation ranged from 2.09 to 2.63 mmol/l, the average figure was 2.38 ± 0.12 mmol/l. The range of Ca + was from 1.29 to 1.35 mmol/l, the average value was 1.27 ± 0.06 mmol/l.

In the plasma of patients for whom dental implantation was planned, inorganic P values ranged from 0.87 to 1.45 mmol/l, the average value was 1.08 ± 0.16 mmol/l, the variability of alkaline phosphatase ranged from 121 to 354 units /l, on average 179 ± 44 U/L and exceeded the physiological norm only in 2 patients.

The results of comparison of FCO data in the preimplantation period are reflected in Table 7

Table 7 Comparative analysis in groups according to biochemical parameters

Index	Group I (n=33)	Group II (n=33)	P=
Total calcium (mmol/l)	2.36±0.13	2.38±0.11	0.6
Ca (mmol/l)	1.25±0.05	1.28±0.04*	0.001
P (mmol/l)	1.12±0.16	1.07±0.16	0.09
ALP (U)	174±31	183±33	0.9

Consequently, in the group of patients with rejected DI, there were high levels of Ca (free ionized), total Ca, and inorganic P. In patients with an undesirable outcome of the operation, a significant difference in ALP activity was detected and it was stated to be high.

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Analysis of the correlation coefficient between DI rejection and biochemical data parameters is shown in Table 8.

Table 8 Analysiscorrelation lines of these enzyme indicators

Mineral metabolism parameters	Correlation coefficient r(Spearmen)	R
alkaline phosphate	0.6	=0.003
Ca2+	0.5	=0.004

So, a positive correlation was revealed between the number of rejected DIs, the degree of alkaline phosphatase activity (r = 0.6) in the blood plasma and the presence of ionized Ca (r = 0.5).

There were no statistically significant correlations between other indicators and cases of early failure of dental implants.

Results of using the drug CALCIVIT- Swiss energy

Analyzing the phosphorus-calcium metabolism (PCA) of patients, we identified a group of people with a presumably increased risk of rejection of dental implants and tried to improve the osseointegration of the DI usingCALCIVIT- Swiss energy.CALCIVIT- Swiss energychosen because it has a dual effect on bone metabolism: the anabolic effect is supported by the activation of osteoblasts, anti-catabolism due to the suppression of osteoclast function.

A vitamin-mineral complex was prescribed in the pre- and postoperative period for a month, the daily dose was 100-200 mg.

By choice in groups that were recommendedCALCIVIT-Swiss energyindicators of Ca ionized, reaching 1.25 mmol/l, and alkaline phosphatase activity greater than 185 IU/l. The group consisted of 33 persons aged from 30 to 50 years, of which there were 16 women and 17 men, they underwent dental installation of DI. In the postoperative period, there was a comparison group consisting of 10 people, 5 females and 5 males; they were given a CI, but they did not take CALCIVIT-Swiss energy. The follow-up period was 1 year (Table 9).

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Table 9 Patients receiving CALCIVIT-Swiss energy, according to biochemical parameters and the number of established and rejected MDIs

Index	Group NG (n=33)	SG Group (n=33)	P=
Age (years)	45±3.6	40±3.7	0.6
Total number of installed DIs	46	20	0.07
Number of lost CIs	1	4	0.02
Satot (mmol/l)	2.38±0.12	2.39±0.11	0.6
Ca (mmol/l)	1.26±0.02	1.26±0.04	0.04
pH (mmol/l)	1.09±0.14	1.12±0.18	0.4
ALP (IU/l)	207±42	148±14	0.003

CALCIVIT-Swiss energy in those who tookThe average age of the patients was 45 ± 0.6 years. In the comparison group, the average number of years was 41 ± 0.5 years, which meant that there was no statistically significant difference between both groups. CALCIVIT- Swiss energy,In the treated patients, 46 DIs were implanted, and in the SG - 20 DIs, of which 18 were implanted in the upper jaw. Although the number of dental implants installed was higher in the group of people receivingCALCIVIT- Swiss energy($p = 0.05$).

In the group of people who usedCALCIVIT- Swiss energy,ionized Ca was in the range from 1.24 to 1.29 mmol/l. The range of levels in the comparison group was in a fairly wide range from 1.14 to 1.33 mmol/l and amounted to a statistically significant higher number compared to the control group, ranging from 1.26 ± 0.03 to 1.24 ± 0.05, respectively. mmol/l

In patients of the CG group, blood plasma with CSF activity fluctuated from 128 to 343 IU/l, with an average value of 194 ± 53 IU/l, and in the CG it ranged from 122 to 210 IU/l, with an average value of 162 ± 25 IU /l. Research results, usersCALCIVIT- Swiss energy, had the most significantly increased alkaline phosphatase activity ($p = 0.04$). So,introduction of the drug into the treatment plan in the postoperative periodCALCIVIT- Swiss energywithin a month allowed, in our opinion, to obtain a significant improvement in the dental implantation operation.

Patients who tookCALCIVIT- Swiss energy, completed treatment with a favorable prognosis and had a low level of alkaline phosphatase activity.

There was a positive correlation between the number of rejected DIs, ionized calcium concentration and alkaline phosphatase activity as well.

Correlation analysis examined in patients in the group who did not receiveCALCIVIT-Swiss energy, also demonstrated a direct negative correlation between the number of years and the number of non-survival CIs: R = -0.3, p = 0.04.

Analysis of early local changes after dental implantation

When analyzing studies conducted by asking patients about their symptoms and pathological manifestations: the symptom-swelling was most noticeable in the CG group than in the observation group using the implantation method we proposed (Fig. 7). The proportion of patients with swelling and edema within the maximum range, equal to 3 points in the CG was 26.8%, while in the MG patients ($p<0.05$) a noticeably significant difference was observed - 6.1%.

In control in the group of patients with less pronounced edema, 2 points were 40.8% higher than in the MG, equal to 30.6%. Much more patients with mild edema were noted in the MG (48.5%) compared to the CG, where it was significantly lower with such symptoms, their percentage was 9.4%. ($p<0.05$). In the main group, the proportion of patients who had no edema at all or whose edema was rated 0 points was 6.1%.

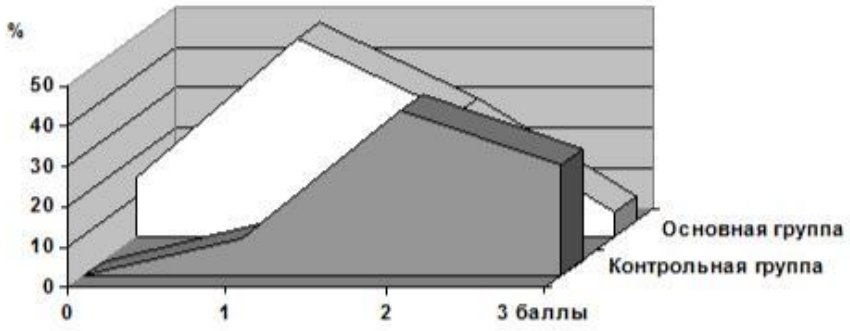

Fig. 7. Post-implantation edema in both study groups.

In the post-implantation period, there was a small number of patients with this sign of 4 points - 6.6 and 1.3% of patients in each group (Fig. 8). At the same time, among the main group of patients who were treated with the method we proposed, there were no bruises

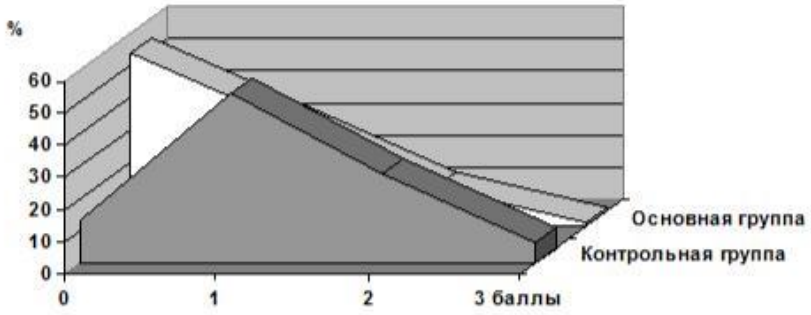

Fig. 8. Symptom of “bleeding” in the studied groups.

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According to the pathological sign of pain (Fig. 9), 57.3%, half of the patients in the OG denied pain, and in the CG, on the contrary, only 3 (2.7%) patients noted the absence of pain. At the same time, it must be said that in the SG, pain equal to 2 and 3 points accounted for 30.4 and 39.1% of patients. In the group whose treatment was based on the use of a new approach, a significant decrease ($p<0.05$) in pain symptoms at a level of 2 points was found in only 3.8%, and in 2.5 percent of individuals it was rated at 3 points.

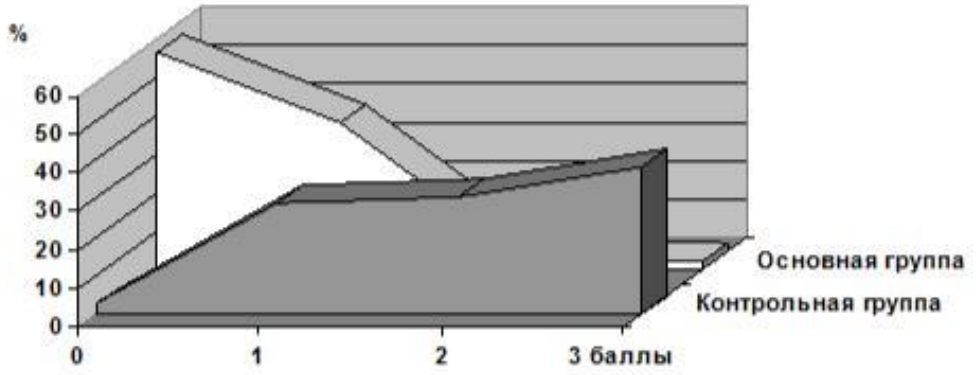

Fig. 9 Pathological sign - pain after surgery in the studied groups

According to the pathological sign - chewing disorder, the percentage of patients in the group was significantly ($p<0.05$) higher according to the score of 1 point, there were 57.3% of them in the control group. group – 42.1%. Immediately after implantation, 1 week later, in the comparison groups CG and OG, there were no noticeable differences, amounting to values equal to 40.7 and 39.5%, respectively (Figure 10).

2 points for chewing disorder was 12.8% and 3 points in the comparison group-CG in 5.2% of patients. 2.5% OG value and, moreover, no significant differences were detected.

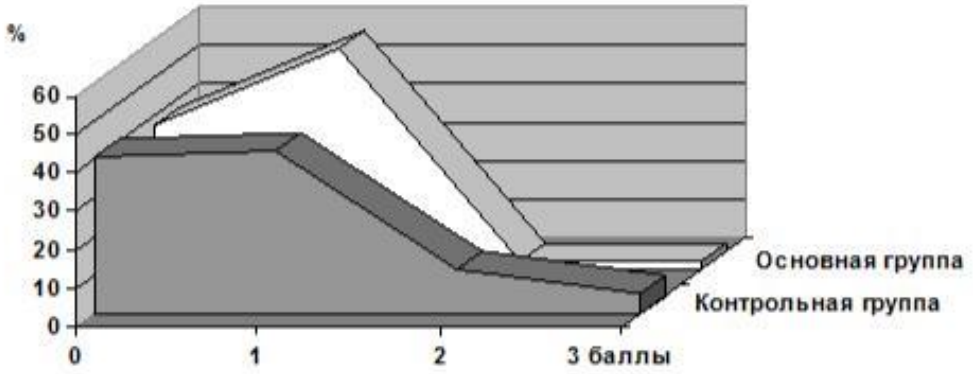

Fig. 10 Sign of chewing disorder in the study groups

According to our observation data in the early post-implantation period, it was noted that the use of the proposed scheme of preoperative preparation for implantation reduces the frequency of local pathological manifestations (pain, swelling and bleeding) and changes in organ function.

The pathogenic effect of concomitant general somatic pathology was manifested by a decrease in the volumetric and linear speeds of blood flow in the microvasculature of the hard and soft tissues of the oral cavity, a decrease in the density of bone tissue of both jaws in Hounsfield units, and a decrease, although not pronounced, in the amount of bone mass.

Based on the data obtained, we recommend the use of dental implantation for arterial hypertension of I and II degrees of severity and CIHD for angina pectoris, I and II.

Conclusions:

1. An algorithm for the actions of the medical staff of the dental clinic has been created, which makes it possible to achieve an objective assessment of both the general condition of the patient with hypertension and the local status of the tissues in the area of the planned intervention.
2. Exact criteria have been developed to determine the very possibility of endosseous implantation. In accordance with them, this manipulation is possible only in cases of hypertension of I and II degrees of severity.

During the study time, dynamic changes in DI stability indicators, regardless of bone density, showed a noticeable increase. This confirms the results obtained regarding the dynamic growth of implant stability in jaws with bone density.

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