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ASSESSMENT OF REGULATORY AND REPARATIVE OSTEOGENESIS IN AUGMENTATION AREA BASED ON ORAL FLUID METABOLIC PARAMETERS

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ABSTRACT — Cases of serious atrophy of the alveolar processes occurring during dental implantation could be restored saving the respective bone volume. There is also a need for postoperative monitoring of the physiological osteogenesis effectiveness in the peri-implant zone. Our paper offers an assessment of regulatory and reparative osteogenesis in the augmentation zone subject to the oral fluid (OF) metabolic parameters obtained from 59 patients. Biochemical methods for oral fluid examination are non-invasive approaches that allow identifying pathologies at the tissue and cellular level. The proposed metabolic indices of collagen C-telopeptide, osteocalcin, alkaline phosphatase (AP) and parathyroid hormone helped identify augmentation zone of disturbed reparation in 6.8% of patients, whereas the worst complications were to be observed one month after the implantation. Through this period, however, orthopantogram featured no pathological change. Given that, the biochemical markers of bone tissue remodeling are employed for early identification and developing a forecast regarding treatment effectiveness.

KEYWORDS — oral fluid, metabolic parameters, augmentation, dental implantation.

INTRODUCTION

Osseointegration of implants often has to be performed under significant atrophy of the alveolar processes [1–5]. This is most common in the upper jaw lateral parts at the maxillary sinuses. The lack of bone volume prevents implants from being placed properly and, as a result, there arises a need for bone-plastic materials to be involved, as well as ways to be found for of bone tissue directed regeneration [6]. Osseointegration in the augmentation zone should be followed, which is to done to exclude complications [7, 8]. X-ray is, undoubtedly, the main choice here, yet it is important to identify early signs of any inflammation and destructive process affecting the bone and soft tissues at the peri-implant before any clinical manifestations, which, in turn, will allow starting treatment, both due and timely. Biochemical methods for studying OF belong to modern non-invasive approaches [9, 10], which offer a way to identify the pathological process at the tissue and cellular level. All this allows assessing reparative osteogenesis at the peri-implant zone.

Studying metabolic process directly in the bone tissue in vivo is a complex issue, which explains the relevance of opting for a non-invasive method that implies assessing the bone tissue status based on data obtained through oral fluid examination, thus also making indirect judgment concerning it.

Aim of study:
to assess regulatory & reparative osteogenesis in the augmentation zone based on oral fluid metabolic indicators.

MATERIALS AND METHODS

The clinical study involved 59 people — 21 males (35.6%) and 38 females (64.4%) aged 35–60. The patients were divided into two groups. Group 1 (main group) included 42 persons (71.2%), who were at the stage of osseointegration in the augmentation zone of allogeneic demineralized lyophilized spongy bone tissue at the maxillary sinus. Group 2 (control group) included 17 (28.8%) clinically and somatically healthy individuals. The groups were comparable in terms of age, gender, and initial periodontal status. The object of the study was the oral fluid.

The study itself focused on biochemical markers of bone modeling (osteocalcin, alkaline phosphatase, parathyroid hormone) and collagen C-telopeptide — a marker of bone resorption (β-Gross Laps), while the obtained data were analyzed and underwent statistical processing.

RESULTS AND DISCUSSION

For the purpose of matching the metabolism of physiological osteogenesis vs the inflammation & destruction process, we set the metabolism biochemical markers indices in the control group aiming thus to identify the values of the norm criterion.

In the control group, the osteocalcin content was found to be 0.55±0.006 ng/ml; alkaline phosphatase — 26.9±2.68 U/l; parathyroid hormone — 1.89±0.13 ng/ml, collagen C-telopeptide — 0.01±0.02 ng/ml. Similar indicators were examined in the main group. The analysis showed that during Week 1, metabolic parameters remained within norm in all the patients of the main group. The subsequent analysis, though, revealed that the dynamics changed within one month (Table 1).

compared with the control group — in another 4 patients.

The parathyroid hormone is a polypeptide with an action aimed at an increase of calcium ions concentration and phosphates concentration in blood plasma.

CONCLUSION

In view of the above, a comprehensive assessment of the bone metabolism parameters in the patients' OF manifest certain changes. On the one hand, an increase

Table 1. *Oral fluid metabolic parameters dynamics in patients of the main group (n=42) depending on the follow-up period (M±m)*

Time	Number of observations	Indicator			
		Collagen C-telopeptide, ng/mg	Osteocalcin, ng/ml	Alkaline phosphatase, U/l	Parathyroid hormone, ng/ml
Week 1	n=42	0.01±0.003	0.56±0.006	27.0±2.45	1.89±0.14
	n=0	0.01±0.002	0.57±0.005	26.3±1.8*	2.01±0.17
Week 2	n=40	0.01±0.05	0.55±0.06	27.02±2.36	1.88±0.14
	n=2	0.015±0.003	0.75±0.04**	19.0±3.1**	2.35±0.12**
Week 3	n=39	0.01±0.04	0.57±0.08	28.3±1.64	1.88±0.13
	n=3	0.02±0.005**	0.82±0.04*	10.9±1.7*	2.51±0.23*
1 month	n=38	0.009±0.09*	0.56±0.09	27.3±1.73	1.86±0.12
	n=4	0.023±0.0009*	0.93±0.07*	5.7±0.4*	2.59±0.21*

Note. *Reliability of deviation from control: * – at p<0.05; ** – p=0.01*

2 weeks following augmentation, for instance, there was a tendency observed, which featured a certain increase in collagen C-telopeptide in 2 patients; after 3 weeks, it doubled sharply in 3 patients, whereas a month later — in 4 patients. An increase in this criterion points at a destructive process in the augmentation zone, since during the resorption process, the telopeptide with the remnants of collagen molecules penetrates the oral fluid. However, the destruction cannot be judged based on one indicator only, therefore, other criteria were additionally employed to assess the osteogenesis status. The osteocalcin content was studied, and its increase in the OF, which was observed in 4 patients after 1 month, indicated a decrease in the mineralization at the area of augmentation, contributing to relative depletion of plastic resources.

The alkaline phosphatase levels in Week 1 went down slightly in one patient (0.97%), yet, 4 patients had the maximum decrease — more than 4 times down – in a month's time. The decrease in the alkaline phosphatase activity serves proof to improper conditions for osteogenesis, namely, reduced inorganic phosphate supply at the stage of bone tissue mineralization.

The parathyroid hormone dynamics from Week 1 until 1 month of observation shows it doubling — if

in C-telopeptide, parathyroid hormone and osteocalcin are indicative of destructive processes in the augmentation zone, whereas on the other, a decreasing activity of the alkaline phosphatase also indicates a slower bone formation. However, against the deep metabolic disorders, there was no change detected in these patients' orthopantomograms, which indicates early signs of structural and regulatory insufficiency. In this regard, given the fact that that 4 out of 59 patients (6.8%) had a disturbed physiological osteogenesis, which reached its maximum after 1 month, it appears reasonable to assess the above-described oral fluid metabolic parameters during the said period, thus preparing to take appropriate measures.

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