

ORIGINAL ARTICLE

IMMEDIATE IMPLANTATION AND AESTHETIC COMPONENT AS A RESULT OF SUCCESSFUL FORECAST TREATMENT

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ABSTRACT

The aim: Improving the method of immediate implantation in the aesthetic zone in case of bone deficiency to obtain the highest aesthetic and predictable treatment result.

Materials and methods: Under clinical observation were 32 patients with different clinical diagnoses in the anterior part of the upper jaw aged 30 to 55 years. In the course of recent advances, the following methods have been used: clinical protocol of immediate implantation with passive exceptional loads by temporary orthopedic constructions, X-ray method using cone-beam computed tomography, statistical analysis.

Results: After surgical treatment of patients 1 year after surgery, the distribution of biotypes was as follows: in group 1 – thick biotype 12.87%, medium – 87.13%; in group 2 – thick biotype 27.04%, medium – 72.96%, with $p < 0.05$. According to the results of CT, the distance between the implant and the vestibular in the first group was after 6 months – 1.67 ± 0.04 mm ($p < 0.05$); in the second group of the study we obtained the following results after 6 months – 1.59 ± 0.06 mm ($p < 0.05$).

Conclusions: The advanced method of immediate implantation in the anterior part of the upper jaw allows to change the biotype of soft tissues, improve the color spectrum of the gums, increase the thickness of soft tissues with connective tissue autograft, and increase gum density and fixation of osteoplastic material in the presence of defect), as well as reduce the risk of recession.

KEY WORDS: Immediate implantation, immediate passive loading, mucosal biotype, smile zone aesthetics, connective tissue graft (CTG)

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INTRODUCTION

The focus of promising research in the field of oral implantology has shifted towards addressing the issues of achieving long-term and stable results of implant treatment, especially in the anterior aesthetic segments of the jaws [1]. Bone remodeling, which actively takes place in the first 3-6 months after tooth extraction, is characterized by the loss of almost 50% of bone mass, as well as significant negative dynamics of the condition and volume of soft tissues: with the development of «tension syndrome», which further complicates the clinical situation, especially in the aesthetic department of the jaws [2,3]. Such changes require multi-stage preparation for implant placement (bone and soft tissue augmentation), which increases the duration of rehabilitation, and often does not provide a successful outcome [4,5]. At the present stage of development of implantology, the focus is on immediate implantation [6]. Thus, implantation in the cavity of a removed tooth is considered an acceptable and quite predictable procedure. Moreover, in many cases, single-stage implantation gives better results compared to the classical two-stage technique [7-9]. Widespread introduction of the method of immediate implantation minimizes the loss of bone and soft tissue and the likelihood of aesthetic and functional defects [10-12]. Therefore, often all possible multi-stage surgical interventions lead to unsatisfactory aesthetic results and

the development of gingival recessions [9]. This problem is always difficult to solve and may occur some time after implant placement and prosthetics (weeks, months, years), which does not provide a high and predictable aesthetic result [7]. All of the above determined the relevance of this study.

THE AIM

Improving the method of immediate implantation in an aesthetic area with a different biotype of the gums with a deficiency of bone tissue to obtain the most predictable high aesthetic outcome of treatment.

MATERIALS AND METHODS

The clinical study was conducted on the basis of the Department of Postgraduate Dentistry of Uzhgorod National University and the Dental Clinic «Art Dentistry» (Zaporozhye, Ukraine). Under clinical observation were 32 patients with different clinical diagnoses in the anterior part of the upper jaw – from the second premolar on one side to the second premolar on the other side. At diagnosis used the generally accepted classification of ICD-10. The study group included: 13 patients (40.63%) with a diagnosis of «fracture of the anterior tooth root» of which 8 people

(61.54%) who had previously undergone orthopedic or endodontic treatment have destruction of the vestibular wall of the alveoli, treatment or recovery which is impossible, and 19 people (59.37%) have «chronic periodontitis». The study was carried out taking into account the main provisions of GCP ICH and the Helsinki Declaration on Biomedical Research, the Council of Europe Convention on Human Rights and Biomedicine (2007) and the recommendations of the Bioethics Committee of the Presidium of NAMS of Ukraine (2002) and the positive conclusion of the Uzbek. The age of patients ranged from 30 to 55 years, including men – 12 people (37.5%), women – 20 people (62.5%). Characteristics of patients by age are presented in table I.

All patients before the operation were examined according to the developed «Aesthetic cards», which are based on a modified scale of «pink aesthetics» R. Fürhauser et al. [13] (Figure 1).

X-RAY EXAMINATION

Using a cone-beam CT scan (ORTHOPHOS XG 5, Sirona, Germany), all patients measured the thickness and height of the bone mass of the alveolar ridge, as well as the thickness of the vestibular wall of the alveoli in millimeters at points A1, A2, A3 (Figure 2). At the same time determined the indicators of soft tissues in the area of intervention – radiodensity of the gums on the Hounsfield scale (HU). All these parameters were measured 6 months and 1 year after surgery. The indicators received in the remote post-operative period – in 1 year became especially significant as emergence of recessions in the field of implants with development of aesthetic complications is registered at this time.

PROTOCOL OPERATIONS

Patients underwent immediate implantation with passive occlusal loading with temporary orthopedic structures [14] according to the traditional protocol (Figure 3) in the area of the anterior maxillary tooth (Schwartz-Arad D. et al., 2007) under local anesthesia Sol. Articaini 4% with vasoconstrictor 1: 100000 and with a single change of gum biotype to prevent the formation of a recession in the implant and reduce aesthetics in the future orthopedic structure using a free connective tissue graft (CTG). At the end of the study, patients were divided into two groups of 16 patients each: 1 – immediate implantation and plastic surgery using a connective tissue graft (CTG) according to the standard protocol and 2 – using a connective tissue graft with an epithelial edge (invention patent [15]). The distri-

bution of patients into groups was carried out randomly and was not fundamental. All grafts were removed from the hard palate in the projection from the first premolar to the second molar, where the glandular zone of the hard palate was located [16]. Collection of connective tissue graft was performed under local anesthesia in the area of missing teeth on the upper jaw or receding 2-3 mm from the teeth with a scalpel 15C. Collection of connective tissue autograft was performed by the method of two or three incisions according to standard methods [16].

STATISTICAL ANALYSIS

The results of laboratory and clinical studies were processed by the methods of variational statistics with determination of the average value, its errors, the Student's t test for multiple comparisons, using Excel (MS Office 2010, Microsoft, USA) and STATISTICA 6.0 (StatSoft, USA). Differences of indicators at significance level $p < 0.05$ were considered statistically significant.

RESULTS

When examining patients, the main parameters were entered in the «Aesthetic Card» six months and a year after immediate implantation. In patients of both groups, in addition to the main indicators, the thickness, width and length of the soft tissue autograft were measured. The average thickness of the autograft in group 2 (CTG + EM) – 1.29 ± 0.18 mm in the epithelial edge was 1.72 ± 0.09 mm, while in group 1 (CTG) it did not exceed 1.24 ± 0.06 mm. After surgical treatment of patients after 6 months in both groups there was a significant increase in the thickness of the mucous membrane on the vestibular side (group 1 by 46.84% with thin biotypes and 66.88% with medium biotypes, and in group 2 by 87.07% with thin biotypes, by 57.94% with the average biotype ($p < 0.05$), which indicates a change in biotypes in the operation (Figure 4).

One year after surgery, the distribution of biotypes was as follows: in group 1 – thick biotype 12.87%, medium – 87.13%; in group 2 – thick biotype 27.04%, medium – 72.96%, with $p < 0.05$. Patients with a thin biotype were absent due to transformation of mucosal thickness (Figure 5).

Compared with group 1, where immediate implantation was performed using a connective tissue graft, in the group using a connective tissue graft with an epithelial margin, there was a positive dynamics of change of «pink aesthetics», namely improvement of the color spectrum of gums in the implantation area (table II).

During the study, the width of the area of keratinized attachment of the gums in group 1 at the end of 6 months after surgery was 4.75 ± 0.28 , $p < 0.05$, and after 1 year – 4.61 ± 0.37 , $p < 0.05$,

Table I. Distribution of patients by age and gender categories.

Age category, years	30-36	37-43	44-50	51-55	TOTAL
Number of women (%)	4(20)	3(15)	6(30)	7(35)	20(62,5)
Number of men(%)	2(16,6)	4(33,4)	3(25)	3(25)	12(37,5)

Table II. Comparative dynamics of changes in aesthetic parameters after 6 months and 1 year after dental implantation of the shell in group 1 (CTG) and group 2 (CTG+EM) ($M \pm m$)

Indicator	Group 1 (CTG)			Group 2 (CTG+EM)		
	Before the operation	After 6 months	After 1 year	Before the operation	After 6 months	After 1 year
The width of the area of keratinized attachment of the gums (WAKAG)	4,78±0,33, p <0,05	4,75±0,28, p <0,05	4,61±0,37, p <0,05	7,02±1,12, p <0,05	6,96±1,02, p <0,05	6,82±1,17, p <0,05
The difference between the zeniths of the gingival contour	0,08±0,06, p <0,05	0,08±0,06, p <0,05	0,07±0,05, p <0,05	0,12±0,06, p <0,05	0,12±0,06, p <0,05	0,11±0,05, p <0,05
The thickness of the alveolar process, taking into account the mucous membrane	9,21±0,64, p <0,05	9,22±0,78, p <0,05	9,24±0,81, p <0,05	9,24±0,98, p <0,05	9,28±1,12, p <0,05	9,31±1,09, p <0,05
Height of the mesial interdental papilla	2,14±0,56, p <0,05	2,12±0,74, p <0,05	2,09±0,68, p <0,05	2,34±0,72, p <0,05	2,32±0,54, p <0,05	2,29±0,42, p <0,05
Height of the distal interdental papilla	2,21±0,46, p <0,05	2,18±0,76, p <0,05	2,16±0,74, p <0,05	2,34±0,68, p <0,05	2,33±0,48, p <0,05	2,3±0,28, p <0,05

Table III. Indicators of changes in vestibular wall thickness in patients of group 1 (CTG) and group 2 (CTG + EM) ($p < 0,05$), mm.

	Group 1 (CTG)		Group 2 (CTG+EM)	
	Before the operation	After 6 months	Before the operation	After 6 months
Point A1	0,38 ± 0,46	0,26 ± 0,06	0,42 ± 0,34	0,21 ± 0,04
Point A2	0,63 ± 0,62	0,24 ± 0,04	0,49 ± 0,61	0,23 ± 0,05
Point A3	0,87 ± 0,74	0,43 ± 0,05	0,79 ± 0,74	0,33 ± 0,04

Table IV. Dynamics of changes in the range of radiodensity of the gums in patients of the first and second groups (HU).

	A1(HU)		A2(HU)		A3(HU)	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Before the operation	From +59 to -447	From +62 to -450	From +288 to -229	From 287 to -237	From +599 to -238	From +611 to -242
After the operation	From +516 to -149	From +520 to -154	From +588 to -398	From +593 to -403	From +661 to -270	From +650 to -275

which is 0.17 ± 0.35 less than before surgery. In group 2, the width of the area of keratinized attachment of the gums at the end of 6 months after surgery was 6.96 ± 1.02 , $p < 0.05$, and after 1 year -6.82 ± 1.17 , $p < 0.05$, which is 0.2 ± 1.15 less than before surgery. The difference between the zeniths of the gingival contour remained stable relative to preoperative parameters at the end of 6 months in group 1 was 0.08 ± 0.06 , $p < 0.05$, after 1 year -0.07 ± 0.05 , $p < 0.05$, and in group 2 – after 6 months 0.12 ± 0.06 , $p < 0.05$, and after 1 year -0.11 ± 0.05 , $p < 0.05$. In both groups there was a slight positive dynamics of the thickness of the alveolar ridge, taking into account the mucous membrane (Figure 6). In group 1 (CTG) there was a slight decrease in the height of the mesial interdental papilla both after 6 months 2.12 ± 0.74 , $p < 0.05$, and after 1 year 2.09 ± 0.68 , $p < 0.05$ after surgery. After 1 year, the difference relative to preoperative parameters averaged -0.05 ± 0.62 , $p < 0.05$. In the second group (CTG + EM) there was also a slight negative dynamics of the height of the mesial interdental papilla as after 6 months 2.32 ± 0.54 , $p < 0.05$ and after 1 year 2.29 ± 0.42 , $p < 0.05$ after surgery. After 1 year, the difference relative to preoperative parameters averaged -0.05 ± 0.57 , $p < 0.05$. In both study groups there was a decrease

in the distal height of the interdental papilla, after 1 year the difference relative to the values before surgery for group 1 was (-0.05 ± 0.6) , $p < 0.05$, and for group 2 -0.04 ± 0.48 , $p < 0.05$.

According to the results of conical – computed tomography (CT) (table III) in patients of the first group of the study, the thickness of the vestibular wall at point A1 at 6 months after surgery was 0.26 ± 0.06 mm ($p < 0.05$), in at point A2 after 6 months there was a significant decrease in the index to 0.24 ± 0.04 mm ($p < 0.05$), and at point A3 the thickness of the vestibular wall after 6 months did not exceed 0.43 ± 0.05 mm ($p < 0.05$). In patients of the second group, the thickness of the vestibular wall, measured at point A1 6 months after surgery was 0.21 ± 0.04 mm ($p < 0.05$). At point A2 after 6 months there was a significant decrease in the index to 0.23 ± 0.05 mm ($p < 0.05$). At point A3, the thickness of the vestibular wall after 6 months did not exceed 0.33 ± 0.04 mm ($p < 0.05$). The dynamics of the change in the indicator in groups 1 and 2 is shown in Figure 7.

Ranges of radiodensity of gum tissues after 6 months in the studied groups are distributed in table IV. Measurements in Hounsfield units of soft tissue density on the basis of CPCT data are not objective enough, however,

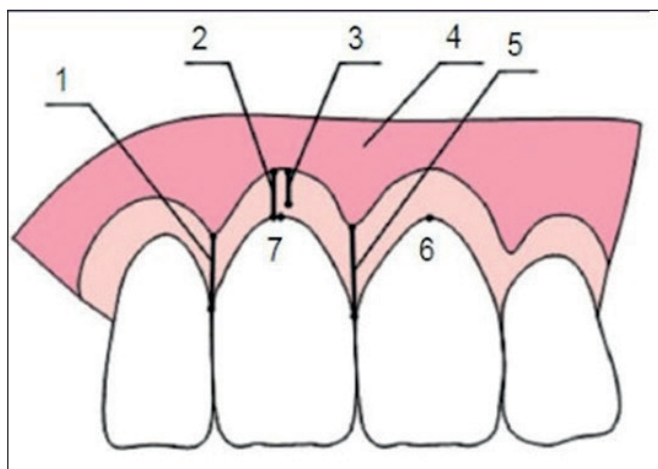


Fig. 1. The main aesthetic parameters of soft tissues: 1- the height to the distal interdental papilla, mm; 2 - the depth of the vestibule of the oral cavity, mm; 3 - zone of keratinized (attached) gums, mm; 4 - zone of non-keratinized (unattached) gums, mm; 5- the height to the mesial interdental papilla, mm; 6- zenith of the gingival contour of the tooth of the same name on the opposite side; 7- zenith of the gingival contour of the examined tooth.

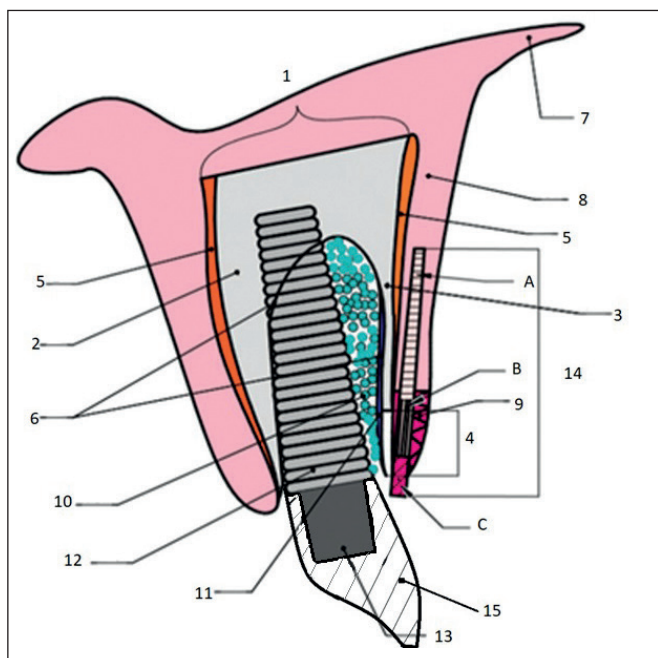


Fig. 3. Scheme of dental implant in stallation. 1- alveolar process; 2- palatal wall of the alveolar process; 3- vestibular wall of the alveolar process; 4- bone defect of the vestibular wall; 5 - periosteum; 6 - the boundaries of the hole of the removed tooth; 7- transitional fold; 8- non-keratinized gums; 9- keratinized gums; 10- osteoplastic material; 11 - collagen membrane; 12- dental implant; 13 - shaper clear; 14- combined soft tissue autograft: A- connective tissue area; B- deep epithelialized zone; C - epithelial edge (1.5 mm), 15 - temporary orthopedic structure.

based on changes in radiodensity ranges at 6 months after surgery that the use of connective tissue graft (CTG) and connective tissue autograft with epithelial edge (CTG + EM) during implantation can increase the density of soft tissues in the field of surgery.

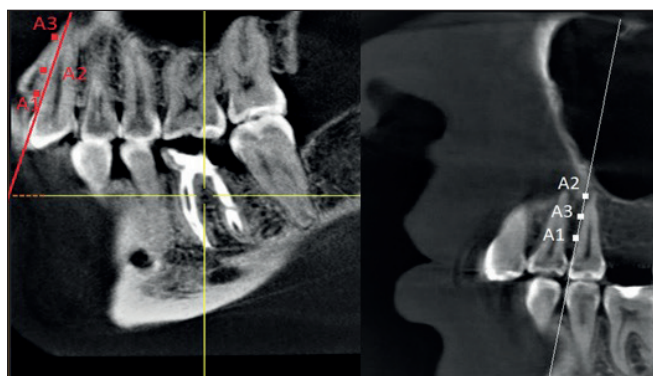


Fig. 2. Diagnostic points for determining the thickness of the vestibular wall (A1, A2, A3). A1- point in the projection of the top of the alveolar ridge; A2- point in the projection of the apex of the tooth root on the vestibular wall; A3 is a point in the middle of the line drawn between A1 and A2.

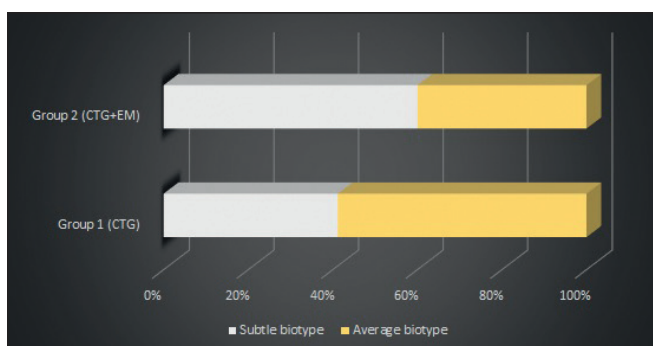


Fig. 4. Comparative dynamics of changes in the thickness of the mucous membrane in group 1 (CTG) and group 2 (CTG+EM) 6 months after surgery.

The distance between the implant and the vestibular wall immediately after surgery according to the CT in the first group was 1.76 ± 0.05 mm, and after 6 months - 1.67 ± 0.04 mm ($p < 0.05$); in the second group of the study, we obtained the following results: before surgery - 1.71 ± 0.04 mm, and after 6 months - 1.59 ± 0.06 mm ($p < 0.05$) (Figure 8).

DISCUSSION

In a short time after tooth extraction there is a significant deficit of bone, which leads to a lack of soft tissue. A number of anatomical and physiological processes occurring in the alveolar ridge after extraction are determined by the close phylogenetic relationship of tooth structures and surrounding bone and gums (Rodriguez A. M. et al., 2012; Araujo M. G. et al., 2015). One of the most important prognostic criteria for long-term implant life is the width of the area of keratinized attached gum. It is this area that becomes a powerful barrier that protects the adjacent bone from bacterial invasion and subsequent resorption [17]. In our study in both the 1st and 2nd groups, the indicator remained stable: almost unchanged or not significantly compared with the value before surgery ($p > 0.05$). This once again confirms that immediate implantation allows to preserve the architecture of soft tissues, and the use of soft tissue graft helps to preserve interdental papillae, preventing the formation of «black triangles» and providing a high aesthetic

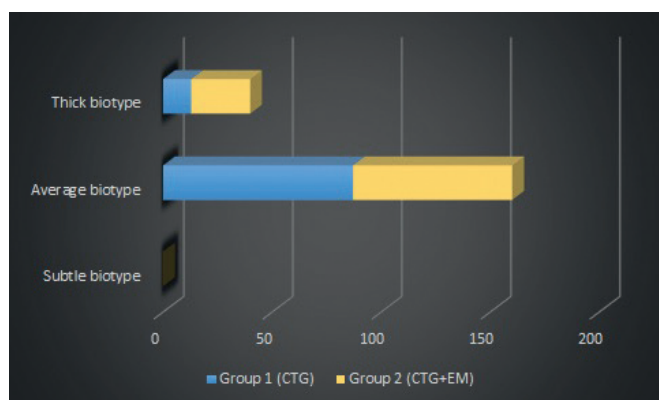


Fig. 5. Comparative dynamics of changes in the thickness of the mucous membrane in group 1 (CTG) and group 2 (CTG+EM) 1 year after surgery.

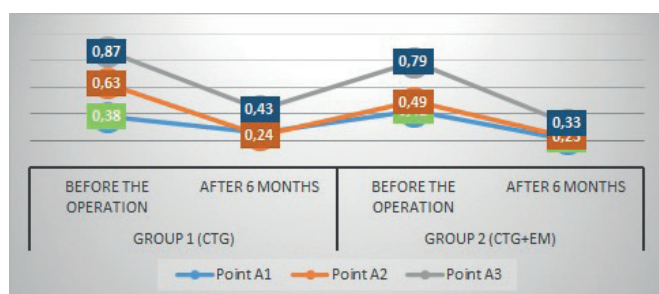


Fig. 7. Comparative dynamics of changes in vestibular wall thickness in patients of group 1 (CTG) and group 2 (CTG + EM) ($p < 0,05$), mm.

result [17,18,19]. The decrease in vestibular wall thickness in the 1st and 2nd groups in comparison with the values before surgery was more than 50%, which confirms the data of works [2,3,20]. The use of soft tissue grafts for immediate implantation allowed to change the biotype of soft tissues, increase the thickness of the gums by 68% ($p \leq 0,05$), preserve and correct the zenith of the marginal margin. In the anterior part of the jaws, the vestibular wall is most prone to destructive processes, due to the large number of Sharpeev fibers contained in it and its small thickness (Lin G.- H. et al., 2014). According to a number of studies [21] in the anterior jaw, the thickness of the anterior wall of the alveoli rarely reaches 1 mm and in almost 100% of cases is resorbable (Braut V. et al., 2011; Januario et al., 2011; Vera C. et al., 2012; Wang HM et al., 2014). Various pathological processes of inflammatory and traumatic nature enhance the natural mechanism of resorption and lead to irreversible destructive changes, especially in the teeth of the aesthetic zone (Alvarez-Camino J. C. et al., 2013). In connection with the above, research in modern dentistry is aimed at finding methods of rehabilitation of patients that will reduce the level of bone resorption, preserve the primary volume of soft tissues, reduce treatment time, while maintaining the most natural appearance of the smile zone. One such method is immediate implantation (Schwartz-Arad D. et al., 2012; Malchiodi L. et al., 2013). However, in a detailed study of this issue, some researchers began to limit the indications for this method due to the development of aesthetic complications: recession in the field of implants installed immediately after removal of the teeth of the anterior maxilla, soft tissue discoloration, which is especially relevant in fine biotypes of the gums and with a

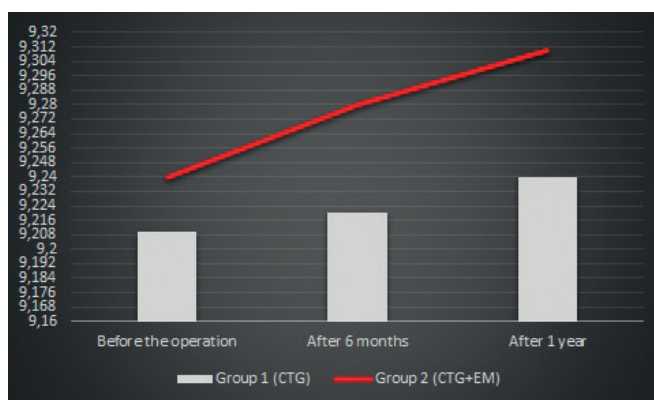


Fig. 6. Comparative dynamics of changes in the thickness of the alveolar ridge, taking in to account the mucous membrane in group 1 (CTG) and group 2 (CTG + EM) relative to the values of the preoperative period ($p < 0,05$).

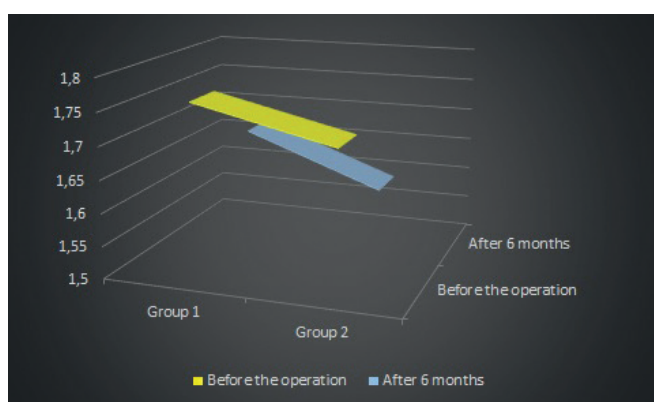


Fig. 8. Comparative dynamics of changes in the distance between the implant and the vestibular wall in patients of the study groups, mm.

high smile line, the appearance of «black triangles» between the restoration and the teeth (Lindeboom JA et al., 2006; Palatella P. et al., 2008; Block MS et al., 2009; Chen ST et al., 2009; Roe P. et al., 2012; Vera C. et al., 2012). The problem is not fully resolved, there are many controversial issues, so this paper conducted research, the main purpose of which was to improve the method of immediate implantation with passive loading of temporary orthopedic structures in the aesthetic zone with bone deficiency with different mucosal biotype to obtain the highest aesthetics the predicted outcome of treatment.

CONCLUSIONS

Thus, immediate implantation in the anterior part of the jaws is an alternative and promising method, as it allows to preserve the anatomy of the alveolar ridge, to provide an acceptable aesthetic result, to reduce the time of rehabilitation of patients. The use of immediate implantation according to the classical protocol is limited in conditions of destructive changes or insufficient thickness of the vestibular wall due to the high risk of recession in the implant in the long term and gum discoloration in the structure due to lysis of the cortical plate and metal translucency through soft tissues. The advanced method of immediate implantation in the anterior part of the upper jaw allows you to install the implant directly into the hole of the removed tooth; change the biotype of

soft tissues, improve the color spectrum of the gums, increase the thickness of soft tissues with a connective tissue autograft, and the presence of a dense epithelial edge and deepithelialized zone with a large number of collagen fibers can increase gum density and fixation of osteoplasty walls (not more than 5 mm), and reduce the risk of recession. The use of CTG + EM allows you to save the volume of the interdental papillae, thereby preventing the formation of «black triangles»; to preserve the area of keratinized gums, excluding the development of «tension syndrome» and the volume of the alveolar ridge, thereby ensuring a high aesthetic result and increase the life of the implant.

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Conflict of interest:

The Authors declare no conflict of interest.

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