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Optimization of the surgical protocol in rehabilitation of stomatological patients for prophylaxis atrophy of alveolar process

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Abstract
The problem of loss of cellular bone volume is one of the most urgent in modern dentistry, which makes it impossible not only dental implantation, but also creates great difficulties for prosthetics and normal functioning of the maxillofacial complex in general. The aim of the study was to improve the technique of tooth extraction using bone-plastic material based on β-three calcium phosphate and methods for stimulating bone regeneration. 262 patients were examined in which tooth extraction was performed according to generally accepted methods and the residual bone defect was filled with blood clot (80 patients), and the post-extraction defect was filled with bone-plasticized material based on β-three calcium phosphate (69 patients) and 67 patients with bone-plastic material on basis of β-three calcium phosphate and plasma enriched by growth factors, and 46 patients with generalized paradontitis, the removal of teeth was carried out according to the technique proposed by us using osteoplastic material on the basis of three β-calcium phosphate and bone marrow. Clinical, anthropometric, radio-visual studies have been carried out. It has been shown that substitution of the post-extraction defect by an osteoplastic material based on β-tris calcium phosphate and plasma enriched with growth factors provided sufficient height after 12-14 months at the time of the surgical stage of dental implantation. The technique of removed teeth proposed by us reduced the number of postoperative complications by 18.84%, compared to patients where the usual methods were used.

Keywords: post-extraction bone defect, choroidal prosthetic, bone-plastic material based on β-three calcium phosphate

Introduction
The problem of loss of cellular bone volume is one of the most urgent in modern dentistry, which makes it impossible not only dental implantation, but also creates great difficulties for prosthetics and normal functioning of the maxillofacial complex in general [1, 2, 3].
It is believed that the largest loss of volume of the colonic process after tooth extraction is 6-12 months, reducing its thickness in the area of premolars and molars to 50% is observed after 12 months. According to researchers, a month after the removal of teeth in 100% of patients, there is atrophy [4, 7, 11].
Loss of a colic process after tooth extraction has negative consequences in aesthetic, hygienic, structural and orthopedic aspects [5, 6, 8].
The aim of the study was to improve the tooth extraction technique using b-three-calcium phosphate (β-TKF) bone and plastic material and methods for stimulating bone regeneration in order to achieve the final result of surgical interventions in the cellular process, which would satisfy the further dental surgery.

Materials and methods of research
To achieve this goal during 2011-2017. A survey of 262 patients who carried out tooth extraction for chronic and acute apical periodontitis, pathological processes in the colonic sprout (biliary and residual cysts, osteoporosis, paradontitis) was performed.
After removing the teeth, a kind of post-extraction defect was established according to the classification proposed by us (10) to determine the recommendations in the plan for orthopedic rehabilitation using dental implantation. There were 4 types of defects:
The first type of bone defect (DPA 1) is characterized as a pure well removed single-rooted tooth with intact walls with a thick periodontal disease in a somatic-healthy patient. The second type (DPA 2) is any hole of the removed root with a slight destruction of only one bone wall of the well and a thin periodontal.

The third type (DPA 3) is a hole of the removed root with vertical or traversing loss of bone and soft tissue from 3 to 5 mm, the destruction of one or two bone walls of the well, the presence of a thin or thick periodontium. The fourth type (DPA 4) is characterized by a vertical or traversing loss of bone tissue more than 5 mm, injured by soft tissues, the presence of a thin or thick periodontal disease.

All patients measured the height and width of the cellular process in the areas of pseudo-extraction defects using an anthropometric method of investigation immediately after surgery, after 3, 6, 12-14 months, and for comparison - anomalous measurements in the area of symmetric existing teeth (these data were considered as the norm) [11, 12].

The method of the radio-visual examination determined the parameters of bone density in the regions of the cellular process of the upper jaw and the cellular part of the mandible after the extraction defects at the same time after removal [13].

In order to improve the preparation of cell removal for the future use of its dental implant in order to maintain its quantity and quality, we proposed that the postextacting defect be filled with osteoplastic material based on β-TKF and plasma enriched with growth factors (Patent №20168138 "Method of reconstruction of post-extraction defects of cellular processes jaws)

Surgical preparation of post-extraction holes was carried out by means of corticotomy of a bone defect bed with surgical cutters with the creation of a roughly uneven surface on all available bone walls. After this, the extraction bone and cavity defect of the cellular appendix was filled with an osteoplastic material based on β-TKF, which assumed the shape of the defect. The introduction of the biomaterial was started from the lower layers of the well in the center, then - on its side walls with a slight excess in the upper part of the defect. In this case, the lower layers of the biomaterial are densely condensed on a moderately moist blood of the bony surface of the well, and the middle and especially the upper layers are modeled with granules of biomaterial, which are abundantly moisturized by plasma-enriched platelets. After the condensation of the biomaterial, the edges of the wells were bridged, mobilized and stitched.

The statistical analysis was carried out using the statistical software package Stadia-7.0 (professional version by A. P. Kulayichev, 1987-2008) and Microsoft Excel 2010 spreadsheets with Attestat data analysis program (version 12.5, author © I. P. Gaidyshev, 2002-2010).

Results of the research and their discussion

In the examination of 262 patients in 80 patients, 1 group of dental extraction was performed according to generally accepted methods, in which the residual bone defect was filled with blood clot, 69 patients in group 2 after the extraction defect were filled with bone-plasticized material on the basis of β-TKF, in 67 patients, 3 groups of tooth extraction were performed with the maximum preservation of the cellular process and surrounding cells of soft tissues, and the post-extraction defect was filled with bone-plastics material based on β-TKF and a plasma enriched by growth factors, and 46 x Weber on the generalized paradontitis of the 4 groups of tooth extraction was carried out according to our proposed method using osteoplastic material based on β-TKF f and bone marrow.

In patients with 1 group, 108 teeth were removed**.** In 24 patients (30%) after removal of 35 (32%) of teeth - the wells were preserved, the bone walls were not damaged, a thick type of paradont was observed, and according to the classification proposed by us, DPA 1, in 19 patients (23.75%) after removal 27 (25%) teeth were set DPA 2, in 21 (26.25%) patients after removal of 26 (24.07%) teeth, DPA 3 was diagnosed, and in 16 (20%) patients after removal, 20 (18%) of teeth were observed the three-and-four-volume loss of the wells and the thick type of paradont (DPA4). The removal was carried out without the use of a drill and a bit, the seams were not superimposed on the wound in any case. In the postoperative period, 34 (42.5%) patients experienced pain and discomfort in the area of intervention. Measurement of the height and width of the collar appendix in the areas of post-extraction defects with an anthropometric method of investigation. The obtained results of measurement are given in Table 1.

Table 1: Height and width of the colonic appendage in patients with the 1st group.

Groups of post-extraction defects	Height of the collar appendix, mm		Loss height of growth,%	The width of the collar appendix, mm		Loss width of growth, %
	conditional norm M±m	a part of the removed teeth M±m		conditional norm M±m	a part of the removed teeth M±m	
DPA1 n=35	10,37	9,03±0,44	12,92%p>0,05	9,21±0,42	7,85±0,40	14,77 % p>0,05
DPA2 n=27	10,48±0,47	8,44±0,46	19,47%p<0,05	8,31 ±0,58	6,73±0,52	19,01 % p>0,05
DPA3 n=26	10,56±0,41	7,64 ±0,38	27,65%<0,001	9,42±0,14	7,05±0,41	25,16% p>0,05
DPA4 n=20	10,49	6,53	37,75%	9,54	6,58	31,03%

Analyzing the obtained data, we can state that the height loss of the cellular process was 12,92% (p> 0,05), even in the area of the post-extraction defect, when the bone walls of the well were not damaged and patients had a thick periodontal disease (DPA1), 19.47 % - in the area of DPA2 when only one bone wall was disturbed and a thin periodontal was diagnosed, 27.65% in the area of destruction of two bone walls with thick and thin periodontal disease (DPA3), and a significant loss of cellular height was observed in the area of the damaged three and four hole walls (DPA4), Country was 37.75%.

The width of the cellular appendix was lost by 14.77% in the area after the first type of extraction defect, 19.01% - the second type, 25.16% - the third type and even 31.03% - the fourth type (p> 0.05)

The density of bone tissue in the area of the cellular process in patients of group 1 in the area of the removed teeth, compared with that in the area of symmetrical teeth, is much smaller. In patients with DPA1 loss of density after 3 months. after removal is - 7.51%, in patients with DPA2 - 17.99%, with DPA3 - 16.09% and in patients with DPA4 reaches 12.21%. Eventually, the density gradually decreased and after 12-14 months after removal was respectively 17.55%, 24.3%, 28.22% and - 36.64% respectively. The greatest loss is in patients with DTP4 at different observation periods.

In 69 patients, 2 groups of the group removed 88 teeth, and the pyleelectric defect was filled with bone-plasticized material based on β-TKF. The removal of the teeth was carried out with the maximum preservation of the cell

appendix and surrounding cells of soft tissues. In 19 patients (27.5%) after removal of 24 (27.3%) of teeth, the wells were preserved, the bone walls were not damaged, a thick type of periodontal was observed, and according to the classification proposed by us, DPA 1 was observed. In 15 patients (21.7%) after removal of 19 (21.6%) of teeth, DPA 2 was installed. In 18 (21.1%) patients after removal of 23 teeth, DPA3 was diagnosed. In 17 (24.6%) patients after removing 22 teeth, the abnormal loss of the three and four bone walls of the well (DPA4) was observed. In the postoperative period, the complication of the wound process was noted in 13 patients (18.84%) after removal of 22 teeth (25%).

Changes in height and width of the colonic process were different in different postoperative observation periods (Table 2).

Table 2: Dynamics of height and width of cellular appendix in patients of the 2nd group after tooth extraction at different observation periods

Groups after-extraction defects	The height of the collar appendix (M ± m) in mm					The width of the collar appendix (M ± m)in mm				
	conditional norm	Immediately after surgery	After 3 months	After 6 months	After 12-14 months	conditional norm	Immediately after surgery	After 3 months	After 6 months	After 3 months
DPA1 n=24	11,15 ±8,46	11,95 ± 8,00	11,40 p<0,05	10.85± 6,36	10,27 ± 6,5	8,28 p<0,001	8,95 ± 3,86	8,15 ± 2,11	8,09 p<0,001	7,86
Summary of creation or loss of width (%)										
		+7,17 p>0,05	+2,24 p>0,05	-2,71 p>0,05	-7,89 p>0,05		+8,09% p>0,05	+1,57 p>0,05	-2,29% p>0,057	-5,07%
DPA2 n=19	1138 ±	12,35± 9,31	11,52±	10,87 ± 5,90	10,35 ± 5,11	7,76 p=0,00	8,14±	7,85 ±	7,14 p<0,001	6,98
Summary of creation or loss of width (%)										
		+8,52%	+1,23%	-4,48%	-9,93%		+4,89%	+1,16%	-4,89%	-10,05%
DPA3 n=23	11,20 ±	11,90 ±	10,95	10,73 ±	9,82 ±	10,25	11,13	10,08 ±	9,74	9,03
Summary of creation or loss of width (%)										
		+6,25%	-3,12%	-4,21%	-12,32%		+8,59%	-1,66%	-4,98%	-11,90%
DPA4	10,97	12,13	10,69	10,14	9,28	9,57	10,08	9,37	8,95	8,14
Summary of creation or loss of width (%)										
n=22		+10,57%	-1,64%	-7,57%	-15,4%		+5,33%	-2,09%	-6,48%	-14,94%

The analyzing data given in Table 2 can be seen from the fact that immediately after modeling of the colic process, OSTEOPLASTIC MATERIAL, after the removal of the teeth, there was a tendency to increase the bone tissue in height and in the area of DPA1 (+ 7.17%), and in the region of DPA2 (+ 8.52%), and in the region of DPA3- (+ 6.25%), and in the DPA 4 (+ 10.57%) region. The increase in bone tissue within 3 months after the operation slightly decreased to + 2.24%, +1.23%, -3.12%, and _66%, respectively (p> 0.05), and after 6 months, a slight loss of bone The tissue of the cellular process, which comprised in the area DPA1 - 2.71%, in the area DPA2 -4.48%, in the area DPA3-4.21%, and in the area DPA4 - 7.57%. This process slowly progressed in 12 to 14 months. the loss of kt was in the area of DPA1 - 7.89%, DPA2 - 9.93%, DPA3 - 12.32%, DPA4 - 15.4%.

Comparing the optical density of the cellular process, we see that in patients with DFT1 this figure was increased immediately and amounted to 175.65 (+ 5.27%) after the operation, somewhat less after 3 months, 169.52 (+ 1.59%). A slight decrease in density occurred after 6 months and in 12-14 months this figure was 154.71 (-7.34%, -3.81). The optical density of the cellular appendage increased quite strongly immediately after the operation with DPA2 at 7.86%, after 12 months, this figure decreased by 14,98%. The optical density of the cellular process in the area of DPA3 increased only slightly (+ 4.74%), but in the long term the observation began to decrease, and in 12-14 months it was 143.7 (-21.65%). The optical density of the cellular process in patients with DFT4 significantly decreased, although osteotropic material was used (-26.9%).

In 67 patients of 3 groups**,** 86 teeth were removed and the post-extraction defect was filled with an osteoplastic material based on β-TKF and a plasma enriched with growth factors (PATENT №20168138, "Method of reconstruction of post-extraction defects of the jawbone branches).

In 15 patients (22.4%), after removal of 18 teeth, the wells were retained, the bone walls were not damaged, a thick type of periodontal was observed, and according to the classification proposed by us, DPA 1. In 19 patients (28.6%) after removal, 23 teeth were set DPA 2**.** In 16 (22.9%) patients after removing 20 teeth, DPA 3 was diagnosed. In 18 (26.1%) patients after the removal of 25 teeth, the volume loss of three and four bone walls of the well (DPA 4) was observed. In the postoperative period, the complication of the wound process was confirmed in 8 patients (11.94%) after removing 12 teeth.

Changes in height and width of the cellular process were different in different postoperative terms of observation (Table 3).

Tabl 3: Dynamics of height and width of cellular process in patients of the 3rd group after the removal of teeth in different observation periods

Groups after-extraction defects	The height of the collar appendix (M ± m) in mm					The width of the collar appendix (M ± m)in mm				
	conditional norm	Immediately after surgery	After 3 months	After 6 months	After 12-14 months	conditional norm	Immediately after surgery	After 3 months	After 6 months	After 3 months
DPA1 n=18	11,01 ±0,43	11,83 ±0,63	11,32 ±0,53	10.56 ± 0,57	10,41 ±0,44	7,79 ±0,34	8,02 ± 3,86	7,89 ±0,40	7,61 ±0,44	7,59 ±0,44
Summary of creation or loss of width (%)										
		+7,45 p>0,05	+2,82 p>0,05	-4,09 p>0,05	-5,45 p>0,05		+2,83% p>0,05	+1,31% p>0,05	-2,37% p>0,057	-2,51%
DPA2 n=23	±10,96	± 11,57	±11,23	± 10,49	± 10,25	±10,60	±11,28	± 10,40	±10,02	±9,79
Summary of creation or loss of width (%)										
		+5,57%	+2,46%	-4,29%	-6,49%		+6,42%	+1,92%	-5,47%	-7,64%
DPA3 n=20	11,26 ±	12,57 ±	11,32	10,82 ±	10,23 ±	9,18	10,04	8,96 ±	8,62	8,37
Summary of creation or loss of width (%)										
		+6,3%	+0,71%	-3,97%	-9,98%		+9,37%	-2,4%	-6,1%	-8,82%
DPA4 n=25	11,17	12,13	10,69	10,14	9,28	8,54	8,95	8,14	7,87	7,73
Summary of creation or loss of width (%)										
		+10,50%	-1,64%	-7,57%	-11,39%		+4,8%	-4,68%	-7,84%	-9,48%

Analyzing data given in tab. 3, it can be noted that immediately after modeling of cellular optocouplers with osteoplastic material and plasma-enriched growth factor there was a removal of teeth, there was a tendency to increase the bone density in height and in the area of DPA1 (+ 7.45%) and in the area of DPA2 (+ 5.57%) and in the area DPA3 (+ 6.3%) and in the area DPA4 (+ 10.50%).

The width of the colonic sprocket changed after the removal after another. Immediately after surgery, it increased by + 2.83%, + 6.42%, + 4.8%, respectively, then in 3 months it decreased slightly and amounted to + 1.31%, -1.92%, -2, 4%, -4.68%. And 12 months later, a significant loss in the cellular process in patients with DPA3 and DPA4 (-8.82%, -9.48%). Optical density in patients with DPA1 increased immediately after surgery (7.55%). After 3 months it was 139.69 (+ 0.44%). However, after 6 months there was a loss of bone density (-3.21%), and in 12-14 months the loss of density was (-6.83%). Indicators of optical density in patients with DPA1 2 and 3 subgroups did not differ significantly. In patients with DPA4, bone densitometry after surgical interventions was noted by us immediately. However, after 3 months, the loss of cellular appendix density increased significantly (-6.24%), and at the end of the observation it was (-17.44%).

Thus, summing up the anthropometric data of the condition of the cellular process in patients of the 1st group, obtained in 12-14 months after the removal of the teeth in accordance with the generally accepted method, we can conclude that the loss of height and width of the cellular process in the area of the removed teeth is significant even in DPA1 (16, 38%) when the bone walls of the wells are preserved and quite significant in the area of DPA4 - 40.74%, which makes it impossible to conduct dental implantation.

The optical density of the cellular bone in the area of the removed teeth also lost unevenness. The largest was in the area of DPA1 - 152.7 u.o., which is 1.9 times higher than DPA 4 - 137.2 u.o. Consequently, the cornea process was the least dense in patients with DPA 4.

Thus, conditions that are created in the collar process when the teeth are removed by commonly used methods are not very favorable for dental implantation.

Although the loss of height and width of the cellular process after the removal of the teeth with the use of β-TKF-based osteoplastic material was observed, but was 1.64 lower than in patients when the wells of removed teeth were healed under the blood clot.

Consequently, introduction into the wells of the extracted teeth of the osteotropic material based on β-TKF allows to maintain sufficient height and especially the width of the colonic process, after 1 year, and reduce the number of postoperative complications.

Filling the hole of the removed root with osteoplastic material, in modern dentistry, should become the rule in everyday practice.

Conclusions

1. Replacement of the post-extraction defect with an osteoplastic material based on β-three calcium phosphate provided sufficient height and width of the cellular process within 12-14 months at the time of the surgical stage of dental implantation
2. The technique of the removed teeth suggested by us reduced the number of postoperative complications by 18.84%,
3. The most vulnerable to the final outcome of bone resuscitation in patients with DPA4, where all 4 walls are destroyed, which is confirmed by anthropometric and radio-visual characteristics and require additional postoperative measures.

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