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Research Article

The Use of Rentgenological Methods of Diagnostics in Surgical Treatment of Atrophy of the Alveolar Process of the Upper Jaw and Part of the Lower Jaw in Women of Postmenopausal Age

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Abstract

The objective of the study is to evaluate the condition of the alveolar part of the upper jaw and the part of the mandible according to X-ray studies in postmenopausal women before and after surgical treatment of the atrophy of jaw bone tissue using osteoplastic material and an ossein-hydroxyapatite compound.

Materials and methods. There were observed 24 women in the postmenopausal period, aged from 51 to 58 years, with atrophy of the alveolar process of the upper jaw and the part of the lower jaw who were surgically treated.

Results of the study. On the basis of the obtained results of the X-ray examination, we can assume that the developed by us technique of surgical treatment of atrophy of the alveolar process of the upper jaw and the part of the lower jaw by the use of bone material of animal origin in combination with the ossein-hydroxyapatite compound allows us to intensify bone tissue regeneration processes, which further will contribute to the increase of the volume of bone tissue.

Conclusions. The use of modern X-ray methods, in particular orthopantomography and cone-beam computerized tomography in the diagnosis and surgical treatment of atrophy of the alveolar process of the upper jaw and the part of the lower jaw, are highly informative, and also provide the possibility of work with a roentgenographic image in a digital format that allows a more detailed assessment of the area of surgical intervention before and after the treatment.

Keywords

cone-beam computerized tomography; orthopantomography; atrophy of the alveolar process of the upper jaw; atrophy of the alveolar part of the lower jaw

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Problem statement and analysis of the latest research

Although more than 90 years has passed since the publication of A. Tseshynsky's work "Dental roentgenology", roentgenology method of diagnosis remains relevant [1]. Great breakthrough occurred in the development of this method in the emergence of digital radiography. This made it possible to get rid of photographic laboratories that in turn made it possible to reduce occupational harmfulness for the personnel, reduce financial maintenance costs for the service, and reduce the area ofthe radiological room. However, the speed of X-rays' performance increased, the radiological burden on patients was reduced (Table 1), the possibilities of work with the image increased, new opportunities for research were opened [1, 3].

The use of X-ray diagnostic methods for assessing the atrophy of the alveolar process of the upper jaw and the part of the lower jaw is an integral part of the planning of surgical interventions. One of the main methods of X-ray assessment of bone tissue of the jaws and teeth is orthopantomography and cone-beam computerized tomography [2]. Using orthopantomogram, it is usually possible to detect the height of the alveolar process of the upper jaw or part of the lower jaw, localization of important anatomical structures (lower alveolar canal, mental opening, maxillary sinus, nasal cavity, lower edge of the mandible). It is important to note that during the performance of this method of X-ray examination the image increases at 15-25%, depending on the design of the apparatus and the position of the patient during the examination, thus, sometimes while receiving such pictures it is recommended to place a metal ball of a known diameter into the cavity of the patient, for a more accurate calculation of the size of anatomical structures [1].

Computerized tomography allows us to get a three-dimensional image with minimal error. On the basis of this study one can perform a review and analysis of the ratio of various anatomical structures. Using this method of diagnosis one can evaluate the form of maxillary sinuses, the direction of the mandibular canal, the position of the incisor opening, the presence and size of the loop of the mandibular canal. In addition, the

Table 1. Radiologic load during the performance of X-ray methods of study

Types of the study	Dose of radiation load, mSv
Spot-film digital radiography	4-5
Spot-film X-ray	10
Panoramic digital radiography	15-20
Panoramic spot-film X-ray	25-40
Cone-beam radiography	25-60
Series of enlargement films of all teeth	80-130
Helical computed tomography	400-1000
Photoroentgenography	700
Recommended dose of X-ray load during the year	3000

use of cone-beam computerized tomography facilitates the diagnosis of atrophied areas of bone tissue of the jaws [5]. In the planning of surgical intervention for regenerative surgical intervention on the alveolar process of the upper jaw or part of the mandible, this method of diagnosis is a method of choice, since it allows performance of measurement and comparison of them in pre- and postoperative periods, assessment of the form, and existing defects.

The objective of the study was to evaluate the condition of the alveolar process of the maxillary jaw and the part of the mandible according to X-ray studies in postmenopausal women before and after surgical treatment of jaw bone tissue atrophy using osteoplastic material and an ossein-hydroxyapatite compound.

1. Materials and Methods

Nowadays, there are many classifications of the atrophy of the alveolar process of the upper jaw and the part of the lower jaw. The most commonly used one is the classification of C. E. Mish and K.W.M. Judi [5, 6], which introduces certain additions to the classification of E. Kennedy (1928), in particular the subgroups A, B, C, D are added to all the classes, and it is intended for surgical interventions aimed at restoration of the masticatory function based on the three main parameters of bone tissue: height, width and medio-distal length of its body [2, 4, 7].

There was performed the observation of 24 postmenopausal women, aged from 51 to 58 years, with atrophy of the alveolar process of the upper jaw and the part of the lower jaw, who were surgically treated. Clinical examinations included:

- Patient's interviewing (patient's complaints, presence and nature of chronic somatic diseases, causes of teeth loss and the period of previous surgical treatment for this disease and its results);
- Examination of the oral cavity and the immediate site of surgical intervention (the state of existing teeth, gum tissues in the oral cavity and directly at the site of the surgical intervention);
- X-ray assessment of the bone tissue of the alveolar process of the upper jaw and the part of the lower jaw using orthopantomogram and cone-beam computerized tomography (height and width of the alveolar process of the upper jaw or the part of the lower jaw).

The functional condition of bone tissue was evaluated by two-photon X-ray absorptiometry using Chelenger apparatus (DMS-France). The method is based on the principle of comparison of the data about mineral density of the patient's bone tissue with the constructed model, the state of mineral density of bone tissue in a separate ethnic population.

The evaluation of the alveolar process condition of the upper jaw and lower jaw and assessment of the pre- and postsurgical interventions for bone tissue atrophy were performed. During the performance of the surgical interventions patients were divided into 3 groups:

Group I – 8 patients with atrophy of the alveolar process of the upper jaw and the part of the lower jaw with osteopenia, with reduced bone density, who were performed surgical treatment of bone tissue atrophy using method developed by us.

Group II – 8 patients with atrophy of the alveolar process of the upper jaw and the part of the mandible with osteopenia, with reduced bone tissue density, who were surgically treated for the bone tissue atrophy using osteoplastic material of animal origin.

Group III – 8 patients with atrophy of the alveolar process of the upper jaw and the part of the lower jaw with bone tissue density parameters within the normal limits who were performed surgical treatment of jaw bone tissue atrophy using osteoplastic material of animal origin.

As a result of the performed research work, we have proposed and developed a technique for surgical treatment of atrophy of the alveolar process of the upper jaw and/or alveolar part of the lower jaw in postmenopausal women with osteopenia using osteoplastic material of animal origin, in combination with the ossein-hydroxyapatite compound.

Patients in the postoperative period were prescribed antibiotic therapy, anti-inflammatory therapy and analgesic therapy. Additionally, the ossein-hydroxyapatite compound "Osteogenon" was prescribed, which consists in the create of two vertical incisions at an angle to the border between the attached and moving part of the gum from the vestibular side in the area of missing teeth, retreating laterally to the middle of the crowns of adjacent teeth, which connect a horizontal incision between them. Then the mocoperiosteal flap is separated, performed decortication of alveolar process in the region, the atrophied area is filled with osteoplastic bone material of animal origin "CeraBone", and resorbing collagen membrane "Jason" is fixed with metal pins, a horizontal peristotomy is performed, a mucoperiosteal flap is mobilized, the edges of the wound are matched, wound is suturing with knot sutures. Repeated clinical studies were performed after 1, 6, 12 months. X-ray examination was performed prior to surgical intervention and 12 months after surgery.

Statistical method for obtained results and all necessary calculations were obtained using withcomputer program of medical statistics computing STATISTICA.

2. Results and Discussion

According to the cone-beam computerized tomography, the size of the alveolar process of the upper jaw and the alveolar part of the lower jaw is given in Table 2.

According to the repeated cone-beam CT scan, after 12 months, patients of the group I have experienced an increase of the height and width of the bone tissue in the area of the alveolar process or alveolar part.

During the examination of the group I patients, whose average age was 51.9±1.3 years, surgical treatment was performed according to the method proposed by us and the prescription of the ossein-hydroxyapatite compound. The sutures were removed on the 12th day after surgical intervention. Postoperative wound healing was performed by the primary tension. According to the computerized tomography, there was an increase of the bone tissue volume with an average value of 3.002 mm ($p<0.05$) width and 1.786 mm ($p<0.05$) height (Table 3), which in future allowed creating sufficient conditions for the performance of orthopedic treatment.

During the examination of the group II patients, whose average age was 52.6±2.3 years, the sutures were removed on the 12th day after the surgical treatment, the healing of the postoperative wound occurred by the initial tension. According to the computerized tomography, an increase of the height and width of bone tissue in the area of the alveolar process or alveolar part was observed in 6 patients, the mean value was 2.048 mm ($p<0.05$) width and 1.658 mm ($p<0.05$) height (Table 4), there was no healing of a postoperative wound in 2 patients, its infection and subsequent rejection of bone material because of non-compliance with the recommendations of the doctor.

During examination of the group III patients, whose average age was 52.2±2.2 years, after the performed operation the sutures were removed on the 12th day after the surgical treatment, the healing of the postoperative wound occurred by the initial tension. According to the computerized tomography, an increase of the height and width of bone tissue in the area of the alveolar process or alveolar part was observed in 5 patients (Table 5), there was no healing of the postoperative wound in 3 patients. the mean value was 1.581mm ($p<0.05$) width and 1.33 mm ($p<0.05$) height its infection and subsequent rejection of bone material in connection with non-compliance with the doctor's recommendations in the postoperative period.

The surgical treatment was most effective in patients of the group I, since according to computerized tomography data, the highest rates of the restored height and width of bone tissue were observed in the area of the alveolar process or alveolar part of the tissue. There were no complications in the postoperative period. Dynamics was also positive in surgically treated patients of the groups II and III, but it was less pronounced in comparison with patients of group I. One of the main indicators of the effectiveness of the surgical treatment of atrophy of the alveolar process of the upper jaw and part of the lower jaw is the long-term results after the treatment. In 9 months after the X-ray treatment, the restoration of height and width of bone tissue was observed in 100% of group I patients, in 86% of group II patients and in 92% of group III patients.

Thus, on the basis of the received results of X-ray examination, we can assume that the developed by us technique of surgical treatment of atrophy of the alveolar process of the upper jaw and the part of the lower jaw using the bone material of animal origin in combination with the ossein-hydroxyapatite compound allows us to intensify the processes of bone tissue regeneration that further increases the height and width of the bone tissue of the alveolar process of the upper jaw or the alveolar part.

3. Prospects of further research

For further reliable results, the continuation of prospective clinical studies, especially among the patients of postmenopausal period, which constitute a significant proportion of the data of anatomical and functional disorders, is necessary. Taking into account the results of such studies in the future may allow adjusting the process of restoration of jaw bone tissue and ease its predictability.

4. Conclusions

The use of modern X-ray methods, in particular orthopantomography and cone-beam computerized tomography, in the diagnosis and surgical treatment of atrophy of the alveolar process of the upper jaw and the alveolar part of the mandible is more informative, and also provides opportunities for work with X-ray images in the digital format, which allows a more detailed assessment of the area of surgical intervention before and after the treatment. However, despite the high informa-

Table 2. Dimensions of the alveolar process of the upper jaw and the alveolar part of the lower jaw in atrophy (before the surgical operation).

Group I								
Indices	Size of the alveolar process/alveolar part							
Width,mm	5.12	4.31	4.23	3.11	5.09	3.22	4.21	4.59
Height, mm	8.33	9.22	9.56	10.08	9.32	8.21	9.34	8.22
Group II								
Width,mm	4.32	5.11	5.23	4.19	5.23	3.34	5.21	4.29
Height, mm	8.12	9.56	8.43	8.56	8.76	10.34	9.12	7.76
Group III								
Width,mm	4.28	3.91	4.22	3.12	4.76	5.21	5.34	4.76
Height, mm	10.56	7.32	9.74	8.23	7.32	8.65	9.32	8.76

Table 3. Dimensions of the alveolar process of the upper jaw and the part of the lower jaw after the operation (group I)

Indicators	Size of the alveolar process/alveolar part							
Width,mm	8.66	6.85	7.37	6.12	8.31	5.63	7.26	7.7
Increase of the width,mm	3.54	2.54	3.14	3.01	3.22	2.41	3.05	3.11
Height,mm	10.38	10.34	11.58	12.11	10.91	11.32	11.71	8.22
Increase of the height, mm	2.05	1.12	2.02	2.03	1.59	3.11	2.37	0

Table 4. Dimensions of the alveolar process of the upper jaw and the part of the lower jaw after the operation (group II)

Indicators	Size of the alveolar process/alveolar part							
Width,mm	6.97	7.66	8.74	6.51	7.47	3.22	5.21	7.41
Increase of the width,mm	2.65	2.55	3.51	2.32	2.24	0	0	3.12
Height,mm	10.15	11.45	10.46	11.02	11.17	10.34	9.12	10.21
Increase of the height, mm	2.03	1.89	2.03	2.46	2.41	0	0	2.45

Table 5. Dimensions of the alveolar process of the upper jaw and the part of the mandible after the operation (group III)

Indicators	Size of the alveolar process/alveolar part							
Width,mm	6.86	6.39	6.81	6.09	6.79	5.21	6.93	6.92
Increase of width,mm	2.58	2.48	2.59	2.97	2.03	0	0	0
Height,mm	11.75	10.34	10.98	10.86	9.88	8.65	10.57	11.31
Increase of height, mm	1.19	3.02	1.24	2.63	2.56	0	0	0

tiveness of these methods, there are certain disadvantages, in particular, during orthopantomography, the structures depicted according to the size can range from 1: 1.2 to 1: 1.75 of the actual dimensions, depending on the design of the apparatus and the impossibility to determine the width of the alveolar process of the upper jaw or part of the lower jaw.

Osteoplastic materials of animal origin combined with an ossein-hydroxyapatite compound in the surgical treatment of atrophy of the alveolar process of the upper jaw and the part of the mandible increase osteogenesis and allow restore the bone tissue volume. The use of X-ray methods, in particular, cone-beam computerized tomography for diagnosis, planning and post-operative repeated examinations, is an integral part, since it allows one to establish an exact diagnosis, to draw up an exact plan of treatment, to reduce the number of complications during and after surgical intervention. The use of segmental sections allows us to assess in detail the height and width of bone tissue before and after the surgical intervention, the nature of the inclination of the alveolar process or alveolar part, the presence or absence of defects, the behavior of biomaterials in the postoperative period.

Summarized the research data, it is recommended to use cone-beam computed tomography during surgery injestion to increase the height and width the alveolar process of maxillary jaw and alveolar part of the mandible as this method allows us to estimate the three-imentional condition of bone tissue in the pre and postoperative period.

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