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DEVELOPMENT OF THE DIAGNOSTIC AND PREVENTION ALGORITHM OF COMPLICATED SUBANTRAL PLASTIC SURGERY

The aim of the study. Development of an algorithm for clinical and radiological examination of patients with atrophy of the alveolar process of the upper jaw when using dental implants and the need for subantral plastic surgery. **Materials and methods of research.** The work was performed at the Department of Maxillofacial Surgery, implantology and Periodontology of Dnipro State Medical University. CT scans of 72 patients of the State Medical University Medical Center were analyzed. The patients ranged in age from 48 to 69 years, including 39 men and 33 women. The role of anatomical factors diagnosed by Cone-Beam computed tomography in the development of perforation of the maxillary sinus mucosa during subantral plastic surgery is determined. The role of the type of pneumatization of the maxillary sinus in residents of the Dnipropetrovsk region was determined, and the relationship between intraoperative complications and the frequency of postoperative sinusitis was established. It was found that in 67 % of cases of sinusitis, pathologies of the structures of the nasal cavity and the bone marrow complex were detected. In addition, it was found that a violation of the structure of the anatomical structures of the nasal cavity and the ostiomeatal complex of the corresponding operating side can cause obstruction of the natural sinus mouth in the postoperative period and lead to a violation of mucociliary clearance. When comparing cone-beam computed tomography data with surgical protocols and postoperative observations, the association between anatomical risk factors and intra- and postoperative complications was determined. **Conclusions.** According to the retrospective analysis of the archival material of the Department of Oral Surgery, Implantology and Periodontology of the Dnipro State Medical University over 3 years, the frequency of complications of subantral plastic surgery using the lateral window technique is influenced by the presence of pathologies of the structures of the nasal cavity and the ostiomeatal complex, as well as the peculiarities of the structure of the maxillary sinus itself – the angle between and, to a lesser extent, the thickness of the mucosa lining of the sinus. It was established that the frequency of perforation of the mucous membrane was 31.9 %, while it occurred in 50

% of cases in patients with a thin mucous membrane and an angle of less than 60 degrees. In the group of patients who had a thick mucous membrane and the angle between the walls in the treated area was more than 60 degrees, perforation of the mucous membrane did not occur. At the same time, comparing different combinations of these factors, it was found that a larger angle value reduces the probability of perforation by 3 times with an equally thin sinus mucosa. It was established that in 67 % of cases of sinusitis, pathologies of the structures of the nasal cavity and ostiomeatal complex were detected. Comprehensive preoperative diagnosis of a group of patients who are scheduled to undergo subantral plastic surgery should include an oral cavity examination by a dentist-surgeon, cone-beam computed tomography, examination and consultation by an otorhinolaryngologist.

Key words: maxillary sinus, computer tomography.

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РОЗРОБКА ДІАГНОСТИЧНОГО АЛГОРИТМУ ПРОФІЛАКТИКИ УСКЛАДНЕНЬ ОПЕРАЦІЇ СУБАНТРАЛЬНОЇ ПЛАСТИКИ

Мета дослідження. Розробка алгоритму клініко-рентгенологічного обстеження пацієнтів з атрофією альвеолярного відростка верхньої щелепи при використанні зубних імплантів і необхідністю субантальної пластичної операції. **Матеріали та методи дослідження.** Робота була виконана на кафедрі щелепно-лицевої хірургії, імплантології та пародонтології Дніпровського державного медичного університету. Були проаналізовані комп'ютерні томограми 72 пацієнтів медичного центру державного медичного університету. Вік пацієнтів варіювався від 48 до 69 років, серед них було 39 чоловіків і 33 жінки. Визначено роль анатомічних факторів, діагностованих за допомогою конусно-променевої комп'ютерної томографії, у розвитку перфорації слизової оболонки верхньощелепної пазухи при субантальній пластичній операції. Визначено роль типу пневматизації верхньощелепної пазухи у жителів Дніпропетровської області, а також встановлено зв'язок між інтраопераційними ускладненнями і частотою післяопераційних синуситів. Встановлено, що в 67 % випадків синуситу були виявлені патології структур порожнини носа і кістково-мозкового комплексу. Крім того, було встановлено, що порушення будови анатомічних структур порожнини носа і остіомеатального комплексу відповідної операційної сторони може в післяопераційному періоді викликати непрохідність природного гирла пазухи і привести до

порушення мукоциліарного кліренсу. При порівнянні даних конусно-променевої комп'ютерної томографії з протоколами операцій і післяопераційними спостереженнями було визначено зв'язок між анатомічними факторами ризику і виниклими інтра- і післяопераційними ускладненнями. **Висновки.** Згідно з ретроспективним аналізом архівних матеріалів кафедри щелепно-лицевої хірургії, імплантології та пародонтології Дніпровського державного медичного університету за 3 роки, на частоту ускладнень субантральної пластики з використанням техніки бічного вікна впливає наявність патології структур порожнини носа та інших органів. остіометальний комплекс, а також особливості будови самої верхньощелепної пазухи – кут між ними і, в меншій мірі, товщина слизової оболонки, що вистилає пазуху. Було встановлено, що частота перфорації слизової оболонки склала 31,9 %, при цьому це відбувалося в 50 % випадків у пацієнтів з тонкою слизовою оболонкою і кутом менше 60 градусів. У групі пацієнтів, у яких була товста слизова оболонка і кут між стінками в обробленій ділянці становив більше 60 градусів, перфорації слизової оболонки не відбулося. У той же час, порівнюючи різні комбінації цих факторів, було встановлено, що більше значення кута знижує ймовірність перфорації в 3 рази при однаково тонкій слизовій оболонці пазухи. Встановлено, що в 67 % випадків синуситу були виявлені патології структур порожнини носа і кістково-мозкового комплексу. Комплексна передопераційна діагностика групи пацієнтів, яким планується субантральна пластикна операція, повинна включати огляд порожнини рота стоматологом-хірургом, конусно-променевою комп'ютерною томографією, огляд і консультацію оториноларинголога.

Ключові слова. верхньощелепна пазуха, комп'ютерна томографія.

Orthopedic structures based on dental implants are the gold standard in cosmetic and functional rehabilitation of patients with dentition defects. Important conditions for a successful dental implant surgery are: healthy oral cavity, absence of severe and decompensated somatic diseases, sufficient amount of bone tissue for implant installation. Loss of teeth due to trauma or removal, periodontal disease, systemic and local osteoporosis lead to a decrease in bone volume. In addition, most often, in the distal parts of the upper jaw, there is an anatomical feature, namely pronounced pneumatization of the maxillary sinus, which also affects the amount of bone tissue. In this regard, in many patients dental implantation becomes impossible without additional osteoplastic surgery performed in the distal part of the upper jaw-subantral plastic surgery [1, 2]. However, in a number of cases, after this reconstructive intervention, inflammatory complications develop, the main reasons of which are insufficient diagnosis of the pathology of the maxillary sinus and the structures of the ostiom-

eatal complex at the preoperative stage, as well as the collection of anamnesis in general [1, 2, 3].

It is possible to evaluate the state of the upper respiratory tract organs and the height of the residual alveolar process of the upper jaw thanks to cone-beam computer tomography. In addition, on the basis of CBCT data, it is possible to estimate the thickness of the mucous membrane, the presence of bone partitions, which can affect the frequency of perforation of Schneider's membrane during subantral plastic surgery, which is the most frequent complication of the operation [4, 5].

Intraoperative perforation of the mucous membrane of the maxillary sinus can lead to the migration of particles of osteoplastic material, as well as the development of an inflammatory process in the postoperative period. The existing inflammatory process of the mucous membrane also increases the risk of developing purulent-inflammatory complications [6, 7, 8, 9, 10]. It has been established that morphological changes in inflammation of the mucous membrane of the maxillary sinus are of a chronic nature. Pathomorphological studies of changes in the mucous membrane of the sinus during post-traumatic processes demonstrate the development of alterative-exudative inflammatory phenomena with the formation of edema up to 7 days after the injury and the possibility of developing chronic forms of sinusitis with metaplasia of the ciliated epithelium in 4 weeks [4, 5, 6, 8, 11, 12, 13].

In order to prevent intra- and postoperative complications, it is necessary to diagnose the condition of the structures of the nasal cavity and ostiomeatal complex, as well as the risk factors of complications from the maxillary sinus itself before performing subantral plastic surgery. An important factor in determining these parameters is the cooperation of the dentist-surgeon and otorhinolaryngologist [9, 10, 11, 14, 15, 16, 17, 18].

The aim of the study.

Development of an algorithm for clinical and radiological examination of patients with atrophy of the alveolar process of the upper jaw when using dental implants and the need for subantral plastic surgery.

study tasks:

1. To estimate the frequency of development of complications in patients after subantral plastic surgery using the lateral window method, depending on the condition and anatomic-topographic features of the nasal cavity and maxillary sinuses, based on the data of a retrospective analysis of archival material of the Department of Oral Surgery, Implantology and Periodontology of the Dnipro State Medical University for 3 years.

2. To determine the anatomical risk factors of complications in patients who, according to the indications, are scheduled for subantral plastic surgery, by conducting complex diagnostics.

3. To assess the frequency of intraoperative complications in patients during subantral plastic surgery.

Research materials and methods.

The work was performed at the Department of Oral Surgery, Implantology and Periodontology of the Dnipro State Medical University.

CT scans of 72 patients of the Medical Center of the State Medical University were analyzed. The age of the patients ranged from 48 to 69 years, among them there were 39 men and 33 women. In the work, we did not separate the groups depending on the presence or absence of dental and ENT pathology, as this was not part of the research objectives.

All CT studies were performed on a Planmeca Promax 3D cone beam computer tomography (Finland) with an 85 kV 5-7 mA X-ray emitter.

The analysis of the study data included the preoperative evaluation of the thickness of the mucous membrane and the angle between the anterolateral and medial walls of the maxillary sinus. The mucosa was considered thin if the examination did not allow visualization of the mucosa due to a minimum step width of 0.5 mm (Fig. 1).

The angle formed by the anterior-lateral and medial walls was considered small, with a value of less than 60 degrees, which corresponded to the average parameter in the medial sections of the

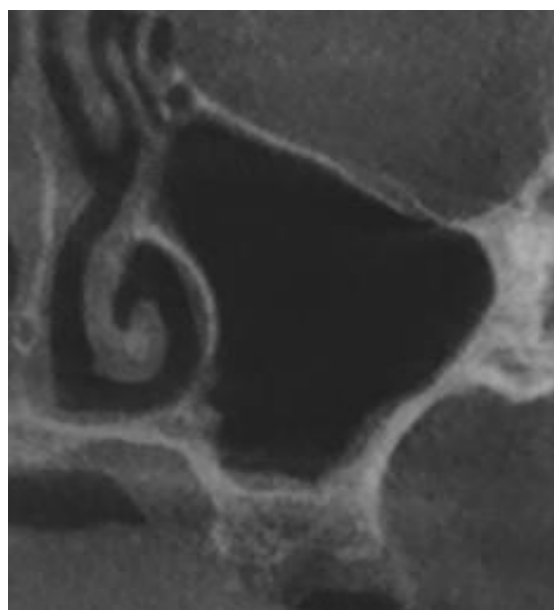
sinus and the projection of the premolars of the upper jaw (Fig. 2).

According to these criteria, 4 different combinations of anatomical risk factors were formed: group 1 – angle greater than 60 degrees, mucous membrane thick, group 2 – angle greater than 60 degrees, mucous membrane thin, group 3 – angle less than 60 degrees, mucous membrane thick, and group 4 – The angle is less than 60 degrees and the mucous membrane is thin.

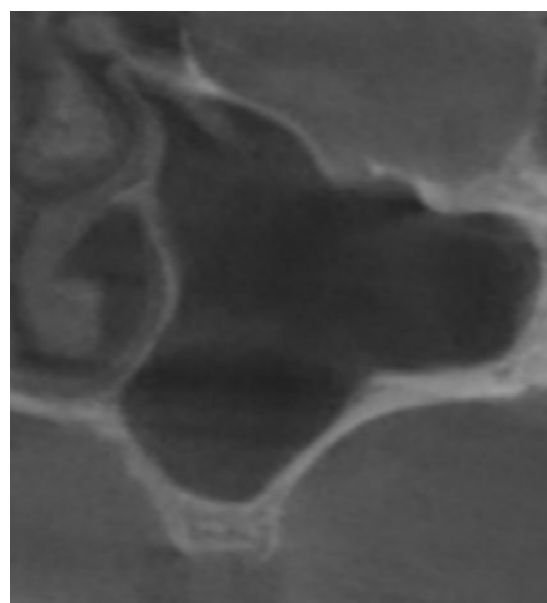
To determine bone mineral density (BMD) in Hounsfield units (HU), the attenuation coefficient of X-ray radiation (absorption coefficient) that passed through the object was measured.

More denser the tissue, more the X-ray beam is absorbed and attenuated, and the higher the attenuation coefficient and BMD value. Bone absorbs X-rays more strongly than other tissues and has the highest coefficient [6].

Air practically does not absorb and has the lowest absorption coefficient. The absorption coefficient of water is assumed to be 0. At the same time, the higher tissue absorption coefficient, more strongly it absorbs radiation, the fewer photons of radiation reach the tomograph detector, and the whiter it looks on the computer screen: bone is the whitest, air is the blackest. Thus, the distinction between normal and pathological formations on a computer tomography is made according to the gradations of the transition from black to white color (gradations of gray color). The evaluation of BMD of the jaws was carried out



a



b

Fig. 1. Thick (A) and thin (B) biotypes of the mucous membrane of the sinus

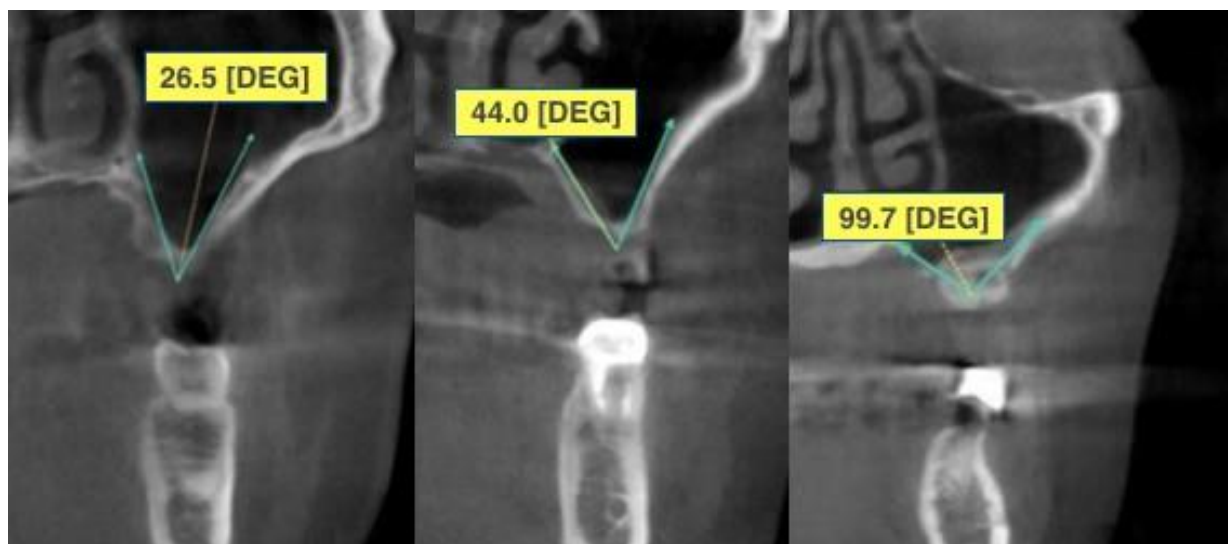


Fig. 2. Different values of the angle between the anterolateral and medial walls of the maxillary sinus

according to the classifications of U. Lekholm and G. Zarb (1985), as well as according to S.

Mish (1990). Bone density greater than 850 HU was considered as intact dense bone; values from 350 to 850 HU as relatively intact, loose bone; less than 350 HU – local osteoporosis [6]. In order to obtain BMD after CT scan of the LN and its image on the monitor screen, the tool of the "bone density measurement" panel was activated with a mouse button [6].

According to the generally accepted classification, the degree of pneumatization of the maxillary sinus: if the level of its floor was below the level of the floor of the nasal cavity, the pneumatic (hyperpneumatization) type was established, if the floor level was above the level of the floor of the nasal cavity, it was apneumatic (hypopneumatization). In cases where the level of the floor of the maxillary sinus coincided with the level of the floor of the nasal cavity, the degree of pneumatization was considered moderate [9].

When calculating the volume of the maxillary sinus, a ruler from a set of tools in the Planmeca Pro-max 3D software package was used.

They tried to reduce the shape of the maxillary sinus to simple three-dimensional figures (cube, pyramid, prism, etc.) that fit into it with the maximum number of contact points, and found their volume by calculating according to classical geometric formulas. In the presence of additional nooks and crannies and a complex shape, division was carried out into several simplified geometric shapes and the sum of the volumes of all components was calculated.

Statistical processing was performed using software packages

Microsoft Excel 2003 and the licensed program STATISTIKA (version 6.1; Statsoft Inc., USA) (License No. AGAR 909E415822FA).

Research results. In the period from 2018 to 2021, 72 patients underwent surgical treatment for vertical atrophy of the bone tissue of the alveolar process of the distal parts of the upper jaw for the purpose of installing dental implants and subsequent prosthetics.

The study of preoperative computer tomograms revealed that 26 patients (36.1 %) had structural abnormalities of the nasal cavity and ostiomeatal complex on the side corresponding to the surgical intervention (table 1).

In addition, the parameters of anatomical risk factors for the development of perforation of the sinus mucosa were determined – the thickness of the mucous membrane in the area of the alveolar bay and the angle between the anterolateral and medial walls of the sinus. Thick mucous membrane was found in 34 (47.2 %), thin – 38 (52.8 %). The value of the angle over 60 degrees was detected in 21 patients (29.2 %), less than 60 degrees in 51 (70.8 %). 4 combinations of these anatomical factors were formed: group 1 – angle greater than 60 degrees, mucous membrane thick, group 2 – angle greater than 60 degrees, mucous membrane thin, group 3 – angle less than 60 degrees, mucous membrane thick and group 4 – angle less than degrees and the mucous membrane is thin. The total number of perforations was 23 (31.9 %). Distribution of patients and comparison of combination data with intraoperative mucosal perforations are presented in Table 2.

Comparison of different groups of combinations of anatomical factors shows that in the second group,

perforation occurred 3 times less often than in the 4th group, which suggests that with a thin biotype of the mucous membrane of the maxillary sinus, but a large value of the angle, the probability of perforation is less. When comparing groups 3 and 4, when the angle in patients was less than 60 degrees, but with different biotypes of the mucous membrane, the frequency of perforation with a smaller thickness increased only 1.6 times. Comparing the data of the group, we can come to the disappointing conclusion that the angle between the anterolateral and medial walls of the sinus plays a greater role in the occurrence of perforation.

In the postoperative period, the phenomena of maxillary sinusitis were observed in 6 patients (8.3%

of the total number of patients), 4 of them had pathology of the anatomical structures of the nasal cavity (67 % of the total number of postoperative sinusitis). When comparing the frequency of inflammatory complications with perforation of the mucous membrane, it was found that intraoperative damage to the mucous membrane occurred in all cases of sinusitis (26.1 % of the total number of perforations) (Fig. 3)

An injury inflicted by a dentist-surgeon, in the conditions described earlier, can aggravate the situation even more. The formation of a lateral window on the anterolateral wall of the maxillary sinus can lead to metaplasia of the epithelium with the appearance of chronic sinusitis, in addition, the separation

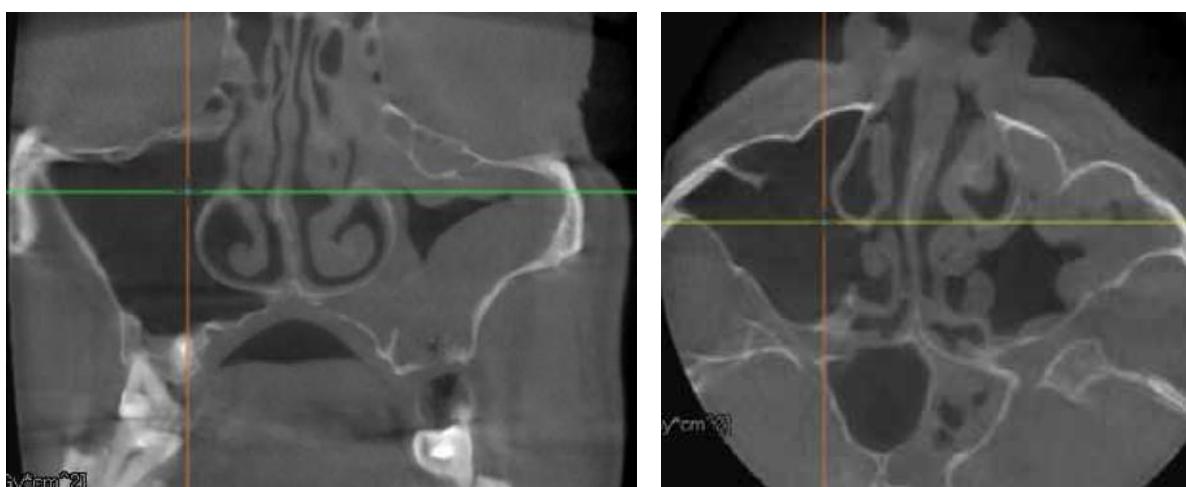


Fig. 3. CT of a patient with radiological signs of left-sided maxillary sinusitis and oroantral communication

Table 1

Pathologies of the anatomical structures of the nasal cavity and paranasal sinuses, revealed in a retrospective group of patients by computer tomography (n=72)

The name of the pathology	Absolute value	%
Curvature of the nasal septum	22	30,6 %
Pathology of the middle nasal concha (concha bullosa)	12	16,7 %
Hypertrophy of the hook-shaped process	8	11,1 %
Hypertrophy of the lattice – that bubble	7	9,7 %
Haller cells	4	5 %
Thickening of the mucous membrane over 5 mm	15	20,8 %

Table 2

The frequency of perforation of the mucous membrane of the maxillary sinus with various combinations of anatomical factors of its development (n=72)

	Number of patients (percentage of the total number of patients)	Number of perforations (percentage of the number of patients in the group)
1 group	9 (12,5%)	0 (0%)
2 group	12 (16,7%)	2 (16,7%)
3 group	25 (34,7%)	8 (32%)
4 group	26 (36,1%)	13 (50%)

of the mucous membrane during the operation stops the work of the cilia of the ciliary epithelium for an indefinite period. In the case of perforation of the mucous membrane, due to the possibility of microbial contamination with microflora of the oral cavity and migration of particles of bone-plastic material, the frequency of occurrence of inflammatory complications increases.

In addition, the influence of the thickness of the mucous membrane of the maxillary sinus and the angle between the anterior-lateral and medial walls on the frequency of perforation was studied. Four combinations of different variations of these anatomical risks were determined. The analysis of retrospective data showed that the greatest influence on the frequency of the development of this complication is exerted by the size of the angle – in the case of its small values (less than 60 degrees in the conducted study), perforations of the mucous membrane occurred 3 times more often than with a similar thickness of the mucous membrane, but a larger value angle. At the same time, postoperative sinusitis occurred in 26.1 % of cases of this complication.

As a result of processing the data obtained in the study, the following algorithm for diagnosing risk factors and preventing the development of intra- and postoperative complications of subantral plastic surgery by the lateral window technique is

proposed. A graphic image of the algorithm is presented in Figure 4.

Conclusions. 1. According to the retrospective analysis of the archival material of the Department of Oral Surgery, Implantology and Periodontology of the Dnipro State Medical University over 3 years, the frequency of complications of subantral plastic surgery using the lateral window technique is influenced by the presence of pathologies of the structures of the nasal cavity and the ostiomeatal complex, as well as the peculiarities of the structure of the maxillary sinus itself – the angle between and, to a lesser extent, the thickness of the mucosa lining of the sinus.

2. It was established that the frequency of perforation of the mucous membrane was 31.9 %, while it occurred in 50 % of cases in patients with a thin mucous membrane and an angle of less than 60 degrees. In the group of patients who had a thick mucous membrane and the angle between the walls in the treated area was more than 60 degrees, perforation of the mucous membrane did not occur. At the same time, comparing different combinations of these factors, it was found that a larger angle value reduces the probability of perforation by 3 times with an equally thin sinus mucosa.

3. It was established that in 67 % of cases of sinusitis, pathologies of the structures of the nasal cavity and osteomeatal complex were detected.

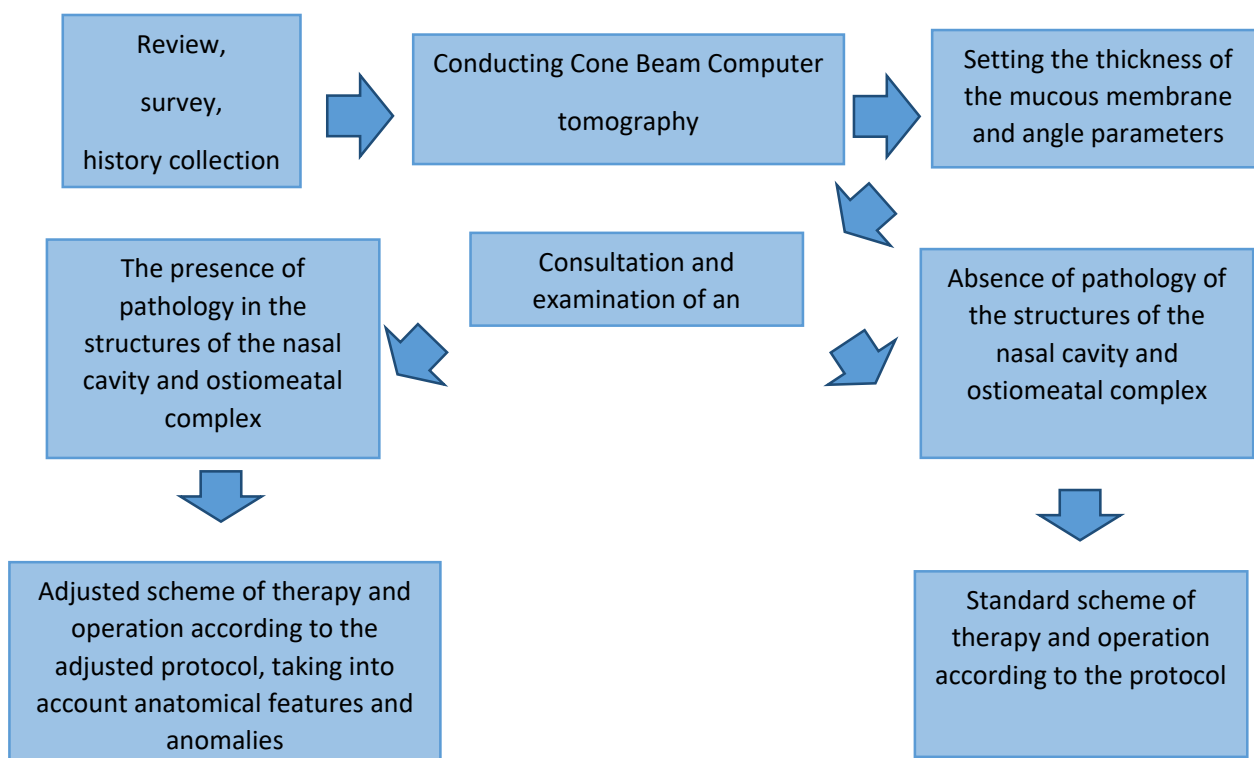


Fig. 4. Algorithm for diagnosis of risk factors and prevention of complications of subantral plastic surgery

4. Comprehensive preoperative diagnosis of a group of patients who are scheduled to undergo sub-antral plastic surgery should include an oral cavity examination by a dentist-surgeon, cone-beam computed tomography, examination and consultation by an otorhinolaryngologist.

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