

# Periosteum Preservation Approach In Endoscopic Sinus Surgery Before Subantral Bone Augmentation

Volodymyr Shkorbotun<sup>1</sup>, Yaroslav Shkorbotun<sup>1</sup>

State Institution of Science “Research and Practical Center of Preventive and Clinical Medicine” State Administration Department 01014, Ukraine, Kyiv Verkhnia str., 5<sup>1</sup>



---

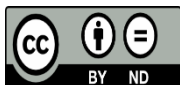
## Keywords:

subantral bone augmentation, complication, periosteum preservation, endoscopic sinus surgery

---

## ABSTRACT

To evaluate the effect of periosteum preservation approach in endoscopic sinus surgery on subantral bone augmentation in patients with the maxillary sinus pathology. The results of subantral bone augmentation of 245 patients who underwent surgery for the paranasal sinus pathology (chronic rhinosinusitis, fungus ball and maxillary sinus cysts) were studied. In 146 patients endoscopic sinus surgery was performed with periosteum preservation approach (main group), and 99 patients underwent traditional surgery (control group). The total proportion of patients who had the perforation of the Schneiderian membrane during subantral augmentation in the group with endoscopic sinus surgery according to the traditional method was 21.21%, which is significantly higher than in patients who underwent surgery in accordance with the periosteum preservation principles – 9.59% ( $p < 0.05$ ). The frequency of application of periosteum restore technologies in subantral augmentation was significantly higher in the control group (49.49%) compared with the main group (24.66%) ( $p < 0.05$ ). The frequency of other complications after subantral augmentation in patients who underwent surgery according to the traditional method was 20.59%, which is significantly higher than in patients with periosteum preserving principles – 10.27% ( $P < 0.05$ ). A reduction in the frequency of complications in subantral bone augmentation, provided that the principles of periosteal preservation in sinus surgery are observed, can be associated with low traumatization of the periosteum, and therefore the preservation of its elastic features with the avoidance of tight adhesions between the periosteum in the area of elevation and the underlying bone.



This work is licensed under a Creative Commons Attribution Non-Commercial 4.0 International License.

---

## 1. Introduction

Endoscopic sinus surgery is an important part of modern surgical treatment of patients with nose and sinus disorders. The advances in medicine, including dental implant technology, necessitate a review of the approaches to treating patients with maxillary sinus disease before dental implantation and subantral bone augmentation in particular.

The pathologies associated with the efficiency of dental implantation involve maxillary sinus cysts, chronic inflammatory processes of the paranasal sinuses, including fungal bodies, and adhesive changes in the periosteum [5- 7].

Scar tissue can either develop as a result of chronic inflammatory processes, or it can be of iatrogenic origin, that is the result of traumatic surgery on the maxillary sinus (MS) [6- 8]. It is known that surgeries with traumatized periosteum make it difficult to perform subantral bone augmentation [1], [7] and some authors consider the Caldwell-Luc operation as a contraindication to sinus lift [3], [6], [10].

All of the above indicates a new problem for otorhinolaryngologists in the treatment of MS pathology, namely the need for maintaining certain conditions during sinus surgery for dental implantation, which is likely to be necessary in the future, regardless of the patient's age and the presence of dental pathology. To this end, the principle of periosteum preservation has been developed [12].

The main goal of the principle is to ensure maximum preservation of the periosteal layer of MS in the area of potential dental implantation while achieving a clinical effect of debridement at the level of traditional endoscopic sinus surgery. Periosteum preservation is achieved through access planning, taking into account the possibility of constant visual control of the intervention and minimization of manipulations in the area of subsequent dental implantation. In case of any manipulations in the area of subsequent dental implantation, the methods with minimal impact on the mucoperiosteum, such as power-assisted methods, should be used.

## 2. The aim

To evaluate the efficiency of periosteum preservation approach in endoscopic sinus surgery by comparing the results of subantral bone augmentation (SBA) in patients with pathology of the maxillary sinus (chronic rhinosinusitis, fungal sinus infection and cysts), who underwent surgical treatment in accordance with the principles of periosteum preservation, and retrospective data on the course of bone augmentation in individuals with a history of surgical treatment of the same pathologies of the paranasal sinuses.

## 3. Materials and methods

The group with periosteum preservation approach (main) included 146 patients, and retrospective group (control) involved 99 patients. The average age of patients in the main group was  $47.3 \pm 5.7$  years, in the control group –  $48.1 \pm 6.4$  ( $p > 0.05$ ). The gender distribution in groups was as follows: the proportion of women in the main group was 42.9%, and in the control group it was 40.4%; the proportion of men – 57.1% and 59.6% respectively.

All patients of the control group underwent surgical treatment more than 6 months before SBA. In the main group, 92 (63.01%) patients had surgery in the period up to 6 months, and 54 (36.99%) – 6 months or more.

The indications for surgery involved chronic rhinosinusitis (CRS), fungus ball of the maxillary sinus (FBMS), maxillary sinus cysts (MSC). The distribution of patients by types of sinus pathology in groups is presented in Table 1.

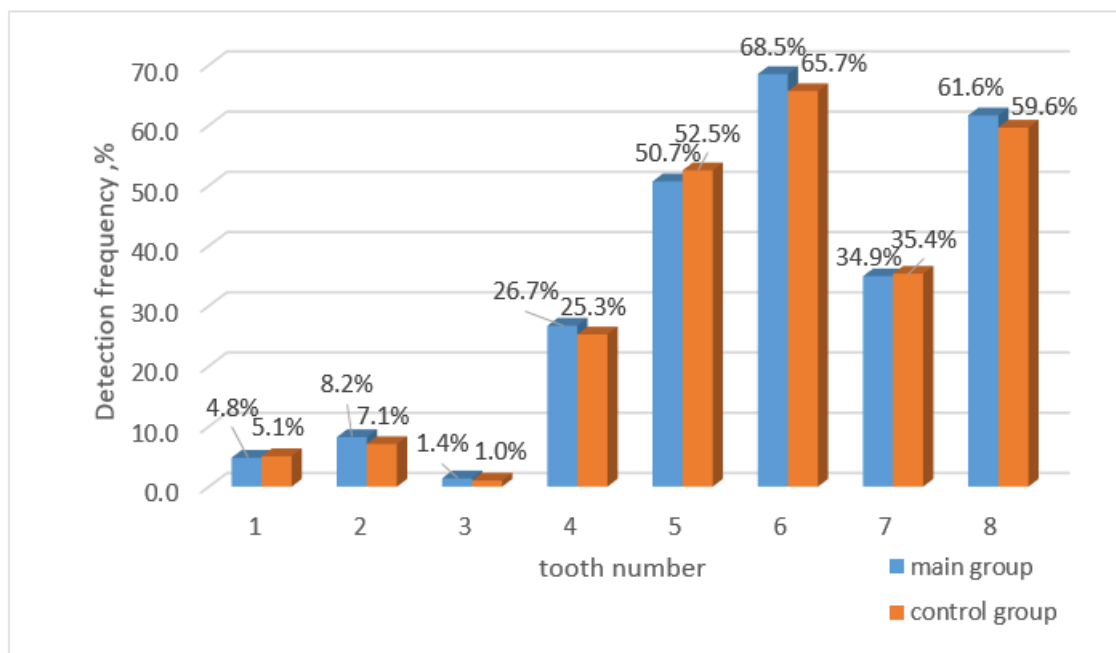
**Table 1** The distribution of patients by types of maxillary sinus pathology in groups

Groups	Type of pathology	Total
--------	-------------------	-------

	CRS	FBMS	MSC	
Main n (%), CI 95%	37 (25.34%), 18.68-33.33	67 (45.89%), 37.69- 54.31	42 (28.77%), 21.74-36.94	146 (100.0%) 96.8-100.0
Control n (%), CI 95%	30 (30.3%), 21.68- 40.47	34 (34.34%), 25,27-44,64	35 (35.35%), 26.18-45.67	99 (100.0%) 95.35-100.0
P	P>0.05	P>0.05	P>0.05	P>0.05

Table 1 shows that the distribution of patients by type of pathology was comparable and sufficient to make statistically reliable conclusions.

The features of adentia of the upper jaw in groups of patients are presented in Figure 1.



**Figure 1.** Features of adentia of the upper jaw in groups of patients

Note: \*- p<0,05;

As can be seen from Figure 1, the absence of the first molar was the most common in both groups. There was no significant difference in the frequency of various types of adentia in the groups. The features of adentia in the groups were comparable.

Regarding the features of rhinosurgical interventions that were performed, in patients of the main group they were conducted in accordance with periosteum preservation principles. At the same time, in all patients of this group, the access through the middle nasal passage was used, while in the control group, anamnestic data and computed tomography (CT) data indicate a typical endoscopic intervention using the access through antrostoma of the middle nasal passage in 81 (81.8%) patients, and in 18 (18.2%) patients using

sublabial access.

The analysis of protocols on subantral bone augmentation involved the frequency of Schneiderian membrane perforations, the presence of intraoperative bleeding and the use of a sealing membrane during the intervention. In addition, the frequency of postoperative complications was studied, such as infection of the crestal mucoperiosteal flap of the alveolar ridge of the upper jaw, the development of maxillary sinusitis and the dislocation of the augmentate into the sinus lumen. It should be noted that the information on the use of periosteum preserving technologies and the perforation of the Schneiderian membrane was reported in all cases of both the main and control groups, while other data on postoperative follow-up, the period after SBA, was available in 68 out of 99 cases.

#### 4. Results

Data on the features of subantral bone augmentation and the frequency of complications after the intervention are presented in Table 2.

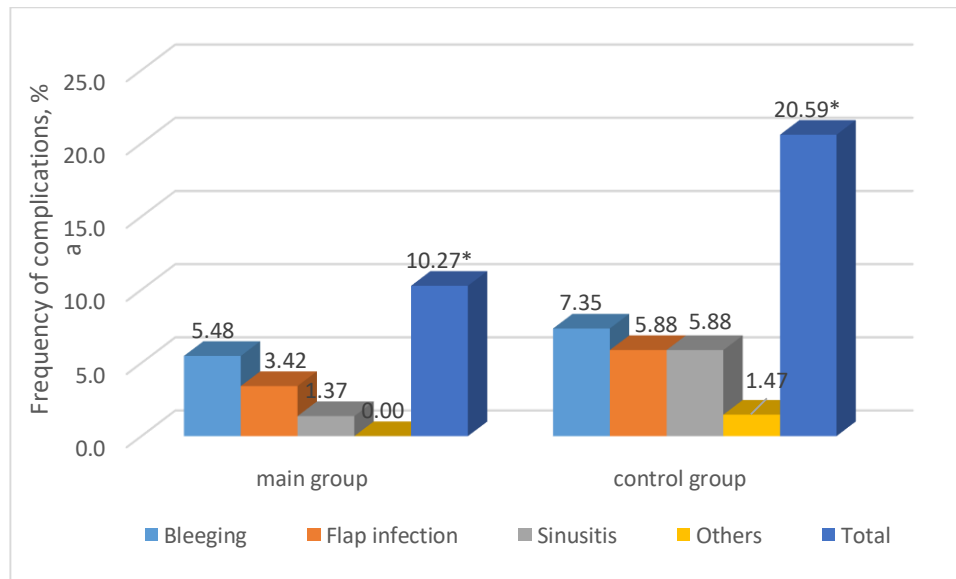
**Table 2** Intraoperative complications and features of subantral bone augmentation in patients with certain maxillary sinus diseases

Groups of patients (n - number of sinuses)	Perforation of the mucoperiosteum	The use of sealing membrane
	n (%), CI 95%	n (%), CI 95%
<b>Chronic rhinosinusitis with nasal polyps</b>		
Main group n=37	4 (10.81%), 3.52;24.71	10 (27.03)**, 14.37;44.39
Control group n = 30	5 (16.0%), 7.89;33.36	16 (53.3%)**, 36.34;68.18
<b>Fungal rhinosinusitis</b>		
Main group n=67	5 (7.46%) 2.8-17.3	17 (25.37%) 15.9-37.7
Control group n = 34	6 (17.14%) 7.17-34.29	16 (45.71%) 29.2-63.1
<b>Maxillary sinus cyst</b>		
Main group n =42	5 (11.9%)*, 4.5-26.4	9 (21.4%)**, 10.9-37.2
Control group n = 35	11 (31.43%)*, 17.43-49.42	17 (48.57%)**, 31.72-65.72
<b>Total by groups</b>		
Main group n =146	14 (9.59%)* 5.54-15.86	36 (24.66%)** 18.08-32.61
Control group n = 99	21 (21.21%)* 13.89-30.81	49 (49.49%)** 39.36-59.66

Note: \*, \*\* - p<0.05 by groups, CI 95%- confidence interval 95%;

According to Table 2, it can be concluded that the total proportion of patients who had the perforation of the Schneiderian membrane during SBA in the group with endoscopic sinus surgery according to the traditional method was 21.21%, CI95% (13.89-30.81) that is significantly higher than in patients who underwent surgery in accordance with the periosteum preservation principles – 9.59%, CI95% (5.54-15.86). In addition, a significant difference between the groups on this basis was found in patients who underwent surgery for cysts of MS. When comparing groups on the use of periosteum preserving technologies, there was a significant predominance of the frequency of their use in the control group in analyzing the data as a whole by groups and separately for chronic rhinosinusitis with nasal polyps and cysts of MS.

Data on the total frequency of detecting other complications of SBA in groups of patients are presented in Figure 2.



**Figure 2.** Frequency of certain types of complications of SBA with the exception of perforation of mucoperiosteum in patients by groups. Note \* – p<0.05

As can be seen from Figure 2, the total frequency of postoperative complications (excluding perforation of the Schneiderian membrane) in patients who underwent FESS with periosteum preserving principles was 10.27%, CI95% (6.06-16.66), which is significantly less than in the control group – 20.59%, CI95% (12.1-32.45) (P <0.05).

The frequency of complications of SBA depending on the type of nosology is presented in Table 3.

**Table 3** The frequency of complications of subantral bone augmentation (excluding perforation of the Schneiderian membrane)

Groups of patients (n – number of sinuses)	Complications n (%), CI 95%				
	Bleeding	Crestal flap infection	Sinusitis	Others	Total
Chronic rhinosinusitis with nasal polyps					

Group 1 (n = 37)	3 (8.11%), 2.12-23.03	2 (5.41%), 0.94-19.54	-	-	5 (13.51%), 5.08-29.57
Group 1 (n = 21)	2 (9.52%), 1.67- 31.82	2 (9.52%), 1.67- 31.82	3 (9.52%), 1.67- 31.82	1 (4.76%), 0.25-25.87	8(33.33%) 15.48- 56.89
<b>Fungal rhinosinusitis</b>					
Group 2 (n = 67)	4 (5.97%) 1.93-15.35	2 (2.99%) 0.52-11.32	1(1.49%) 0.08-9.13	-	7(10.45%) 4.66-20.94
Group 2 (n =22)	1 (4.55%), 0.24-24.89	1 (4.55%), 0.24-24.89	1 (4.55%), 0.24-24.89	-	3 (13.64%) 3.59-35.97
<b>Maxillary sinus cyst</b>					
Group 1 (n=42)	1 (2.38%), 0.12-14.09	1 (2.38%), 0.12-14.09	1 (2.38%), 0.12-14.09	-	3 (7.14%), 1.86-20.55
Group 1 (n =25)	2 (8.0%), 1.4-27.5	1 (4.0%), 0.21-22.32	2 (8.0%), 1.4-27.5	-	5 (20.0%), 7.61-41.3
<b>Total by groups</b>					
Group 2 (n = 146)	8 (5.48%), 2.57-10.87	5 (3.42%), 1.26-8.22	2 (1.37%) 0.24-5.37	-	15 (10.27%)*, 6.06-16.66
Group 2 (n = 68)	5 (7.35%), 2.74-17.02	4 (5.88%), 1.9-15.13	4 (5.88%), 1.9-15.13	1(1.47%), 0.08-9.01	14 (20.59%)*, 12.1-32.45

Note: CI 95% – confidence interval 95%; \* –  $p < 0.05$  by groups;

According to Table 3, the frequency of complications in patients who underwent surgery according to the traditional method (20.59%, CI95% 12.1-32.45), was significantly higher than in those who had surgery with periosteum preserving principles (10.27%, CI95% 6.06-16.66) ( $p < 0.05$ ).

## 5. Discussion of the results

Thus, the presented data confirm the clinical efficiency of periosteum preservation approach, namely the reduction in the frequency of intra- and postoperative complications of SBA. According to the literature, perforations of the mucoperiosteum are found in 8.3 – 56% of augmentations [5], [2], [14] the total frequency of complications of augmentation is from 20.3 to 64% [4], [5], [14]. The use of the proposed method makes it possible to reduce the perforation of the Schneiderian membrane in patients with such types of pathologic processes of sinuses as cysts and chronic rhinosinusitis, as well as in all groups of patients. It should be noted that in the main group, the obtained indicators of complications correspond to the lowest level noted by other authors in the total number of patients, when we have patients with primary pathology of the paranasal sinuses.

The role of the Schneiderian membrane perforation during maxillary bone augmentation is debatable. Some authors indicate an increase in the frequency of complications in such patients [5], [7], [13] while [8] noted the lack of a statistically significant relationship between perforation and implant survival rate. [9] indicate the relationship between the Schneiderian membrane perforation and the development of sinusitis. In our work, we considered perforation of the mucoperiosteum not only as a prognostic factor for the efficiency of

implantation, but also as a marker of changes in the density of the mucoperiosteum as a result of intervention. After all, a high frequency of signs of perforation indicates a deterioration in the elastic properties of the periosteal layer and, as a result, requires more frequent use of periosteum preservation technologies, which leads to an increase in the duration of the intervention and the cost of consumables.

In our opinion, the differences in the results of patients with cysts of the maxillary sinus and chronic rhinosinusitis in relation to patients with fungal sinusitis can be explained by the difference in mucoperiosteum changes in each of these pathological processes [9]. Thus, cysts located in the alveolar cavity are characterized by localization at the level of the mucosal layer of the mucoperiosteum with a decrease in its thickness at the site of attachment of the cyst, and chronic rhinosinusitis – changes in the form of edema and fibrosis at the level of its own plate [9]. In the surgical treatment of patients with this pathology, the technique of removal is important, in particular the choice of the tool with minimal impact on the periosteum, namely – power-assisted [12], which was used in patients of the main group.

We believe that the positive effect we found in the use of periosteum preservation approach in endoscopic sinus surgery before dental implantation can be explained by the choice of optimal surgical approach to the sinus using appropriate minimally invasive endoscopic power-assisted technique to remove pathological tissues and avoid traumatization of the periosteum due to visual control.

## **6. General conclusion**

The use of periosteum preservation approach in endoscopic sinus surgery provides a reduction in the frequency of mucoperiosteum perforation during subantral bone augmentation, as well as other complications.

A reduction in the frequency of complications in subantral bone augmentation, provided that the principles of periosteal preservation in sinus surgery are observed, can be associated with low traumatization of the periosteum, and therefore the preservation of its elastic features with the avoidance of tight adhesions between the periosteum in the area of elevation and the underlying bone.

Compliance with Ethics Requirements: „The author declare no conflict of interest regarding the article “ „The author declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008, as well as the national law. Informed consent was obtained from the patient included in the study. No funding for this study“.

## **7. REFERENCES**

- [1] Amid R, Kadkhodazadeh M, Moscowchi A, Nami M. Effect of Schneiderian Membrane Thickening on the Maxillary Sinus Augmentation and Implantation Outcomes: A Systematic Review. *J Maxillofac Oral Surg.* 2021; 20(4):534-544. doi: 10.1007/s12663-021-01551-y. Epub 2021 Apr 2. PMID: 34776681; PMCID: PMC8554926.
- [2] Kim JS, Choi SM, Yoon JH, Lee EJ, Yoon J, Kwon SH, Yeo CD, Ryu JS, Lee JH, You YS. What aspects postoperative sinusitis and implant failure after dental implant: A meta-analysis. *Otolaryngol. Head Neck Surg.* 2019; 160: 974–984.,
- [3] Kim SJ, Park JS, Kim HT, et al. Clinical features and treatment outcomes of dental implant-related paranasal sinusitis:A 2-year prospective observational study. *Clin Oral Implants Res.* 2016;27:e100–e104



- [4] Mohammad A H. Maxillary Sinus Lifting: Review of the Two Main Approaches. *Glob J Oto* 2017; 8(4): 555745.
- [5] Moy PK, Aghaloo T. Risk factors in bone augmentation procedures. *Periodontol* 2000. 2019;81(1):76-90. doi:10.1111/prd.12285
- [6] Riedl D, Dejaco D, Steinbichler TB, et al. Assessment of health-related quality-of-life in patients with chronic Rhinosinusitis - Validation of the German Sino-Nasal Outcome Test-22 (German-SNOT-22). *J Psychosom Res.* 2021; 140:110316. doi:10.1016/j.jpsychores.2020.110316,
- [7] Ritter A, Rozendorn N, Avishai G, Rosenfeld E, Koren I, Soudry E. Preoperative Maxillary Sinus Imaging and the Outcome of Sinus Floor Augmentation and Dental Implants in Asymptomatic Patients. *Ann Otol Rhinol Laryngol.* 2020;129(3):209-215. doi: 10.1177/0003489419883292.5
- [8] Schwartz-Arad D, Herzberg R, Dolev E. The prevalence of surgical complications of the sinus graft procedure and their impact on implant survival. *J Periodontol.* 2004.75: 511–516. doi: 10.1902/jop.2004.75.4.511
- [9] Schwarz, L., Schiebel, V., Hof, M., Ulm, C., Watzek, G., & Pommer, B.. Risk Factors of Membrane Perforation and Postoperative Complications in Sinus Floor Elevation Surgery: Review of 407 Augmentation Procedures. *Journal of Oral and Maxillofacial Surgery*, 2015. 73(7), 1275–1282. doi:10.1016/j.joms.2015.01.039
- [10] Shao L, Qin X, Ma Y. Removal of maxillary sinus metallic foreign body like a hand sewing needle by magnetic iron. *Int J Clin Pediatr Dent.* 2014;7(1):61-4. doi: 10.5005/jp-journals-10005-1237.,
- [11] Testori T, Weinstein T, Taschieri S, Wallace SS. Risk factors in lateral window sinus elevation surgery. *Periodontology* 2000. 2019;81(1):91-123. <https://doi.org/10.1111/prd.12286>
- [12] Testori T, Yu SH, Tavelli L, Wang HL. Perforation Risk Assessment in Maxillary Sinus Augmentation with Lateral Wall Technique. *Int J Periodontics Restorative Dent.* 2020;40(3):373-380. doi: 10.11607/prd.4179.
- [13] Шкорботун ЯВ, Курик ОГ. Патоморфологічні особливості мукоперіосту гачкоподібного відросту при окремих захворюваннях верхньощелепного синусу. *Український журнал медицини, біології та спорту.* 2021;6(5):255-262.
- [14] Шкорботун ЯВ. Особливості хірургічного лікування хворих на хронічний риносинусит з поліпами при запланованій денціальній імплантациї з синусліфтингом. *Актуальні проблеми сучасної медицини: Вісник Української медичної стоматологічної академії.* 2021. Том 1, №3. DOI: <https://doi.org/10.31718/2077-1096.21.3.123>