ORIGINAL RESEARCH

Effects of Bone Grafting and Non–Bone Grafting on Implant Stability and New Bone Formation in Patients Undergoing Maxillary Sinus Floor Elevation Combined with Bicon Short Implants

Shuangxi Liu, MM; Shaoshan Chen, BM; Zhuogeng Chen, MM; Xue He, BM; Xieshan Huang, MM

ABSTRACT

Objective • To compare the effects of bone grafting versus non–bone grafting on implant stability and new bone formation in patients undergoing maxillary sinus floor lift combined with placement of a Bicon short dental implant.

Methods • We recruited 60 patients with posterior maxillary tooth loss and insufficient jaw bone mass from December 2017 to December 2019, and the patients were divided into 2 groups in accordance with the surgical method: the bone grafted group (n = 32) and the non–bone grafted group (n = 28). Both groups underwent maxillary sinus floor elevation combined with Bicon short dental implant placement. No bone-grafting materials were used in the non–bone grafted group, and autologous bone chips mixed with Bicon bone substitute were used for bone grafting in the bone grafted group. The 2 groups were compared for their peri-implant index and periodontal bleeding index immediately after the operation, as well as at 3, 6, and 12 months postoperatively. The study also compared the sub–sinus-membrane height, peri-implant bone density, implant stability quotient, and alveolar bone height in the implant area at 3, 6, and 12 months after the operation, as well as the implant survival rate and complications (infection, bleeding, mucosal perforation, sinus-floor cyst, and bone-graft displacement) 12 months after the operation.

Results • The peri-implant index and periodontal bleeding index immediately after the operation in the bone grafted group were higher than those in the non–bone grafted group (all $P < .05$), but there were no significant differences in the 2 indices between the 2 groups at 3, 6, and 12 months after the operation (all $P > .05$). The sub–sinus-membrane height, peri-implant bone density, implant stability quotient, and alveolar bone height in the bone grafted area were higher in the bone grafted group than in the non–bone grafted group at 3, 6, and 12 months after the operation (all $P < .05$). Although the implant survival rate in the bone grafted group was slightly higher than that in the non–bone grafted group at 12 months after the operation, the difference was not statistically significant ($P > .05$). One case of mucosal perforation occurred in the bone grafted group, but there was no significant difference in the complication rate between the 2 groups ($P > .05$).

Conclusion • The findings of this study support the use of autologous bone chips mixed with Bicon bone substitute in maxillary sinus floor elevation combined with Bicon short dental implant placement for improved implant stability and new bone formation. Further research is needed to evaluate long-term outcomes and potential complications associated with this technique. (*Altern Ther Health Med.* 2023;29(8):240-245).

Shuangxi Liu, MM; **Zhuogeng Chen**, MM; **Xue He**, BM; Department of Oral Implantology, Haikou Affiliated Hospital of Central South University Xiangya School of Medicine, Haikou, Hainan, China; **Shaoshan Chen**, BM; Department of Periodontics, Haikou Affiliated Hospital of Central South University Xiangya School of Medicine, Haikou, Hainan, China; **Xieshan Huang**, MM; Department of Oral and Maxillofacial Surgery, Haikou Affiliated Hospital of Central South University Xiangya School of Medicine, Haikou, Hainan, China.

Corresponding author: Xieshan Huang, MM
E-mail: hnsun3@126.com
Corresponding author: Zhuogeng Chen, MM
E-mail: chenzgdent@163.com

INTRODUCTION

With the continuous development of dental implant technology, the treatment of posterior maxillary tooth loss has shifted from traditional lateral window sinus-lift techniques to the internal sinus-lift technique. The internal sinus-lift technique involves the upward movement of the sinus-floor membrane inside the maxillary sinus to create a space suitable for bone growth, allowing the implant to be firmly implanted in the maxillary bone.[1] The Bicon short implant (Bicon, LLC) is a new type of implant that has a small diameter and short length and is easy to insert, making it a superior choice for use in the internal sinus-lift procedure. The combination of internal sinus lift and Bicon short implant placement creates a complex surgical procedure, and the surgical outcome is

influenced by multiple factors, such as the depth of maxillary sinus mucosa, bone quality, and bone mass. Inadequate bone mass in the maxillary sinus is an important factor that affects the stability of the implant after the surgical procedure.[2] Bone grafting can add new bone tissue around the implant, increase the surrounding bone mass and density, and provide bone-tissue support for the implant. Bone-graft materials and implantation methods are constantly being improved. However, there is still no unified standard for whether or not to use bone grafts and how to select bone-graft materials.[3] In this study, we used autologous bone chips mixed with Bicon bone substitute (Bicon, LLC) as the bone-graft material. Autologous bone provides essential osteogenic cells and growth factors, promoting new bone formation. Bicon bone substitute serves as a scaffold, facilitating bone regeneration. This combination aims to improve implant stability and enhance bone formation, minimizing the need for additional surgical sites and reducing potential complications associated with harvesting autologous bone alone. Combining the high biological compatibility and osteogenic ability of autologous bone with the strong support and plasticity of the Bicon bone substitute can fully leverage the advantages of different materials and improve the bone-grafting effect.[4,5] We aimed to compare the effects of bone grafting and non–bone grafting on implant stability, bone formation, and complications after internal sinus lift and Bicon short implant placement in the maxillary sinus. The specific goals were to evaluate the impact of bone grafting on implant stability, assess the extent of new bone formation around the implant, and analyze the occurrence of complications such as infection, mucosal perforation, bleeding, sinus-floor cyst, and bone-graft displacement. The study aimed to provide evidence and guidance for the selection of bone-grafting strategies in the context of internal sinus-lift procedures to ultimately improve the success and outcomes of dental-implant treatments in patients with posterior maxillary tooth loss.

PATIENTS AND METHODS

Patients

We recruited 60 patients with posterior maxillary tooth loss and insufficient jaw bone mass from December 2017 to December 2019. This study was approved by the Ethics Committee of Haikou Affiliated Hospital of Central South University Xiangya School of Medicine.

The inclusion criteria were patients aged from 18 to 65 years; maxillary posterior tooth loss with insufficient bone mass (3 mm ≤ alveolar ridge height ≤ 5 mm); no separation of maxillary sinus; no obvious lesions in maxillary sinus; no surgical contraindications; no major medical history; current good physical condition; provided informed consent; and willingness to cooperate with the study.

The exclusion criteria were concurrent periodontitis or other periodontal diseases; oral infection that cannot be operated on; concomitant chronic osteomyelitis, osteoporosis, or other metabolic bone diseases; serious systemic diseases such as immune system diseases, blood system diseases, or malignant tumors; or pregnancy or lactation. Exclusion criteria also included inability to complete follow-up or incomplete and unreliable follow-up data.

The patients were divided into 2 groups based on different surgical procedures: the bone grafted group (n = 32) and the non–bone grafted group (n = 28). In the bone grafted group, there were 12 men and 20 women; their ages ranged from 21 to 62 years, with a mean (SD) age of 43.7 (4.0) years. Of the 32 patients in the bone grafted group, 19 cases had missing first molars, and 13 cases had missing second molars; 23 cases were classified as grade III bone quality, and 9 cases were classified as grade II. In the non–bone grafted group, there were 11 men and 17 women; their ages ranged from 20 to 60 years, with a mean (SD) age of 42.1 (3.5) years. Of the 28 patients in the non–bone grafted group, 16 cases had missing first molars, and 12 cases had missing second molars; 20 cases were classified as grade III bone quality, and 8 cases were classified as grade II. There were no statistically significant differences in gender, age, missing tooth position, and bone quality between the 2 groups (all $P > .05$), indicating comparability between the groups.

Surgical procedures

The surgical procedures were performed in accordance with the assigned groups, with the key distinction lying in the graft material used. The bone grafted group received a mixture of autologous bone chips and Bicon bone substitute, whereas the non–bone grafted group did not receive bone-grafting materials.

Bone grafted group. Local anesthesia and routine disinfection were administered to each patient. The gingiva was incised and a flap was raised. The implant site was marked, and a hole was drilled to approximately 1 mm from the maxillary sinus floor. The osteotomy was gradually lengthened, and a sinus-lift tool was used to gently tap the sinus membrane, elevating the sinus floor to the implant length. The nasal pinch and blow method was performed to check for sinus membrane perforation. A mixture of autologous bone chips and Bicon bone substitute was added into the maxillary sinus, and a sinus-lift tool was used again with gentle tapping to lift the sinus membrane to the desired height; this process was repeated several times. A Bicon short implant was inserted and buried to allow for healing. The gingiva was sutured.

Non–bone grafted group. Local anesthesia and routine disinfection were administered to each patient. The gingiva was incised and a flap was raised. The implant site was marked, and a hole was drilled to approximately 1 mm from the maxillary sinus floor. The osteotomy was gradually lengthened, and a sinus-lift tool was used to gently tap the sinus membrane, elevating the sinus floor to the implant length. The nasal pinch and blow method was performed to check for sinus membrane perforation. Subsequently, the Bicon short implant was inserted, with adjustments made to its direction and depth for optimal placement. The implant was buried to allow for healing, and the gingiva was sutured.

Observation indicators

We compared the periodontal health status of the 2 groups of patients immediately after the operation and at 3, 6, and 12 months postoperatively. We also evaluated cone-beam computed tomography (NewTom) indices at 3, 6, and 12 months postoperatively, such as the maxillary sinus mucosa subantral height, the sinus bone density around the implant, the implant stability quotient (ISQ), and the alveolar bone height in the grafted area. We also assessed the implant survival rate and incidence of complications 12 months after the operation.

The periodontal health status was evaluated using a periodontal probe gently inserted into the gingival sulcus to observe the depth of the periodontal pocket, bleeding, and suppuration. Based on the periodontal pocket depth and bleeding, we divided the patients into 4 levels: level 0, no gingival pocket or bleeding; level 1, no gingival pocket, but bleeding present; level 2, gingival pocket of 1 to 2 mm in depth; and level 3, gingival pocket of 3 to 5 mm in depth. We then calculated the peri-implant index (PI) for each patient. Peri-implant index (PI) is a measure used to assess the health of tissues surrounding dental implants. It is calculated by evaluating the presence and severity of inflammation and bleeding around the implant. Six sites around the implant are examined for bleeding on probing (BOP) and the presence of plaque. Each site is assigned a score based on the severity of inflammation and bleeding. The scores from all sites are added together to obtain the overall PI score, which ranges from 0 to 18. A higher PI score indicates more severe inflammation and poorer peri-implant health. The PI is an important tool for monitoring and maintaining the health of dental implants. We also measured the periodontal bleeding index (PBI) for each patient by inserting a periodontal probe gently into the gingival sulcus to a depth of 3 mm, waiting for 10 seconds, and recording the number of bleeding episodes. We then divided the number of bleeding episodes by the total number of insertions and multiplied by 100 to obtain the PBI.

Cone-beam computed tomography was used to evaluate the maxillary bone and the maxillary sinus mucosa subantral edge in relation to the dental implant. The cone-beam computed tomography scans provided detailed images of the maxillary bone structure and allowed for the visualization of the implant position within the bone. To assess the relationship between the implant and the maxillary sinus mucosa, a specific scan section perpendicular to the bottom of the maxillary bone was selected. The implant position was identified in the section, and the distance from the implant to the highest point of the maxillary sinus mucosa subantral edge was measured. This measurement represents the maxillary sinus mucosa subantral height, indicating the vertical distance between the implant and the maxillary sinus mucosa. Furthermore, a region of interest was defined around the implant within the sinus area. Using QCT Analyze, the bone density within this region of interest was measured. The bone-density value provided an indication of the density or mineralization of the bone surrounding the implant in the sinus area. Cone-beam computed tomography evaluation allowed for the precise assessment of implant position in relation to the maxillary sinus mucosa and for the measurement of important parameters such as subantral height and bone density.

We used the Osstell ISQ technique to lightly tap around the implant and record the resonant frequency between the implant and bone tissue using a handheld device with a sensor. The ISQ scale ranges from 0 to 100, with a higher value indicating greater implant stability. We measured the alveolar bone height in the grafted area by taking a periapical radiograph of the periodontal region. We assessed the implant survival rate by observing the stability of the implant for 12 months postoperatively, with survival of the implant defined as without loosening or displacement.

The incidence of postoperative infection, bleeding, mucosal perforation, maxillary-sinus cysts, and displacement of bone-graft materials was calculated.

Statistical analysis

Data processing was performed using SPSS version 22.0 statistical software (IBM Corp). Count data were presented as No. (%), and intergroup comparisons were conducted using the chi-square test or Fisher exact test. Rank-sum tests were used for comparisons of ordinal data. Measurement data were presented as mean (SD). Repeated measures analysis of variance was used to compare changes in indicators between 2 groups at multiple time points, and pairwise comparisons were performed using Bonferroni correction. Differences were considered statistically significant when $P < .05$, with the level of significance (α) set at .05.

RESULTS

Comparison of postoperative periodontal health status

The PI and PBI immediately after the operation were higher in the bone grafted group than in the non–bone grafted group (both $P < .05$). There was no significant difference between the 2 groups for PI and PBI at 3, 6, and 12 months after the operation (all $P > .05$), as shown in Table 1.

Comparison of postoperative submucosal anterior height of the maxillary sinus and sinus bone mineral density around the implants

The height of the anterior submucosal margin of the maxillary sinus and the sinus bone mineral density around the implants were greater in the bone grafted group than in the non–bone grafted group at 3, 6, and 12 months after the operation (all $P < .05$), as shown in Table 2.

Comparison of postoperative ISQ

The ISQ at 3, 6, and 12 months after the operation was higher in the bone grafted group than in the non–bone grafted group (all $P < .05$), as shown in Table 3.

Comparison of postoperative alveolar bone height in the bone grafted area

The alveolar bone height in the bone grafted area at 3, 6, and 12 months after the operation was higher in the bone

Table 1. Comparison of Postoperative Periodontal Health Status

Group	No. of cases	Postoperative PI, mean (SD)				Postoperative PBI, mean (SD)			
		Immediately	3 mo	6 mo	12 mo	Immediately	3 mo	6 mo	12 mo
Bone grafted group	32	2.52 (0.31)[a]	1.84 (0.39)[b]	1.29 (0.32)[b]	0.88 (0.21)[b]	0.33 (0.09)[a]	0.21 (0.07)[b]	0.14 (0.05)[b]	0.09 (0.04)[b]
Non–bone grafted group	28	2.38 (0.27)	1.88 (0.31)[b]	1.33 (0.39)[b]	0.82 (0.26)[b]	0.24 (0.10)	0.22 (0.06)[b]	0.14 (0.05)[b]	0.08 (0.03)[b]

[a]$P < .05$, compared with the non–bone grafted group.
[b]$P < .05$, compared with the immediate postoperative period.

Abbreviations: PBI, periodontal bleeding index; PI, peri-implant index.

Table 2. Comparison of the Postoperative Height of the Submucosal Anterior Edge of the Maxillary Sinus and Sinus Bone Mineral Density Around the Implant

Group	No. of cases	Postoperative height of anterior submucosal margin of maxillary sinus, mean (SD), mm			Postoperative peri-implant sinus bone density, mean (SD), H		
		3 mo	6 mo	12 mo	3 mo	6 mo	12 mo
Bone grafted group	32	5.42 (0.64)[a]	4.63 (0.95)[b]	4.23 (0.83)[b]	936.25 (90.54)[a]	1020.82 (72.09)[b]	1160.12 (82.74)[b]
Non–bone grafted group	28	3.62 (0.89)	3.52 (1.02)	3.34 (0.96)	840.79 (84.28)	910.94 (87.33)[b]	1030.72 (79.60)[b]

[a]$P < .05$, compared with the non–bone grafted group.
[b]$P < .05$, compared with 3 months after the operation.

Table 3. Comparison of Postoperative Implant Stability Quotient (ISQ) After the Operation

Group	No. of cases	Postoperative ISQ, mean (SD)		
		3 mo	6 mo	12 mo
Bone grafted group	32	70.58 (3.37)[a]	74.24 (2.17)[b]	80.82 (1.76)[b]
Non–bone grafted group	28	68.02 (3.09)	72.15 (2.79)[b]	78.16 (2.24)[b]

[a]$P < .05$, compared with the non–bone grafted group.
[b]$P < .05$, compared with 3 months after the operation.

Table 4. Comparison of Postoperative Alveolar Bone Height in the Bone grafted Area

Group	No. of cases	Postoperative alveolar height in bone grafted area, mean (SD), mm		
		3 mo	6 mo	12 mo
Bone grafted group	32	9.42 (1.23)[a]	9.05 (1.44)[b]	8.57 (1.73)[b]
Non–bone grafted group	28	7.36 (1.01)	7.21 (1.10)	7.10 (1.53)

[a]$P < .05$, compared with the non–bone grafted group.
[b]$P < .05$, compared with 3 months after the operation.

Table 5. Comparison of Postoperative Implant Survival Rate and Complications

Group	No. of cases	Implant survival rate, n (%)	Complication, n (%)				
			Infection	Hemorrhage	Mucosal perforation	Sinus-floor cyst	Graft-material migration
Bone grafted group	32	32 (100)[a]	0	1 (3.1)	1 (3.1)	0	0
Non–bone grafted group	28	24 (86)	0	1 (3.1)	0	0	0

[a]$P < .05$, compared with the non–bone grafted group.

grafted group than in the non–bone grafted group (all $P < .05$), as shown in Table 4.

Comparison of postoperative implant retention rate and complications

The implant retention rate at 12 months after the operation was slightly higher in the bone grafted grouped than in the non–bone grafted group, but the difference was not statistically significant ($P > .05$). One case of mucosal perforation occurred in the bone grafted group, and the difference in the incidence rate of complications between the 2 groups was not statistically significant ($P > .05$), as shown in Table 5.

DISCUSSION

The maxillary sinus floor elevation technique combined with implant surgery is an important method for repairing maxillary bone defects. The method involves lifting the sinus membrane in the maxillary sinus to expand the area of the maxillary sinus floor and then implanting the implant into the expanded cavity.

This study divided 60 patients into a bone grafted group and a non–bone grafted group depending on whether bone grafting was used during sinus lift combined with Bicon short implant placement in the maxillary sinus. We compared the surgical outcomes and complications of the 2 groups. The bone grafted group received autologous bone chips mixed with Bicon bone substitute as the bone-graft material; there were significant advantages in using this bone-graft material with sinus lift and Bicon short implant placement in the maxillary sinus. The advantages of this bone-graft material are its good biocompatibility, no immunogenicity, low variability, and its ability to promote new bone formation and growth while increasing the stability and success rate of the implant.[6,7] Autologous bone chips are fragments of bone tissue from the patient's own skeleton that have good compatibility with human tissue, do not cause rejection reactions, and have good biological activity, promoting bone healing and reconstruction. Bicon bone substitute is artificial bone made of β-tricalcium phosphate and hydroxyapatite that has high biocompatibility and biological activity, can be decomposed and absorbed by the body, and can be rebuilt into new bone tissue by the body.[8] The combined application of autologous bone chips and Bicon bone substitute uses the advantages of both to achieve better bone healing and reconstruction effects.[9,10]

Our results show that, at 3, 6, and 12 months after the bone-grafting procedure, both the subantral mucosal height and the bone density around the intrasinus implant were greater in the bone grafted group than in the non–bone grafted group, suggesting that bone grafting can promote bone regeneration, enhance bone-tissue healing, and improve implant stability. The reason for this is that bone grafting can provide better support and stability of the bone, making it easier for an implant to integrate with the surrounding bone tissue and promote bone regeneration. Moreover, a mixture of autologous bone chips and Bicon bone substitute used as a bone-grafting material can promote the growth and regeneration of bone cells during the grafting process, thereby increasing bone density and subantral height.[11,12]

Higher ISQ values indicate greater stability of the implant in bone tissue. A study by Raghoebar and colleagues[13] showed that, at 3, 6, and 12 months postoperatively, the ISQ values of the bone grafted group were higher than those of the non–bone grafted group, indicating that the implant stability in the bone grafted group was more stable. In addition, the bone height of the alveolar ridge was significantly higher in the bone grafted group than in the non–bone grafted group, indicating that the implants in the bone grafted group were fixed in a more-solid bone tissue and were not prone to loosening or displacement. Therefore, the use of autologous bone chips mixed with Bicon bone substitute as a bone-grafting material during maxillary sinus floor elevation combined with implantation surgery can improve the stability of the implants and the height of the alveolar ridge, resulting in better clinical outcomes.

Our study also found that the PI and PBI were higher in the bone grafted group immediately after the operation compared with the non–bone grafted group. This may be caused by temporary periodontitis caused by operative trauma and bone grafting, leading to local inflammatory reactions and swelling of periodontal tissues. However, as time passed, the inflammatory reaction gradually subsided and the local periodontal tissues returned to normal. Therefore, there were no significant differences in PI and PBI between the 2 groups at 3, 6, and 12 months postoperatively. The difference in the incidence of complications between the 2 groups was not statistically significant, suggesting that bone grafting did not significantly increase the risk of the surgical procedure. However, there was 1 case of mucosal perforation and 1 case of hemorrhage in the bone grafted group during the operation.

Bone-grafting operations require precise techniques, and the operator needs to have a high level of experience and skill, otherwise damage to the surrounding tissues could occur, leading to unexpected situations such as mucosal perforation. In addition, some patients may have confounding factors, such as osteoporosis or weak mucosa, that may increase the risk of mucosal perforation.

The limitations of this study include a relatively small sample size and short follow-up duration of 12 months and that the study was conducted at a single center, which may limit the generalizability of the findings. The lack of randomization and potential confounding factors, such as patient characteristics and variability of surgical technique, could introduce bias. Additionally, blinding was not feasible, which may lead to performance and measurement biases.

Despite these limitations, our results suggest that the use of autologous bone chips mixed with Bicon bone substitute improves implant stability and promotes new bone formation. However, further research studies with larger sample sizes and conducted as randomized controlled trials with longer follow-up periods are needed to validate these findings and assess long-term outcomes and potential complications associated with this technique.

CONCLUSION

The use of autologous bone chips mixed with Bicon bone substitute as the bone-graft material in maxillary sinus floor elevation combined with short implant placement can improve implant stability and promote new bone formation. However, this technique requires high technical proficiency, meticulous operation techniques, and thorough preparation to ensure the success and safety of the surgical procedure, while reducing the risk of mucosal perforation. This study provides a more scientifically rational treatment plan for clinicians and offers new ideas and directions for further

exploration of bone-tissue regeneration and biological repair after implantation, which will contribute to the development and progress of this field.

CONFLICTS OF INTEREST

The authors have no potential conflicts of interest to report relevant to this article.

AUTHORS' CONTRIBUTIONS

SL, SC, XieH, and ZC designed the study and performed the experiments; SL, XueH, and ZC collected the data; SL and SC analyzed the data; and SL, XieH, and ZC prepared the manuscript. All authors read and approved the final manuscript. SL and SC, contributed equally to this work.

FUNDING

This study was supported by Hainan Provincial Natural Science Foundation of China (grant No. 819QN391).

REFERENCES

1. Blinstein B, Bojarskas S. Efficacy of autologous platelet rich fibrin in bone augmentation and bone regeneration at extraction socket. *Stomatologija*. 2018;20(4):111-118.
2. Azim AA, Wang HH, Serebro M. Selective retreatment and sinus lift: an alternative approach to surgically manage the palatal roots of maxillary molars. *J Endod*. 2021;47(4):648-657. doi:10.1016/j.joen.2020.08.028
3. Song DS, Kim CH, Kim BJ, Kim JH. Tenting effect of dental implant on maxillary sinus lift without grafting. *J Dent Sci*. 2020;15(3):278-285. doi:10.1016/j.jds.2020.05.008
4. Franceschetti G, Farina R, Minenna L, et al. The impact of graft remodeling on peri-implant bone support at implants placed concomitantly with transcrestal sinus floor elevation: A multicenter, retrospective case series. *Clin Oral Implants Res*. 2020;31(2):105-120. doi:10.1111/clr.13541
5. Mendes LD, Bustamante RPC, Vidigal BCL, et al. Effect of amount of biomaterial used for maxillary sinus lift on volume maintenance of grafts. *J Clin Exp Dent*. 2020;12(9):e830-e837. doi:10.4317/jced.56315
6. Leighton Y, Weber B, Rosas E, Pinto N, Borie E. Autologous fibrin glue with collagen carrier during maxillary sinus lift procedure. *J Craniofac Surg*. 2019;30(3):843-845. doi:10.1097/SCS.0000000000005203
7. Lombardo G, Marincola M, Signoriello A, Corrocher G, Nocini PF. Single-crown, short and ultra-short implants, in association with simultaneous internal sinus lift in the atrophic posterior maxilla: a three-year retrospective study. *Materials (Basel)*. 2020;13(9):2208. doi:10.3390/ma13092208
8. Sonoda T, Yamamichi K, Harada T, Yamamichi N. Effect of staged crestal maxillary sinus augmentation: A case series. *J Periodontol*. 2020;91(2):194-201. doi:10.1002/JPER.18-0632
9. Zenóbio EG, Cardoso LD, Oliveira LJ, Favato MN, Manzi FR, Cosso MG. Blood clot stability and bone formation following maxillary sinus membrane elevation and space maintenance by means of immediate implant placement in humans. A computed tomography study. *J Craniomaxillofac Surg*. 2019;47(11):1803-1808. doi:10.1016/j.jcms.2018.10.004
10. Akbulut A, Dilaver E. Correlation between prevelance of Haller cells and postoperative maxillary sinusitis after sinus lifting Procedure. *Br J Oral Maxillofac Surg*. 2019;57(5):473-476. doi:10.1016/j.bjoms.2019.04.013
11. Dumitrescu A, Martu MA, Nemtoi A, et al. Association between cone-beam computed tomography and histological and immunohistochemical features in periapical lesions correlated with thickened maxillary sinus mucosa. *Medicina (Kaunas)*. 2021;57(8):840. doi:10.3390/medicina57080840
12. Karslioglu H, Çitir M, Gunduz K, Kasap P. The radiological evaluation of posterior superior alveolar artery by using CBCT. *Curr Med Imaging*. 2021;17(3):384-389. doi:10.2174/1573405616666200628134308
13. Raghoebar GM, Onclin P, Boven GC, Vissink A, Meijer HJA. Long-term effectiveness of maxillary sinus floor augmentation: A systematic review and meta-analysis. *J Clin Periodontol*. 2019;46(suppl 21):307-318. doi:10.1111/jcpe.13055