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# Analysis of the Applying Implants Methods in Conditions of Subantral Deficiency, Compared to the Available Subantral Bone in Cases with Completed Maxillary Sinus Floor Augmentation with Lateral Approach

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Abstract: <u>Materials and methods</u>: The aim of the study is to establish factors for conducting immediate or delayed implant placement. A total of 76 preoperative Cone Beam Computed Tomography (CBCT) of patients examined, a maxillary sinus floor augmentation with lateral approach (MSFALA) procedure was performed on 108 maxillary sinuses, and a total of 305 missing teeth were identified. The absence of these teeth was rehabilitated with 161 implants according to data from the patients' medical records. Subantral bone height (SBH) was in each of the 161 areas. <u>Results</u>: The method for the application of implants in conditions of subantral deficiency-maxillary sinus floor augmentation procedure with lateral approach with immediate implant placement (MSFALAIIP) is in a wider range of the height of the subantral bone. The extended range of the SBH is a result of the lower minimum value of the SBH when applying MSFALAIIP. <u>Conclusion</u>: The height of the available subantral bone is a factor in undertaking an implant placement method in the setting of subantral deficiency in MSFALAIIP, but not for MSFALADIP. The height of the available subantral bone in which MSFALAis undertaken with immediate implant placement acquires a wider range due to the lower minimum value of the height of the available subantral bone for the application of the method.

Keywords: maxillary sinus floor augmentation, lateral approach subantral bone loss, immediate implant placement, atrophic maxilla

#### 1. Introduction

Willams in 1999 defined bone augmentation as an increase in the size or volume of bone in a specific area of the body. This is a broad group of methods including guided bone regeneration, sinus floor elevation, block grafting, split osteotomy (9).

Maxillary sinus floor augmentation with lateral approach is a predictable bone augmentation technique in cases of subantral bone deficiency. The augmentation procedure is aimedto obtain the quality and volume of the newly formed bone, suitable for placing osseointegratable implants. The success of the procedure is largely due to the skill of the surgeon, but does not depend on the biomaterial used (8)

The sinus floor augmentation procedure can be performed with immediate or delayed implant placement.

In 2015 Peev suggests a classification of bone deficiency in dental implantology, aswellas a clinicall protocol for choosing a method for applying dental implants in conditions of reduced volume of available bone (1). According to the author, augmentation of the maxillary sinus floor with lateral approach with immediate placement of implants is undertaken when the height of the subantral bone is 2 to 5 mm, and below 2 mm augmentation of the sinus floor is undertaken with lateral approach with delayed placement of implants.

#### 2. Materials and methods

We performed a monocentric, retrospective study of preoperative CBCT images, taken at the X-ray Diagnostic Department of the University Medical and Dental Center of Medical University - Varna, Bulgaria on patients, who underwent MSFALA, unilateral or bilateral, with immediate or delayed dental implants placement for rehabilitation of the masticatory apparatus in the period 2014 to 2021 by four operators-doctors of dental medicine. The study included 76 3D images of the entire maxilla and MS in which no alteration in the sinus mucoperiosteum was observed, i.e., Schneiderian membrane thickness < 2mm. Selected images ranged from single edentulous sections in the region of the first maxillary molar, partially distally restricted and unrestricted edentulous sections to totally edentulous maxilla. Since the study conducted was retrospective, indications for CBCT imaging could not bedefined. Patients included in the study signed an informed consent cstating that the imaging data obtained may be used for research.

The aim of the study is to establish if the SBH is a factor for conducting immediate or delayed implant placement.

Forty-four patients (57.9%), whose preoperative CBCTs were included in the study had a unilateral MSFALA, and 32 patients (42.1%) had a bilateral MSFALA.

Out of a total of 76 preoperative CBCTs of patients examined, a MSFALA augmentation procedure was

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performed on 108 maxillary sinuses, and a total of 305 missing teeth were identified. The absence of these teeth was rehabilitated with 161 implants according to data from the patients' medical records. The application of implants in conditions of subantral deficiency by the four operators was carried out using two methods - maxillary sinus floor augmentation procedure with lateral approach with immediate implant placement (MSFALAIIP) and maxillary sinus floor augmentation procedure with lateral approach with delayed implant placement (MSFALADIP).

In 70 cases of MSFALA, a MSFALAIIP method was used for the application of implants in conditions of subantral deficiency (65%), and in 38 cases MSFALADIP was used (35%).

The method for the application of implants in conditions of subantral deficiency MSFALAIIP was used by operator 1 in 27 (39%) maxillary sinuses, by operator 2 in 21 (30%), by operator 3 in 15 (21%) and by operator 4 in 7 (10%)

The method for the application of implants in conditions of subantral deficiency MSFALADIP was used by operator 2 in 19 (50%) maxillary sinuses, by operator 3 in 14 (37%) and by operator 4 in 5 (13%). Operator 1 did not apply the method for the application of implants in conditions of subantral deficiency MSFALADIP in his/her clinical cases.

Of the one hundred and sixty-one implants placed, the application of 100 (62%) of them was using the MSFALAIIP method, and 61 (38%) with the MSFALADIP method.

The distribution of the hundred implants with the MSFALAIIP method by operators is as follows-by operator 1 there are 38 (38%), by operator 2-28 (30%), by operator 3-22 (22%) and by operator 4-12 (12%).

The allocation of implants using the MSFALADIP method by operator 2 in 30 (49%), by operator 3 in 24 (39%) and by operator 4 in 7 (12%). There is no data on implant application using the MSFALADIP method for operator 1.

In all 76 examined preoperative CBCT examinations of patients and all 108 observed sinuses, a measurement of the subantral bone height (SBH) was made in each of the 161 areas with performed MSFALAIIP and/or MSFALADIP. The measurement was made on a paraxial section of the preoperative cone-beam tomography, taking the distance from the crest of the alveolar ridge to the floor of the maxillary sinus as reference points (Figure 1).

The data on the SBH were analyzed according to a method for the application of implants in conditions of subantral deficiency MSFALAIIP and MSFALADIP with the help of IBM SPSS Statistics 25. To prepare the statistical analysis of the collected data, the following statistical methods were applied-non-parametric tests-Mann-Whitney test (U-test) for two independent samples and Kruskal-Wallis test for comparing more than two groups.



Figure 1: Subantral bone height (SBH)

## 3. Results

**3.1.** Analysis according to operators by method for the application of implants in conditions of subantral deficiency MSFALAIIP and MSFALADIP.

Data on the SBH in millimeters according to operators by method of the application of implants in conditions of subantral deficiency and their analysis are shown in table 1.

Implant application method	N	Operator	Mean	SD	M edian	Qı	Q3	IQR	Range	M in	Max	Kruskal Wallis	P
MSF AL AIIP	38	1	3,75	1,53	3,60	2,55	5,00	2,45	5,60	1,20	6,80	10,036	0,018
	28	2	4,43	1,16	4,50	3,30	5,40	2,10	4,25	2,00	6,25		
	22	3	4,09	1,52	3,71	2,90	5,45	2,55	5,40	1,40	6,80		
	12	4	5,27	1,28	5,70	4,28	6,35	2,07	3,80	3,00	6,80		
MSFALADIP	0	1	X	Χ	X	X	X	X	X	X	X	X	X
	30	2	3,13	1,65	2,40	2,00	3,86	1,86	5,80	1,00	6,80	0,196	0,907
	24	3	3,34	2,04	2,51	1,61	5,58	3,97	5,75	1,00	6,75		
	7	4	3,26	1,59	2,80	2,00	4,22	2,22	4,60	1,80	6,40		

Table 1

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The data analysis shows a statistically significant difference in the size of the SBH compared to the MSFALAIIP method for the four operators  $p \le 0.05$ . In the analysis of the data on the height of the SBH in relation to the MSFALAIIP method, operator 1 is excluded, since there is no data that he applies this method. For operator 2, 3 and 4, no statistically significant difference was observed in the sizes of the height of the SBH compared to the MSFALADIP method  $p \ge 0.05$  **3.2** Analysis by method for the application of implants in conditions of subantral deficiency MSFALAIIP and MSFALADIP by operators.

The data on the SBH in millimeters according to the method for the application of implants in conditions of subantral deficiency MSFALAIIP and MSFALADIP by operators and their analysis are shown in table 2.

Operator	N	Implant application method	Mean	SD	Median	Q1	Qı	IQR	Range	Min	Max	t	U	Р
Operator 1	38	MSFALAIIP	3,75	1,53	3,60	2,55	5,00	2,45	5,60	1,20	6,8	x	x	x
	0	MSFALADIP	X	X	X	X	X	X	X	X	X			
Operator 2 28 30	28	MSFALAIIP	4,43	1,16	4,50	3,30	5,40	2,10	4,25	2,00	6,25	x	213,50	0,001
	30	MSFALADIP	3,13	1,65	2,40	2,00	3,86	1,86	5,80	1,00	6,80			
<b>Operator 3</b> 22	22	MSFALAIIP	4,09	1,52	3,71	2,90	5,45	2,55	5,40	1,40	6,80	x	189,00	0,099
	24	MSFALADIP	3,34	2,04	2,51	1,61	5,58	3,97	5,75	1,00	6,75			
Operator 4	12	MSFALAIIP	5,27	1,28	5,70	4,28	6,35	2,07	3,80	3,00	6,80	2,84771	x	0,01649
	7	MSFALADIP	3,26	1,59	2,80	2,00	4,22	2,22	4,60	1,80	6,40			

Table 2

It is noticed that, the method for the application of implants in conditions of subantral deficiency

MSFALAIIP, with operator 1 and 3 is in a wider range of the height of the SBH, respectively 5, 60 mm and 5, 40 mm, compared to operator 2 and 4-4.25 mm and 3, 80 mm. The extended range of the SBH in operator 1 and 3 is a result of the lower minimum value of the SBH when applying MSFALAIIP - 1, 20 mm and 1, 40 mm, respectively, compared to operator 2 and 4 - 2, 00 mm and 3, 00 mm (Figure 2).



Figure 2: Box plot of SBH, in which operators undertake MSFALAIIP

The data analysis for operator 2 and 4 shows a statistically significant difference in the size of the SBH compared to the method of applying implants in conditions of subantral deficiency MSFALAIIP and MSFALADIPp $\leq$ 0.05. In operator 3, no statistically significant difference was observed in the size of the SBH compared to the method of applying implants in conditions of subantral deficiency MSFALAIIP and MSFALADIP,  $p \geq 0.05$ . Operator 1 is

excluded from the analysis because he/she only applies the MSFALAIIP method in solving his/her clinical cases.

## 4. Discussion

Bhandari etal. (3) in a clinical study of 10 patients reported a sinus floor elevation with lateral approach and immediate implant placement at a height of 4-6 mm of SBH.

Tukel et al. (6) in a retrospective study in the period from March 2015 - September 2016, at the Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Cukurova University, Turkey, reported performing lateral approach sinus floor elevation and immediate implant placement in 120 patients. The height of available subantral bone of the patients varied from 3 - 6 mm.

Barbu et al. (2) in a clinical study of 14 patients in the period from October 2013-July 2014 reported on the lifting of the sinus floor with lateral approach and immediate placement of an implant at a SBH 4-5 mm.

De Souza et al. (5) reported on the attempted and performed elevation of the sinus floor with a lateral approach and immediate placement of an implant in the upper right first molar region of a female patient, with a SBHof 3.5 mm.

Valentini et al. (7) in a clinical study of 56 patients reported sinus floor elevation with lateral approach performed and immediate implant placement at a mean SBH2.1 mm

D'Elia et al. (4) in a systematic review stated that elevation of the sinus floor with lateral approach and immediate implant placement can be used to treat patients with an atrophic maxilla with a SBH 1-3 mm, in cases, when initial stability of the implants can be achieved.

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In the literature today, a trend is noticed that the SBH at which the method for the application of implants in conditions of subantral deficiency MSFALAIIP is undertaken acquires a wider range. This is due to the lower reported minimum value of the SBH at which MSFALAIIP is undertaken-1-2 mm, but only in cases where initial stability of the implants can be achieved. This same trend is observed in the clinical cases of operator 1 and 3, who undertake MSFALAIIP at a SBH1-2 mm.

## 5. Conclusion

The height of the available subantral bone is a factor in undertaking an implant placement method in the setting of subantral deficiency in maxillary sinus floor augmentation with lateral approach with immediate implant placement, but not for maxillary sinus floor augmentation with lateral approach with delayed placement of implants. The height of the available subantral bone in which maxillary sinus floor augmentation with lateral approach is undertaken with immediate implant placement acquires a wider range due to the lower minimum value of the height of the available subantral bone for the application of the method.

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