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Analysis of Clinical Observations on the Approach for Endoscopic Control in Maxillary Sinus Floor Augmentation

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Abstract: ***The aim of the study is to evaluate the approach for endoscopic control during maxillary sinus floor augmentation with lateral approach (MSFALA). Materials and methods: A prospective clinical study was conducted at the University Medical Dental Center (UMDC) at Medical university of Varna, Bulgaria, whose object were ambulatory patients with observed deteriorated conditions for rehabilitation by implant treatment. The twenty - three patients included in the study underwent a planned unilateral surgical intervention through an endoscopically navigated MSFALA. Results: Ensuring endoscopic approach using the trocar - guided technique is a difficult task to perform from a clinical point of view, especially when the anterior wall of the maxillary sinus is thicker. The resulting endoscopic approach opening with the trocar - guided technique is larger compared to that obtained with the machine osteotomy technique. The use of the trocar - guided technique does not provide any advantages over the machine osteotomy technique. Visibility is the same when using both techniques. Conclusion: The opening for endoscopic approach made by trocar - guided technique is a difficult task compared to machine osteotomy technique. The trocar - guided technique offers no advantages over the machine osteotomy technique, and endoscope visibility is the same with both techniques for creating an approach opening.***

Keywords: maxillary sinus floor augmentation, lateral approach, endoscopy, endoscopically guided surgery, endoscopic access

1. Introduction

The history of paranasal sinuses diagnostic endoscopy started more than 120 years ago. In Berlin in 1901, A. Hirschmann performed the first maxillary sinus endoscopies using a modified cystoscope with a diameter of 5 mm, introducing it through the alveolus of a previously extracted tooth, and thus he was able to take the first pictures of chronic maxillary sinusitis. In 1903, he introduced the diagnostic function of the endoscope alone, which he also used to examine nose, ear, and epipharynx, describing it in his article "On Endoscopy of the Nose and Paranasal Sinuses" (7).

Medicine and dentistry development in recent years towards minimally invasive procedures has necessitated the increasing use of navigated endoscopic surgery (4).

Köhler et al. (7) concluded that the endonasal approaches for the treatment of maxillary sinus disease described in otorhinolaryngology prove to be inapplicable to the needs of dental implantology and more specifically to the performance of endoscopic - guided maxillary sinus floor augmentation procedure, as they cannot provide an overview optical, atraumatic, and direct view of the maxillary sinus floor above the Schneiderian membrane. The authors state that an approach along the fossa canina called anthroscopy - time honored, but long overlooked, is appropriate for the needs of dental implantology when performing an endoscopically assisted maxillary sinus floor elevation procedure.

Technological advancements in endoscopic rigid systems using integrated optics with an angular visual axis, deviated with respect to the instrument axis, improve visualization of the surgical field and contribute to more precise and atraumatic surgery (9).

There are not many reports in the literature focusing on implantology using endoscopically guided augmentation procedure to lift the maxillary sinus floor by using endoscopes with angled visual axis 0°, 30°, 45°, 70°, 90°, and 120° deviated from the instrument axis. The authors point to the endoscopically assisted maxillary sinus floor augmentation procedure as a minimally invasive technique with good visual control on the operative field, allowing detection of intraoperative Schneiderian membrane perforations during manipulation (2, 3, 5, 6, 8, 10).

2. Materials and methods

Aprospective clinical study was conducted at the University Medical Dental Center (UMDC), whose object were ambulatory patients with observed deteriorated conditions for rehabilitation by implant treatment. The twenty - three patients included in the study underwent a planned unilateral surgical intervention through an endoscopically navigated augmentation procedure for MSFALA.

The aim of the present study is to evaluate the approach for endoscopic control in the augmentation procedure byMSFALA.
The study was approved by decision of the Research Ethics Committee (REC) No.116/28.04.2022 at Medical University - Varna "Prof. Dr. Paraskev Stoyanov", Bulgaria.

Criteria for inclusion in the study:

- Persons aged 18 to 74 years.
- Patients with single edentulous areas in the upper first molar area, partially distally limited and unlimited edentulous areas up to totally edentulous upper jaw.
- Patients with established presence of subantral bone height on preoperative Cone beam computed tomography (CBCT) ≤ 6mm.

- Patients with no changes observed in the sinus mucoperiosteum.
- A completed and signed informed consent form.

Criteria for exclusion from the study:

- Persons under 18 years of age.
- Patients with established presence of subantral bone height on preoperative CBCT ≥ 6mm.
- Patients with observed changes in the sinus mucoperiosteum, with a thickening of Schneider's membrane ≥ 2mm.
- Persons, who do not have a completed and signed declaration of informed consent.

2.1 Preoperative preparation.

All patients underwent a preliminary primary consultation for implant treatment, in order to assess the functional state of the masticatory apparatus, and a preoperative CBCT was assigned, to assess the SBH, the anatomical variations of the maxillary sinus were analyzed (the presence of full/ and/or partial septa, prominent tooth roots, the thickness of the Schneider's membrane) and the planning of the osteotomy to create an approach window at the site of the planned augmentation. Patients filled out and signed a Questionnaire on General Health, Declaration of Informed Consent for X - ray Examination.

The patients underwent a preliminary anesthesia consultation before the operation by an anesthesiologist - resuscitator according to the rules and protocols adopted in the operating block of the UMDC, during which they filled in and signed a Preoperative Anesthesia Consultation and Assessment Sheet and a Protocol for a preliminary explanatory conversation about anesthesia between the patient and the anesthetist. Before performing an endoscopically navigated MSFALA, patients fill out and sign a Declaration of Informed Consent regarding the implementation of medical - dental diagnostic and treatment activities at the University Medical - Dental Center.

2.2 Treatment methods

For all patients, the endoscopically navigated MSFALA was performed in the conditions of an operating block located in the UMDC - Varna, and all measures for asepsis and antiseptics were observed. In all cases, for the purposes of the surgical intervention, general, intubation anesthesia was used, performed by an anesthesiologist - resuscitator according to the rules and protocols adopted in the operating block of the UMDC. All twenty - three endoscopically navigated MSFALA were performed by a single operator, with the endoscopic approach opening making was timed using a stopwatch in seconds. Also, according to a modified subjective scale PFS - 12 (Piper Fatigue Scale - 12), the fatigue of the operator was recorded immediately after making the opening (1) (Table 1).

Table 1: The subjective assessment of fatigue by operator

The subjective assessment of fatigue /digital/	Interpretation of the numerical scale
0	Lack of fatigue
1 - 3	Mild fatigue
4 - 6	Moderate intensity fatigue
7 - 9	Severe fatigue
10	The strongest possible fatigue

2.2.1. Method of approach for endoscopic control during MSFALA

In all patients, the endoscopically navigated MSFALA was performed using an ENDOCAMELEON ENT HOPKINS Telescope Karl Storz endoscope with built - in optics with an angled visual axis deviated from 15º - 90º to the axis of the instrument. The observation was carried out with a visual axis deviated at 45º to the axis of the instrument and the lowest focal angle when entering it in the antero - posterior direction at 10 mm. In all patients, before using the endoscope, it is necessary that its camera underwent preliminary preparation in order to eliminate the formation of condensation on it, consisting in wiping the camera with sterilegauze soaked in sterile sodium chloride solution at room temperature. Endoscopic approach was performed through the fossa canina.

We divided the patients included in the study into two groups according to the technique used in making the opening providing the endoscopic approach through the fossa canina. Two techniques were used – trocarguided and machine osteotomy.

Group I – included twelve patients in whom the opening providing endoscopic approach was made by machine osteotomy using a calibrated osteotome drill with a diameter of 4.2 mm. All patients in the area of the planned fossa canina approach were administered local anesthesia using a 4% solution of articaine with adrenaline 1/100, 000 (Septanest). To find the center of the fossa canina approach hole, one took the canine apex projection 5 mm vertically and then 5 mm distally as a starting point. Due to the diameter of the osteotome drill with which the opening was created, itwas necessary to measure another 2 mm in the vertical direction and 2 mm in the distal direction. A 10 mm incision was made with soft tissue dissection, the osteotomy for endoscopic approach was performed using an implantology unit (iChiropro 1600784 - 001, Bien Air Dental, Switzerland) with a 20: 1 reduction tip and a calibrated osteotome drill with a diameter of 4, 2 mm (Figure 1 and 2), at a rotation speed of 1, 000 rpm and continuous cooling with 0.9% sterile sodium chloride solution.

The use of the endoscope for observation was accomplished by means of a STAMMBERGER telescopic round cannula 14, 5sm long and 4 mm in diameter (Figure 3).

Figure 1: Implantologyunit (iChiropro 1600784 - 001, Bien Air Dental, Switzerland)

Figure 2: Calibrated osteotome drill with a diameter of 4, 2 mm

Figure 3: ENDOCAMELEONENT HOPKINS TelescopeKarl Storz and telescopicroundcannula STAMMBERGER with long 14, 5 smand 4 mm in diameter

Group II - included eleven patients in whom the opening providing endoscopic approach was made by a trocar - guided technique using a trocar with an outer diameter of 5 mm and a cannula with a fenestrated tip 5 mm in diameter and 85 mm long. The fenestrated tip of the cannula served for endoscope lens bed (Figure 4). All patients in the area of the planned fossa canina approach were administered local anesthesia using a 4% solution of articaine with adrenaline 1/100, 000 (Septanest). To find the center of the fossa canina approach hole, one took the canine apex projection 5 mm vertically and then 5 mm distally as a starting point. Due to the diameter of the trocar used to create the opening, it was necessary to measure another 2.5 mm in the vertical direction and 2.5 mm in the distal direction. By means of operator's pressure on the trocar, the soft tissues and the front wall of the maxillary sinus were fenestrated, and the opening was formed by the compression that the operator exerted on the trocar and the rotary - progressive movements for additional shaping.

Figure 4: Endocameleonent Hopkins TelescopeKarl Storz, cannula with a fenestrated tip 5 mm in diameter and 85 mm longand trocar with an outer diameter of 5 mm

2.2.2. Method of MSFALA

All patients underwent local anesthesia in the area of planned approach to the lateral wall of the maxillary sinus using a 4% solution of articaine with adrenaline 1/100, 000 (Septanest). *MSFALA* was performed after dissection of a mucoperio steal flap providing approach to the lateral wall of the maxillary sinus. The osteotomy to create an approach window was performed using an implantology unit, a straight surgical hand piece, and a 4 mm diameter round head diamond surgical bur at a rotation speed of 30, 000 rpm and continuous cooling with 0.9% sterile sodium chloride solution. After the osteotomy was completed, one proceeded to dissection of the sinus mucoperiosteum with the help of sinus elevators in a vertical direction, which formed a cavity with a planned height. One proceeded to implant osteotomy in the SBH, during which there was protection of the already elevated sinus mucoperiosteum with the help of a sinus elevator. After finalizing the implant osteotomy, a collagen fleece (Collagen fleece Botiss, Berlin, Germany) was placed on the ceiling of the grafting cavity, the implants were placed in the implant osteotomy in order to avoid collapse of the elevated sinus mucoperiosteum with the collagen fleece, then there followed the application of the bone restoration material – nanohydroxylapatite aqueous gel with two – phase calcium phosphate ceramic particles (Maxresorb Inject Botiss, Berlin, Germany). The approach window was covered with a pericardial collagen barrier membrane (Jason Membrane Botiss, Berlin, Germany) that covers at least 2 mm of the bone edge of the approach window. The flap was repositioned, adapted and sutured using 5/0 monofilament suture (Dafilon, BBraun, Germany).

After performing the endoscopically navigated MSFALA, patients undergo a stay in a day hospital with observation for up to 12 hours. All patients were administered antibiotic protection for 5 to 7 days to prevent postoperative infection.

3. Results

The data obtained for operator fatigue and machine execution time for the osteotomy technique and trocar - guided endoscopic approach technique and their analysis is presented in table 2.

Table 2: Data on operator fatigue and machine run time osteotomy technique and trocar - guided technique for endoscopic access and the result of their analysis

Researched criterion	n	Technique	Mean	SD	Median	Q_1	Q_3	IQR	t	U test	P
Time in sec.	12	*Machine osteotomy*	93,08	15,11	95,00	80,5	108,25	27,75	x	132	0
	11	*Trocar guided*	231,91	58,66	273,00	187	279	92			
Fatigue	12	*Machine osteotomy*	2,83	1,59	2,50	1,25	4,75	3,5	-6,2	x	0,000004
	11	*Trocar guided*	7,27	1,85	7,00	5	9	4			

Data analysis showed a statistically significant difference in operator fatigue and time to perform endoscopic approach with the machine osteotomy technique compared to the performance of the trocar - guided technique - $p \leq 0.05$.

Ensuring endoscopic approach using the trocar - guided technique is a difficult task to perform from a clinical point of view, especially when the anterior wall of the maxillary sinus is thicker. The resulting endoscopic approach opening with the trocar - guided technique is larger compared to that obtained with the machine osteotomy technique.

It was expected that in the trocar - guided technique, the cannula used because of its fenestrated tip would contribute to less blood staining of the endoscope camera, which in turn would improve visibility during MSFALA. Visibility is the same when using both cannulas.

The use of the trocar - guided technique does not provide any advantages over the machine osteotomy technique.

4. Discussion

Engelke et al. (4) suggest special endoscopic techniques for the needs of dentistry that are comparable in many respects to the techniques used in otorhinolaryngology. They are direct endoscopy, immersion endoscopy, assisted endoscopy, assisted immersion endoscopy, trocar guided endoscopy. Trocar - guided endoscopy is performed in the center of the canine fossa and requires a puncture of the anterior wall of the maxillary sinus with a trocar. The formation of the resulting opening with a diameter of up to 5 mm provides a space between the floor of the maxillary sinus and Schneider's membrane and the endoscope, which is called the subantral space. The procedure is for direct endoscopic visualization, for the purpose of biopsies, removal of foreign bodies, for evaluation of Schneider's membrane in case of suspected inflammation, identification and control of perforations of Schneider's membrane during its elevation during an augmentation procedure to elevate the floor of the maxillary sinus, as well as control of the positioning of the barrier membrane and bone repair material during an augmentation procedure on maxillary sinus floor elevation.

There is evidence in the literature of an endoscopically guided maxillary sinus floor elevation procedure with approach through the fossa canina, with the endoscopic approach opening being accomplished through a machine osteotomy.

Gandhi (5) in a clinical study of 20 patients undergoing an augmentation procedure for endoscopically guided maxillary sinus floor elevation and a total of 30 implants placed, aimed to evaluate the usefulness and applicability of endoscopic control during the procedure. Patients with residual subantral bone height between 2 mm and 5 mm were included in the study. Patients were divided into two groups. One included patients with a subantral bone height < 4 mm, who underwent a maxillary sinus floor elevation procedure with a lateral approach, and the other group included patients with a subantral bone height > 4 mm who underwent a maxillary sinus floor elevation procedure using an osteotomy technique. In both groups, endoscopic control was performed through the fossa canina, using a Xuzhou Ikeda (China) endoscope with an angled visual axis of 45° or 70° deviated from the axis of the instrument. The threemillimeter opening for the endoscopic approach is made by machine osteotomy, using a round surgical carbidebur.

Hu et al. (6) reported a clinical case in which the objective was to simultaneously remove an antral pseudocyst and perform an augmentation procedure to elevate the floor of the maxillary sinus through endoscopically guidedsurgery. For the endoscopic control, approach through the fossa canina and an endoscope with a visual axis of 0° to the axis of the instrument were used. The opening for the endoscopic approach was made by machine osteotomy, using a piezoelectric surgical device (Piezo surgery, Silfradent, Italy). The opening measured 5mm by 8mm.

No data were found in the literature for a comparative evaluation between the machine osteotomy technique and the trocar otorhinolaryngology technique for creating an opening for endoscopic approach through the fossa canina.

5. Conclusion

The opening for endoscopic approach made by trocar - guided technique is a difficult task compared to machine osteotomy technique. The trocar - guided technique offers no advantages over the machine osteotomy technique, and

endoscope visibility is the same with both techniques for creating an approach opening.

References

[1] Armijo PR, Huang CK, High R, Leon M, Siu KC, Oleynikov D. Ergonomics of minimally invasive surgery: an analysis of muscleeffort and fatigue in the operating room between laparoscopic and robotic surgery. Surg Endosc.2019 Jul; 33 (7): 2323 - 2331. doi: 10.1007/s00464 - 018 - 6515 - 3.
[2] Berardini, Marco & Falco, Antonello & Amoroso, Cinzia & archivio, Lanfranco. (2015). Studio retrospettivo dei risultati clinici e radiologici di 69 rialzi di seno mascellare consecutivi associati a chirurgia endoscopica funzionale del seno (FESS).10.11607/jomi.3757).
[3] Engelke W, Deckwer I. Endoscopically controlled sinus floor augmentation. A preliminary report. Clin Oral Implants Res.1997 Dec; 8 (6): 527 - 31.
[4] Engelke W., Beltran V., Endoscopic Techniques in Minimally Invasive Oral Surgery, Endo Press, 2014
[5] Gandhi Y. Endoscopically monitored maxillary sinus augmentation – Thechairside approach (Rationale and protocol). J Oral Biol Craniofac Res.2020Jul - Sep; 10 (3): 247 - 252. doi: 10.1016/j. jobcr.2020.05.002. Epub 2020 May 12.
[6] Hu YK, Yang C, Qian WT. Endoscopic - Assisted Sinus Floor Augmentation Combined With Removal of an Antral Pseudocyst of the Ipsilateral Maxillary Sinus. J Craniofac Surg.2017 Sep; 28 (6): 15491551.
[7] Köhler S. G., Behrbohm H., Thiele T., Behrbohm W. THE SINUS LIFT: Practical Interdisciplinary Guide with a Description of the Berlin Training Model. Endo - Press, 2015
[8] Nkenke E, Schlegel A, Schultze - Mosgau S, Neukam FW, Wiltfang J. Theendoscopically controlled osteotome sinus floor elevation: a preliminaryprospective study. Int J Oral Maxillofac Implants.2002 Jul - Aug; 17 (4): 557 - 66.
[9] Sapundziev N., Endoscopy in otorinolaringology. Arethereanyborders?, MedInfo, 2021
[10] Wiltfang J, Schultze - Mosgau S, Merten HA, Kessler P, Ludwig A, Engelke W. Endoscopic and ultrasonographic evaluation of the maxillary sinus after