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Possibilities for Breathing Improvement in Patients with Unilateral Postoperative Defects of the Upper Jaw

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Abstract: ***Introduction: The injuries occurred after surgical treatment of tumors in maxillofacial area seriously violated breathing. Aim: The aim of this survey is to follow up the breathing changes in patients with unilateral postoperative defects of the upper jaw, after prosthetic treatment with obturators, made of heat cured acrylic and rebased directly with silicone material. Material and methods: In this study was included 15 patients (9 men and 6 women) with oncological operations of the upper jaw and prosthetic treatment by heat cured acrylic obturators, rebased directly with silicone material in the period of 2013-2016 year. For assessing the progress of hermetization in the area of the defect and breathing was used the device RhinoScan SRE2000. Results: The described approach of prosthetic rehabilitation ensured optimum hermetization of post resection defects and normalization of the nasal breathing. The results of acoustic rhinograms have shown an improvement of breathing in all examined patients. Conclusions: Prosthetic treatment with obturators, made of heat cured acrylic and rebased with silicon material, improves significantly the nasal breathing in patients with unilateral maxillary defects.***

Keywords: breathing, breathing with obturator, maxillofacial defects, maxillary resection, post-resection prosthesis

1. Introduction

The injuries occurred after surgical treatment of tumors in maxillofacial area violated significantly the breathing [1, 2, 3].

According to Demez et Moreau [4] the most frequent problems in operated patients with cancer of the head and neck are breathing difficulties and pain. This is caused by a communication between the oral and nasal cavity, which on one hand, violates the normal nasal breathing, and allows the passage and retention of food debris, on other. This is a precondition for chronic inflammation in the nasal cavity and sinuses [1, 2]. Despite of the seriousness of the problem, there is little information in the literature for patients with maxillary resection, before and after prosthetic treatment [3]. The possibilities of nasal breathing restoration by different prosthetic closing modifications are mostly followed up [5, 6, 7, 8].

Major problem in normal breathing restoration is hermetization of the defect [9, 10]. To assess the level of hermetization and nasal breathing, Aksenov [9] uses specially calibrated mirror. The test reveal s the prosthetic effectiveness, through examination of the area of sweating during expiration. Stilyanov [11] applies acoustic method by connecting a rubber tube to the nose of the patient with the ear of the scientist. Kantner [12] uses an alcoholmeter to make measurements in open and closed nostrils. The described methods indirectly lead to conclusions about breathing at all, but can't be used as an objective assessment of the level of nasal cavity hermetization. This is the reason why Mikhailov [2] developed the electronic-pneumatic device "Oronasopneumotest" , which allows simultaneous recording of pressure in the oral and nasal cavity during expiration. Acoustic rhinometry is one of the modern methods applied in Otorhinolaryngology for monitoring the breathing changes [13]. This method gives an assessment of the geometry and volume of nasal cavity and its cross-sectional area through analysis of sound reflection [14].

The position of the obturator in nasal cavity is very significant for the success of breathing reconstruction [5, 15]. Its proper position ensures free air flow, which reduces patients' breathing efforts and improves breathing itself [16]. This condition is very important for extending the borders of the obturator [8,17]. In this case, computer design and manufacturing could provide the proper position of the obturator in the defect [18].

According to some authors [7, 19], optimal respiratory restoration is possible only using two piece obturators. A two-stage technique is used, in which the body is made of heat cured resign and the obturation part is formed with silicone materials for better hermetization of the defect [20, 21, 22]. Schaaf [23] uses a medical silicone, which provides less debris and dryness of the oral and nasal cavities. Masumi et al. [7] installed aspiration catheter in the silicone part, to make the breathing easily. Reitemeier et al. [24] formed two holes with 5 mm in diameter in the distal part of the obturator and use it in patients with soft palate defects. Toeg et al. [15] use a valve, which provides one way air flow.

2. Aim

The aim of this survey is to follow up the breathing changes in patients with unilateral postoperative defects of the upper jaw, after prosthetic treatment with obturators, made of heat cured acrylic and rebased directly with silicone material.

3. Materials and Methods

The device RhinoScan SRE2000 (Interacoustics, Denmark) is used for examination of changes in the airway patency before and after prosthetic treatment. Its working principle is

related to reflection of audio signals, which are generated and conducted by acoustic tube and reach the nasal cavity through a tip (Figure 1). Reflected acoustic signals are registered by a microphone and submitted to a computer, which provides a graphical representation of cross-sectional area of the nose and a numerical value of the minimum cross-sectional areas and volumes between certain points in the nasal cavity.

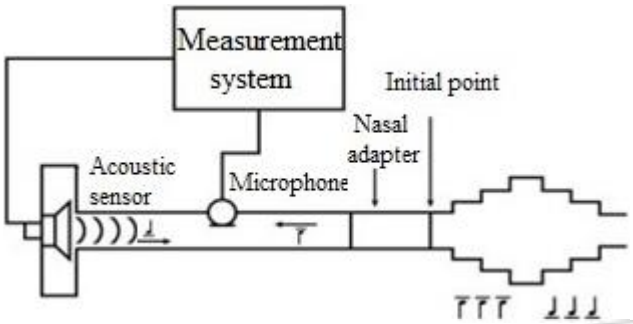

Figure 1: Diagram of the Acoustic rhinometry system

The established results allow to create an Acoustic rhinogram and give the opportunity to measure the total volume and the minimal cross-sectional area (MCSA) of the nasal cavity (Figure 2).

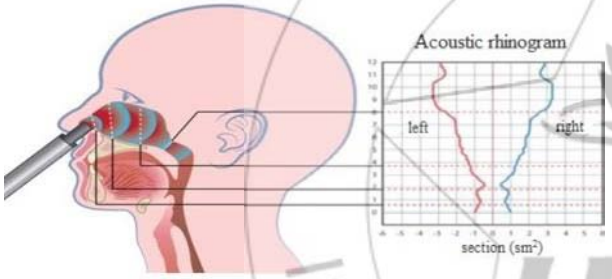

Figure 2: A comparison between the elements of acoustic rhinogram and the elements of the nasal cavity

The examination of all 15 patients (9 men and 6 women) was conducted after decongestion of the nasal mucosa by 3 drops Xylomethazoline 0,01% and 15-minutes waiting to take an effect. Standard aluminum probes were fixed to the nostrils of the patients by anatomically designed nasal polystyrene adaptors and silicon sealing gel (Figure 3). Three serial measurements of each nostril were made with and without obturator. Wave signal with frequency 0.1-10 KHz and intensity 92 db was used.

Figure 3: Examination with the device Rhino Scan SRE2000 of a patient with maxillary resection

The collected data were submitted with RhinoScan software, which measured the value of an minimal cross-sectional area (MCSA) and the value of an cross-sectional area (CSA) of 2,2 sm. This values are accepted as most authentic in acoustic rhinometry (Figure 4).

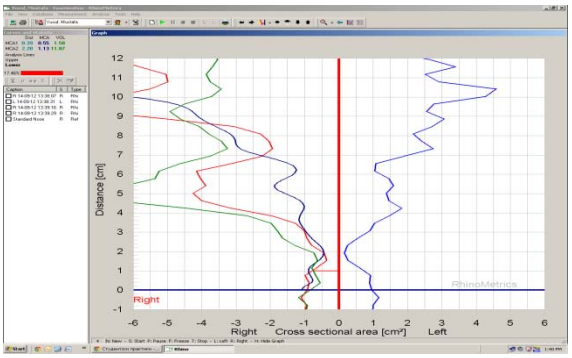

Figure 4: Acoustic rhinogram of patient with operated right side and healthy left side

4. Results

According to the analysis of the results of the survey, was registered average value of 0,56 sm^2 of MCSA before prosthetic treatment (Table 1). After the prosthetic treatment we achieved reduction of this value to 0,34 sm^2, compared to 0,20 sm^2 on the non-operated side.

Table 1: Values of MCSA before and after treatment

Examined side / Examined patients	Non-operated side (sm^2)	Operated side	
		Before treatment (sm^2)	After treatment (sm^2)
Patient 1	0,26	0,68	0,60
Patient 2	0,43	1,14	0,78
Patient 3	0,28	0,88	0,61
Patient 4	0,30	0,84	0,59
Patient 5	0,32	0,98	0,72
Patient 6	0,46	1,10	0,75
Patient 7	0,32	1,17	0,95
Patient 8	0,28	0,99	0,81
Patient 9	0,32	0,98	0,59
Patient 10	0,47	1,23	0,90
Patient 11	0,37	1,83	0,99
Patient 12	0,39	1,90	0,62
Patient 13	0,31	1,26	0,90
Patient 14	0,34	1,40	0,87
Patient 15	0,36	0,87	0,70
Average value	**0,35**	**1,15**	**0,76**

Table 2: Values of CSA 2,2 sm before and after treatment

Examined side / Examined patients	Non-operated side (sm^2)	Operated side	
		Before treatment (sm^2)	After treatment (sm^2)
Patient 1	0,20	0,46	0,29
Patient 2	0,21	0,48	0,35
Patient 3	0,17	0,45	0,40
Patient 4	0,18	0,49	0,31
Patient 5	0,16	0,56	0,36
Patient 6	0,20	0,49	0,33
Patient 7	0,22	0,59	0,40
Patient 8	0,19	0,48	0,32
Patient 9	0,22	0,59	0,36

Patient 10	0,21	0,69	0,40
Patient 11	0,22	0,63	0,39
Patient 12	0,18	0,65	0,37
Patient 13	0,22	0,59	0,30
Patient 14	0,19	0,53	0,31
Patient 15	0,20	0,69	0,28
Average value	**0,20**	**0,56**	**0,34**

Based on the fact, that in acoustic rhinometry the most authentic results are those from the front sections of the nose, which are the most important for nasal breathing, as well, we measured the volume of the nasal cavities in the distance between 2,2 sm of the nostril to the inferior concha (Table 2).

In this case, the average values before treatment was 1,15 sm^2 and 0,76 sm^2 after prosthetic treatment. They had a significant difference from established values of 0,35 sm^2 on the non-operated side, which we accept as a result of reducing the hermetization of the prosthesis with increasing the distance of configuration of the palate on the vertical of the nasal septum.

4. Discussion

The results of the acoustic rhinometry have shown serious violations in nasal breathing after maxillary resection. The registered data from our survey confirmed the statement of some authors [4], that breathing problems are very common consequences in cancer patients in maxillofacial area. The study allowed comparison of the results between the operated and healthy side before and after treatment. The obtained data have shown average values of 0,56 sm^2 MCSA before prosthetic treatment and its reducing to 0,34 sm^2 after definitive prosthetic treatment. Such changes were established in CSA 2,2 sm, where the registered values were 1,15 sm^2 before treatment and 0,76 sm^2 after treatment. The survey revealed the important role of the prosthesis for restricting and regulating the air flow during inspiration. As a result of this, were measured 60,7% lower values of MCSA and 66% of CSA 2,2 sm. Despite of that, the established values were different from these ones on the healthy side, on which was measured 0,20sm^2 of MCSA and 0,35sm^2 of CSA 2,2sm.

The analysis of acoustic rhinograms revealed the significant role of prosthetic treatment for restoration of normal nasal breathing and confirmed the statement of Minsley et al. [3], that post resection prosthesis reduce breathing efforts of patients and improve breathing. The post resection prosthesis, created by us from heat cured acrylic and silicone relining material, improved significantly breathing. This was not in align with the opinion of any authors [7, 19], that optimal hermetization and breathing reconstruction can be possible only using two piece obturators. The silicone materials, which were used, provided the needed hermetization of the defect and retention and stability of the prostheses. This made the breathing easier, such as some others authors clamed [22, 23].

5. Conclusions

Examination using acoustic rhinometry is efficient method for follow up breathing changes after maxillary resection and conducted treatment. The obtained results allow an objective assessment of the breathing recovery after prosthetic treatment. Prosthetic treatment with obturators, made of heat cured acrylic and rebased with silicone material, improves significantly nasal breathing in patients with unilateral maxillary defects. Despite of achieved hermetization , the nasal breathing of the resection side can't be restored to the normal values of the healthy side.

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