https://doi.org/10.5272/jimab.2023292.4967

Journal of IMAB. 2023 Apr-Jun;29(2)

Journal of IMAB
ISSN: 1312-773X
https://www.journal-imab-bg.org

Review article

OPPORTUNITIES FOR SPEECH RESTORATION IN PATIENTS WITH MAXILLECTOMY. LITERATURE REVIEW

Ivan Gerdzhikov
Department of Prosthetic Dentistry, Faculty of Dental Medicine, Medical University - Sofia, Bulgaria.

ABSTRACT

Background: Over the last few years, there has been an increase in oncologic morbidity in the maxillofacial region. A significant increase in cases of cancer of the maxilla has been established. As a result of the surgical treatment of maxillary tumours, the barrier between the oral and nasal cavity is broken, which leads to serious speech disorders.

Aim: The purpose of the literature review is to analyse data from different studies on the changes in speech after maxillectomy and the opportunities for its restoration with different types of dentures.

Discussion: The opportunities for treatment of patients with maxillary defects include surgical restoration or obturator, as there are contradictory data on what are the optimal means of restoring speech. The predominant opinion is that the choice of treatment method depends on the size and the location of the defects, with most authors considering obturators the optimal means of treatment. Their role in the normalisation of speech function by restoring the barrier between the oral and nasal cavity is indisputably proven. Immediate prosthetics have been found to provide faster and easier recovery of speech. To preserve the achieved results, a three-stage method of treatment with surgical, temporary and definitive obturator is recommended, which restores not only speech but also normal articulation.

Conclusion: Surgical treatment of cancer of the upper jaw causes defects differing in size, which seriously disturbs speech function. Depending on the size and location of the defect, specific prosthetic treatment methods are used, with different types of dentures being produced.

Keywords: cancer of the upper jaw, maxillary resection, speech, obturator, tumor,

BACKGROUND

The literature, there are relatively few studies on the changes in speech after maxillary resection and the opportunities for its restoration with prosthetic treatment methods. Most of them show that despite the successes of modern surgery, prosthetic constructions remain the main treatment method [1, 2]. The predominant opinion is that they need to be produced immediately after resection. A study of 41 patients aged 20–73 proves that immediate prosthetics are the leading factor contributing to the rapid recovery of speech [2]. In order to preserve the achieved treatment results, it is necessary to rebase the immediate denture during the first 2-3 months after the surgery until the definitive completion of the healing process and the production of the definitive obturator. In this case, the use of a speech intelligibility test indicates 94,10% speech intelligibility after immediate prosthetics, 95,60% on the 20th day after surgery and 95,97% after the definitive prosthetics. The important role of immediate prosthetics is also confirmed by other studies, according to which restoration of the preoperative shape of the palate and dentition facilitates speech [3]. In order to preserve this shape and carry out fast modification of the surgical obturator, some authors use a method consisting of the addition of acrylic teeth, which improves the articulation and aesthetics of the patients [4]. Considering the importance of immediate prosthetics for the recovery of a patient's speech and social activity, most authors agree that the production of a surgical obturator should become the standard of care for the patient [5].

Most studies examine speech impairments after maxillectomy as a part of the overall change in the quality of life of the patients. Above all, the degree of damage and the possibilities of recovery during the various stages of prosthetic rehabilitation is monitored. In such a study, Dholam et al. [6] analyse the speech changes in 30 patients during the stages of treatment with surgical, immediate and definitive obturator, comparing the data obtained with those before surgery. Assessment is done using the EORTC QLQ-C30, EORTC QLQ-H & N35 questionnaires and acoustic speech software that assesses intensity, frequency, vibration and maximum phonation time. The results of the study show a significant improvement in intensity, vibration and maximum phonation time over the

course of treatment. The leading role of prosthetic treatment for the recovery of speech and its close relationship with patients' quality of life is proven. The authors believe that preoperative speech analysis enables subsequent evaluation of the effect of the treatment and directs the treating specialist to the optimal prosthetic method for the specific case.

OBJECTIVE

The purpose of the literature review is to analyse data from different studies on the changes in speech after maxillectomy and the opportunities for its restoration with different types of prosthetic constructions.

LITERATURE SURVEY

Literary data show that impaired speech function is a major problem in patients with maxillectomy. Some studies establish that speech intelligibility after resection is 61% and increases to 94% after treatment with a definitive obturator in which there is also an improvement in nasality from 5,8 to 1,6 (on a 7-point rating scale) [7]. Such results are also reported by a study by the National prevention program of the USA, which found 57,5 % speech intelligibility and 5,3 nasality (on a 13-point rating scale) after resection and 95,6% and 0,66 after prosthetic treatment [8]. The effectiveness and role of prosthetics in the normalisation of speech after maxillectomy is also proven by the studies of Umino et al. [9] carried out in 54 patients with definitive obturators. The registered values are significantly lower compared to other studies - 35,7% ± 22,7% before and 84,9% ± 12,7% after the treatment, but the threefold increase gives the authors reason to define prosthetic treatment as the optimal means to restore speech. Improvement in speech intelligibility was also reported in a retrospective study of 73 patients with the questionnaires of head and neck cancer (PSS-HN) of the University of Washington (UWQOL) and the obturator rating scale (OFS). The results obtained show 87% speech intelligibility after the treatment, which according to patients, is a leading factor in improving their quality of life [10].

Studies by Sullivan et al. [7] indicate that the location and size of the defect are deciding factors for the degree of speech impairment. The most severe are the cases with resection of the soft palate in which prosthetic treatment is difficult or impossible and the recovery of speech extremely difficult [11]. This is the reason some authors use mainly surgical methods of treatment for these types of defects and prosthetics only in cases of refusal or contraindications for surgery [12]. Digital planning of the surgery provides predictability of the size and location of the defect as well as the expected changes in speech [13].

Literary data indicate close dependence between patients' speech and quality of life. A study by the University of California in 43 patients with obturators shows that speech improvement leads to the restoration of social contacts and confidence. The University of Washington Questionnaires (UWQOL), Obturator Functioning Scale (OFS) and Mental Health Scale (MHI) showed 92% satisfaction after the end of treatment and mean values of 77.3% for UWQOL, 72% for OFS and 4.5 for MHI in the course of rehabilitation [14]. It is significantly more difficult to recover the speech of radiotherapy patients who have xerostomia and impaired speech intelligibility [15]. Another problem is numbness of the upper lip, which makes patients' articulation and phonetics difficult [16]. However, the most serious and frequent complication after radiotherapy is trismus, which makes not only speech but also treatment difficult [17].

Studies indicate that speech is an important criterion for treatment satisfaction, which is the reason why speech recovery is the main goal of prosthetics. This, according to most authors, necessitates a three-stage treatment methodology with a surgical, temporary and definitive obturator [18]. Chaubai et al. [19] offer a systematic approach for restoring speech that includes the production of an immediate obturator in the first 2-3 weeks after the surgery, temporary until the sixth month and a definitive obturator after completion of healing processes in the defect. It is accepted that restoring speech with a surgical obturator is the most difficult and complex [2]. There are different views on the optimal terms for its production**,** with the prevailing opinion being that immediate prosthetics has a great number of advantages compared to deferred treatment [20].

A main problem for the recovery of speech after maxillary resection is the healing process in the defect, which requires continuous rebasing to ensure the pressurisation of the obturator [21]. The aim is to create a stable barrier between the oral and nasal cavity, the purpose of which is to prevent air transfer and to normalise speech. Some authors use methods which preserve the preliminary shape of the pallate, which facilitates adaptation and sound formation [22]. The production of a temporary obturator is necessary in cases when the healing process leads to substantial changes in he prosthetic field, and a correction of the surgical obturator is not possible [23]. Different methods for the production of temporary obturators exist, and it is accepted that those preserving the preoperative shape of the pallate and the teeth provide optimal speech recovery [24]. It is proven that these methods allow regulation of the depth of the obturating part, which decreases nasal speech and improves breathing [25]. Prosthetic treatment during this intermediate stage of treatment with a temporary obturator is connected with plenty of difficulties and problems, which result from the dynamics of the healing processes and a reason. It is assumed that its duration is until about the sixth month after the operation, and in order to maintain normal speech during this period, about 12-14 clinical visits are required [26].

Definitive and lasting speech restoration is implemented with the definitive obturator, which is the final stage of prosthetic rehabilitation of patients with maxillary resection. This requires correct planning and construction of the type and shape of the obturator, consistent with the main prosthetic principles and the characteristics of the clinical case [27]. Particular attention is given to the factors that can influence the retention and stability of the obturator, as this is a major element in the recovery of speech [28].

According to some studies, the size and location of the defect, as well as the presence of teeth, determine the degree of speech impairment and the possibilities of its recovery [2, 15]. Tripathi et al._[29] found a relationship between the inner diameter of the maxillary defect, resonant frequency and effectiveness of the obturator in reducing nasal speech. Their study in 29 patients with defects of the hard palate (Aramany class I and II) that have used an obturator for more than 3 months proves better effectiveness and improvement of nasal speech in smaller maxillary defects. Other data indicate that the stage of speech restoration also depends on the type of materials which are used in the fabrication of the obturator [3, 4]. Most authors believe that the use of acrylic resin allows for achieving stable support and relatively good retention of the obturator, which improves speech [30]. Other authors prefer light-curing resin, emphasising the advantages connected with the opportunity for easy and fast processing, the lack of residual monomer and the low porosity [31]. Direct shaping and corrections in the defect allow unproblematic modification and transformation of the different types of obturators until optimal speech recovery is achieved. Studies show that using light-curing resin reduces the weight of the obturator by 25 %, which also improves phonetics [32].

Other factors that influence speech are the type and shape of the obturator. Most authors accept that the lightened construction of hollow obturators creates a prerequisite for better phonetics [33]. These views are confirmed by the studies of Kumar et al. [34] in 10 patients with Aramany I and II class defects, which show insignificant changes in articulation and nasal speech six weeks after the treatment with hollow obturators. An important role in phonetics is played by the height of the obturating part and its positioning in the defect. According to some data, high lateral and low mesial walls provide optimal speech restoration [35]. Other authors recommend a maximum height of the lateral walls for the reduction of nasal speech [36]. However, some studies indicate that speech normalisation is only possible with low walls of the obturator [37]. A comparative study to determine the optimal obturator height shows 94.24% speech intelligibility at the height of 10 mm, 91.2% at 5 mm and 90.5% at 15 mm, with measured values of 45.04% ± 5.86 % before treatment [38].

The shape and depth of the palatal arch play an important role in the restoration of speech, which requires the use of treatment methods, allowing preservation of the preoperative shape of the palate. In some cases, this is possible only with two-piece prefabricated obturators in which the replacing obturating part is removable and fixed with magnets to the obturator plate [39]. This allows the production of lower arches for eating and higher for speech, which can be replaced depending on the needs of the patient. However, the described methodology is not widely used in practice due to the inconvenience of replacing the arches, despite the reported increase in speech intelligibility from 19% before to 74% after the treatment.

A major problem in speech restoration in patients with maxillary resection is the weight and size of the prosthesis, because of which most authors use hollow obturators [40]. Some authors use soft resin for better pressurisation of the defect and for improving phonetics [41]. Other authors prefer silicon materials, which provide easy placement of the obturator in the defect with the opportunity for faster rebasing in conformity with the phonetics of the patient [42]. According to some data, their use is only possible in small defects [43]. In cases of larger defects, combined obturators, with a plastic plate and a silicon obturating part providing pressurisation of the defect, are made [44]. The studies of Ramasamy and Chandra [45] indicate that adding silicon material to the acrylic obturators provides a tight fit in the defect and improves speech function. The data indicate that silicon materials improve not only phonetics but also masticatory function and aesthetics, leading to improvement of the patient's psyche [46].

In some cases, speech restoration is very difficult because of the size of the defect. This makes treatment with classic methods impossible and requires two-piece obturators, the plate and replacing part of which are assembled in the mouth. Their application is particularly useful in patients with trismus and after radiotherapy. Most often, magnets fixed in each of the parts of the obturator are used for linking [47]. Some authors use this treatment approach in relatively rare cases of total maxillectomy [48]. Others accept that correct articulation in big maxillary defects is only possible with hollow obturators [49].

Depending on the size and anatomical characteristics of the defects, sometimes the retention and stabilisation of the obturators is possible only with implants, which provides tight pressurisation of the defect and optimal speech restoration [50]. In some cases, mini dental implants are used, and in others, classic implants are fixed to preserved areas of the jaw [51]. The clinical experience of Vosselman et al. [52] shows that for large defects, the placement of zygoma implants is the only treatment option. An important condition for achieving positive results is their correct planning and positioning in the defect [53]. Depending on the location of the defect, it is sometimes necessary to combine zygoma and classic implants [54]. In the rare cases of total maxillectomy, it is necessary to combine surgical and prosthetic treatment methods with the use of pterygoid implants [16]. In the case of defects with a large bone loss, it is impossible to carry out prosthetic treatment, which necessitates a bone transplant [55].

Several studies on the impact and role of implants on speech recovery after maxillectomy have been described in the literature. Dholam et al. [56] trace the treatment of 12 such patients with the standardised questionnaire of the European Organisation of Research and cancer treatment QLQ-C30 and Speech Software (Tiger DRS Inc), where they found improved vocal resonance and intonation as well as the opportunity for stronger and continuous speech. Although in 37% of patients with radiotherapy, osseointegration was unsuccessful 18 months post-treatment, the authors believe that the use of implants allows anatomical, functional and aesthetic recovery. The data are also confirmed by another study showing improvement in gestural and mimic efficiency, articulation and breathing [1].

Very often, surgical treatment of maxillary tumours affects the surrounding soft tissues, the nose and the eyes of the patient. The extensive defects created in the middle floor of the face require a multidisciplinary treatment approach with the participation of different specialists. Studies indicate that due to a lack of maxillofacial prosthetics specialists, such cooperation is possible only in 65% of the cases, which leads surgeons to carry out only surgical treatment in 19% of the cases [57]. In cases of the terminal stage of a disease or due to the impossibility of carrying out plastic restoration, the only opportunity for speech restoration are prosthetic treatment methods [58, 59].

Speech recovery in patients with defects of the soft palate, where the inability to close the palatal valve impairs sound formation, is very difficult [60]. Studies show that shaping the distal section of the prosthesis is essential for speech restoration [61]. Three types of obturators are used, depending on the location of the defect - "hinge" type, in which the obturating part is connected by a hinge to the plate, horizontal obturator, which is fixed on the level of the palate and during function contacts with the pharyngeal musculature and "meatus" obturator, which is extended in the pharyngeal region and is used in major defects of the palate. Fluoroscopic and nasoendoscopic studies show the best recovery of speech and masticatory function with the use of a horizontal (fixed) obturator [62]. According to Bohle et al. [63], a main factor for speech intelligibility in patients with defects of the soft palate is the position of the obturator towards the anterior tubercle of the first cervical vertebra.

Studies indicate that there is no protocol for speech restoration in defects of the soft palate, which is why some authors propose an algorithm for treatment with surgical and prosthetic methods [64]. However, in most cases, prosthetic methods of restoration are preferred, which allow rapid and effective overcoming of palatal insufficiency [65]. To achieve optimal results, the use of instrumental visualisation methods such as nasoendoscopy is recommended, which allow proper adjustment and fixation of the obturator [66].

The development of modern technologies such as CAD-CAM and 3D-printing led to the creation of new treatment methods providing for better speech restoration [67]. The results of the application of these treatment methods show 93% speech satisfaction 6 months after surgery [68]. Digital methods are also applicable in cases requiring duplication of an existing obturator when a new three-dimensional model of plastic is made by scanning with computer tomography [69].

Control examinations play an important role in maintaining normal speech function and correct articulation. It is recommended that the prosthesis be evaluated every 2 weeks during the first 3 months of treatment, then every 3 months for the next 3 years and annually thereafter [29]. Studies prove that the application of prosthetic adhesives improves sound articulation and speech intelligibility [70].

DISCUSSION

Treatment options for patients with maxillary defects include surgical restoration or obturating prostheses, with conflicting data as to which is the optimal means of speech restoration. Systematic database review in Medline, PubMed and Web of Science shows that most authors consider speech recovery as part of the overall assessment of the quality of life (QoL) after obturator treatment and/or tissue transfer. Results show that the most frequently used indicator for assessment of the quality of life, and accordingly the speech, is the questionnaire of the University of Washington (UW-QOL). According to some data, the two treatment options have no considerable difference in speech and quality of life. According to others, the quality of life of patients with obturators is comparable to or even better than in other chronic illnesses.

Studies indicate that the most common types of defects are class IIa and IIb, which allow successful speech restoration with prosthetic methods of treatment. The prevailing opinion is that the choice of treatment method depends on the size and localisation of the defect and the presence of teeth. It is accepted that open obturators provide better phonetics, independently of the height of the replacing part and speech in defects of the soft palate is the hardest to restore.

Despite the lack of agreement on the question of what is the optimal method of treatment, the prevailing opinion is that prosthetics provides faster and easier recovery of damaged functions, especially in cases with large defects. Immediate prosthetics have been found to provide faster and easier recovery of speech. To preserve the achieved results, a three-stage treatment methodology with a surgical, temporary and definitive obturator is recommended, which ensures not only the successful restoration of speech but also normal articulation. Auditory and spectral analysis studies indicate that this treatment approach reduces nasal speech and creates a correct speech stereotype. Some studies have found an interesting relationship between the degree of speech recovery, the intellectual abilities of the patient and the will to solve the problem. There is consensus that the involvement of a speech therapist during each stage of treatment facilitates speech recovery.

Analysis of literature data indicates the need for further studies on the advantages and disadvantages of prosthetic and surgical treatment methods in terms of speech improvement after maxillectomy.

CONCLUSIONS

Surgical treatment of cancer of the upper jaw causes defects differing in size, which seriously disturb speech function. Depending on the size and location of the defect, specific prosthetic treatment methods are used, with different types of prosthetic constructions being produced. Their correct planning and construction allows successful speech recovery, which is the main purpose of the treatment after maxillectomy.

REFERENCES:

1. Rolski D, Kostrzewa-Janicka J, Nieborak R, Przyby³owska D, Stopa Z, Mierzwiñska-Nastalska E. Prosthetic Rehabilitation of Patients After Surgical Treatment of Maxillary Tumors With Respect to Upper Airway Protection. *Adv Exp Med Biol.* 2016;885:83-8. [PubMed]

2. Dalkiz M, Dalkiz AS. The Effect of Immediate Obturator Reconstruction After Radical Maxillary Resections on Speech and Other Functions. *Dent J (Basel).* 2018 Jun;6(3):22. [PubMed]

3. Shambharkar VI, Puri SB, Patil PG. A Simple Technique to Fabricate a Surgical Obturator Restoring the Defect in Original Anatomical Form. *J Adv Prosthodont.* 2011 Jun;3(2):106-9. [PubMed]

4. Kamarudin KH, Hattori M, Sumita Y, Taniguchi H. A Chairside Technique to Add Customised Anterior Acrylic Resin Teeth to a Surgical Obturator. *J Prosthet Dent.* 2018 May;119(5):852-4. [PubMed]

5. Huryn JM, Piro J. The maxillary imediate surgical obturator prosthesis. *J Prosthet Dent.* 1989 Mar;6(3):343-7. [PubMed]

6. Dholam K, Bachher G, Gurav S. Changes in the Quality of Life and Acoustic Speech Parameters of Patients in Various Stages of Prosthetic Rehabilitation With an Obturator After Maxillectomy. *J Prosthet Dent.* 2020 Feb;123(2):355-63. [PubMed]

7. Sullivan M, Gaebler C, Beukelman D, Mahanna G, Marshall J, Lydiatt D, et al. Impact of palatal prosthodontic intervention on communication performance of patients' maxillectomy defects: a multilevel outcome study. *Head Neck.* 2002 Jun;24(6):530-8. [PubMed]

8. Mahanna GK, Beukelman D, Marshall J, Gaebler C, Sullivan M. Obturator prostheses after cancer surgery: an approach to speech outcome assessment. *J Prosthet Dent.* 1998 Mar; 79(3):310-6. [PubMed]

9. Umino S, Masuda G, Ono S, Fujita K. Speech intelligibility following maxillectomy with and without a prosthesis: an analysis of 54 cases. *J Oral Rehabil.* 1998 Feb;25(2):153-8. [PubMed]

10. Seignemartin CP, Miranda ME, Luz JG, Teixeira RG. Understandability of Speech Predicts Quality of Life Among Maxillectomy Patients Restored With Obturator Prosthesis. *J Oral Maxillofac Surg.* 2015 Oct; 73(10):2040-8. [PubMed]

11. Anandakrishna GN, Gali S. Management of velopharyngeal disorders. A case series. *J Prosthodont.* 2010 Jul;19(5):397-402. [PubMed]

12. Stüttgen U. [Impressions of defects in the area of the soft palate.] [in German] *Quintessenz.* 1984 Mar;35(3): 493-6. [PubMed]

13. Wang Y, Yang X, Gan R, Liu H, Wu G, Yu Q, et al. Digital Planning Workflow for Partial Maxillectomy Using an Osteotomy Template and Immediate Rehabilitation of Maxillary Brown II Defects With Prosthesis. *J Oral Rehabil.* 2019 Dec;46(12):1133-41. [PubMed]

14. Chigurupati R, Aloor N, Salas R, Schmid B. Quality of Life After Maxillectomy and Prosthetic Obturator Rehabilitation. *J Oral Maxillofac Surg.* 2013 Aug;71(8):1471-8. [PubMed]

15. López-Jornet P, Camacho-Alonso F, López-Tortosa J, Palazon Tovar T, Rodríguez-Gonzales M. Assessing quality of life in patients with head and neck cancer in Spain by means of EORTC QLQ-C30 and QLQ-H&N35. *J Craniomaxillofac Surg.* 2012 Oct;40(7):614-20. [PubMed]

16. Lethaus B, Lie N, de Beer F, Kessler P, de Baat C, Verdonck H. Surgical and prosthetic reconsiderations in patients with maxillectomy. *J Oral Rehabil.* 2010 Feb;37(2):138-42. [PubMed]

17. Barrett NV, Martin J, Jacob R, King GE. Physical therapy techniques in the treatment of the head and neck patient. *J Prosthet Dent.* 1988 Mar;59(3):343-6. [PubMed]

18. Dos Santos DM, de Caxias FP, Bitencourt SB, Turcio KH, Pesqueira AA, Goiato MC. Oral Rehabilitation of Patients After Maxillectomy. A Systematic Review. *Br J Oral Maxillofac Surg.* 2018 May;56(4): 256-66. [PubMed]

19. Chaubey P, Tripathi R, Ajay Singh A. Rehabilitation of Hemi-Maxillectomy With a Definite One Piece Hollow Bulb Obturator. *Natl J Maxillofac Surg.* 2018 Jan-Jun; 9(1):82-5. [PubMed]

20. Appadurai R, Lingeshwar D, Dilshad B, Maria S. Surgical Retention for Immediate Obturator in Maxillectomy Patients. *Indian J Dent Res.* 2019 Jan-Feb;30(1):133-4. [PubMed]

21. Wolfaardt, JF. Modifying a surgical obturator prosthesis into an interim obturator prosthesis. A clinical report. *J Prosthet Dent.* 1989 Dec; 62(6):619-21. [PubMed]

22. Jacob RF, Martin J, King G. Modification of surgical obturators to interim prostheses. *J Prosthet Dent.* 1985 Jul;54(1):93-5. [PubMed]

23. Bettie NF. A Conservative Method of Retaining an Interim Obturator for a Total Maxillectomy Patien. *J Pharm Bioallied Sci.* 2017 Nov;9(1): 299-301. [PubMed]

24. Shimizu H, Yoshida K, Mori N, Takahashi Y. An alternative procedure for fabricating a hollow interim obturator for a partial maxillectomy patient. *J Prosthodont.* 2009 Apr;18(3): 276-8. [PubMed]

25. Collin JD, Main B, Barber A, Thomas S. Airway Compromise by Dislodged Obturator in a Patient With Severe Trismus. *J Prosthet Dent.* 2014 Jul;112(1):83-5. [PubMed]

26. King GE, Chambers M, Martin J. Patient appointments during interim obturation: is it cost-effective? *J Prosthodont.* 1995 Sep;4(3):168-72. [PubMed]

27. Lee SK, Baier LD, Hock DA, Munz SM. Application of the Basic Tenants of Restorative Dentistry in the Management of a Patient Post-Maxillectomy. *J Mich Dent Assoc.* 2015 Feb;97(2):66-70. [PubMed]

28. Singh M, Limbu IK, Parajuli PK, Singh RK. Definitive Obturator Fabrication for Partial Maxillectomy Patient. *Case Rep Dent.* 2020 Mar; 2020:6513210. [PubMed]

29. Tripathi A, Gupta A, Arora V. Effect of Prosthodontic Rehabilitation of Maxillary Defects on Hypernasality of Speech. *J Prosthodont.* 2016 Apr; 25(3):202-6. [PubMed]

30. Ali R, Altaie A, Nattress B. Rehabilitation of Oncology Patients With

Hard Palate Defects Part 3: Construction of an Acrylic Hollow Box Obturator. *Dent Update*. 2015 Sep 42;(7):612-4. [PubMed]

31. Kar AK, Parkash H, Garhnayak L, Chittaranjan B. Fabricating a Hollow Obturator With Light-Cured Resin System. *J Indian Prosthodont Soc.* 2013 Sep;13(3):348-51. [PubMed]

32. Benington IC, Lappin C, Linden G, Thompson R. The clinical success and periodontal evaluation of patients rehabilitated with light-cured obturators. *J Oral Rehabil.* 1996 Feb; 23(2):135-8. [PubMed]

33. Patil PG, Patil PS. A Hollow Definitive Obturator Fabrication Technique for Management of Partial Maxillectomy. *J Adv Prosthodont.* 2012 Nov;4(4):248-53. [PubMed]

34. Kumar P, Jain V, Thakar A. Speech Rehabilitation of Maxillectomy Patients With Hollow Bulb Obturator. *Indian J Palliat Care.* 2012 Sep;18(3):207-12. [PubMed]

35. Oki M, Iida T, Mukohyama H, Tomizuka K, Takato T, Taniguchi H. The vibratory characteristics of obturators with different bulb height and form designs. *J Oral Rehabil.* 2006 Jan;33(1):43-51. [PubMed]

36. Kwon HB, Chang S, Lee S. The effect of obturator bulb height on speech in maxillectomy patients. *J Oral Rehabil.* 2011 Mar;38(3):185-95. [PubMed]

37. Murase I. In-vivo modal analysis of maxillary dentition in a maxillectomy patient wearing buccal flange obturator prostheses with different bulb height designs. *Nihon Hotetsu Shika Gakkai Zasshi.* 2008 Apr;52(2): 150-9. [PubMed]

38. Turkaslan S, Baykul T, Aydin M, Ozarslan M. Articulation performance of patients wearing obturators with different buccal extension designs. *Eur J Dent.* 2009 Jul;3(3):185-90. [PubMed]

39. Shimodaira K, Yoshida H, Yusa H, Kanazawa T. Palatal augmentation prosthesis with alternative palatal vaults for speech and swallowing: a clinical report. *J Prosthet Dent.* 1998 Jul;80(1):1-3. [PubMed]

40. Rani S, Gupta S, Verma M. Hollow Bulb One Piece Maxillary Definitive Obturator - A Simplified Approach. *Contemp Clin Dent.* 2017 Jan-Mar;8(1):167-70. [PubMed]

41. Tannamala PK, Pulagam M, Pottem SR, Karnam S. Flexible Resins in the Rehabilitation of Maxillectomy Patient. *Indian J Dent Res.* 2012 Jan-Feb;23(1):97-100. [PubMed]

42. Mishra N, Chand P, Singh RD. Two-Piece Denture-Obturator Prosthesis for a Patient with Severe Trismus: A New Approach. *J Indian Prosthodont Soc.* 2010 Dec;10(4):246-8. [PubMed]

43. Padmanabhan TV, Kumar V, Mohamed K, Unnikrishnan N. Prosthetic Rehabilitation of a Maxillectomy with a Two-Piece Hollow Bulb Obturator. A Clinical Report. *J Prosthodont.* 2011 Jul;20(5):397-401. [PubMed]

44. Sukumaran P, Fenlon MR. Two-piece obturator using "lock-and-key" mechanism. *J Indian Prosthodont Soc.* 2017 Apr-Jun;17(2):207-11. [PubMed]

45. Ramasamy TV, Chandra J. An Innovative Sectional Silicone Obturator in a Patient With Partial Maxillectomy: A Case Report. *J Indian Prosthodont Soc.* 2020 Jan-Mar;20(1): 115-19. [PubMed]

46. Lanzara R, Viswambaran M, Gopi A. Comprehensive Prosthetic Rehabilitation of a Case of the Orofacial Digital Syndrome. *Indian Prosthodont Soc.* 2020 Jan-Mar; 20(1):110-14. [PubMed]

47. Parameswari BD, Rajakumar M, Jagadesaan N, Annapoorni H. Case Presentation of Two Maxillectomy Patients Restored With Two-piece Hollow Bulb Obturator Retained Using Two Different Types of Magnets. *Pharm Bioallied Sci.* 2017 Nov;9(1):252-6. [PubMed]

48. Kapetanakos M, Golden M, Huryn JH. Rehabilitation of a Patient After a Total Maxillectomy With a 2-piece Magnetically Retained Obturator: A Clinical Report. *J Prosthet Dent.* 2020 Jan;123(1):184-7. [PubMed]

49. Usman JA, Ayappan A, Ganapathy D, Nasir NN. Oromaxillary Prosthetic Rehabilitation of a Maxillectomy Patient Using a Magnet Retained Two-Piece Hollow Bulb Definitive Obturator; A Clinical Report. *Case Rep Dent.* 2013; 2013:190180. [PubMed]

50. Chi WJ, Hanasono MM, Hofstede TM, Aponte-Wesson RA. Prosthodontic Treatment of a Patient With Ewing Sarcoma of the Left Maxillary Sinus: A Clinical Report. *J Prosthet Dent.* 2019 Apr;121(4):698-702. [PubMed]

51. Beyabanaki E, Alikhasi M. Restoring a Partial Maxillectomy Patient by an Implant-Supported Obturator on Two Implants: A Case Report. *J Dent (Tehran).* 2018 May;15(3):187-92. [PubMed]

52. Vosselman N, Merema BJ, Schepman KP, Raghoebar GM. Patient-specific Sub-Periosteal Zygoma Implant for Prosthetic Rehabilitation of Large Maxillary Defects After Oncological Resection. *Int J Oral Maxillofac Surg.* 2019 Jan;48(1):115-7. [PubMed]

53. Zhao LL, Hong L, Hou Z. Position and orientation of zygomatic-area implant of zygo-buccal flange osseointegrated implant obturator. *Zhonghua Kou Qiang Yi Xue Za Zhi.* 2005 Nov;40(6):445-7. [PubMed]

54. Shirota T, Shimodaira O, Matsui Y, Hatori M, Shintani S. Zygoma implant-supported prosthetic rehabilitation of a patient with a maxillary defect. *Int J Oral Maxillofac Surg.* 2011 Jan;40(1):113-7. [PubMed]

55. Gary JJ, Donovan M, Garner F, Faulk J. Rehabilitation with calvarial bone grafts and osseointegrated implants after partial maxillary resection: a clinical report. *J Prosthet Dent.* 1992 Jun;67(6):743-6. [PubMed]

56. Dholam KP, Bachher GK, Yadav PS, Quazi GA, Pusalkar HA. Assessment of Quality of Life After Implant-Retained Prosthetically Reconstructed Maxillae and Mandibles Postcancer Treatments. *Implant Dent.* 2011 Feb;20(1):85-94. [PubMed]

57. Ali A, Fardy M, Patton D. Maxillectomy-to reconstruct or obturate? Results of a UK survey of oral and maxillofacial surgeons. *Br J Oral Maxillofac Surg.* 1995 Aug;33(4):207-10. [PubMed]

58. Gerdzhikov I. Prosthetic treatment with facial prosthesis in patient in terminal stage of cancer disease. *Knowledge - Int J.* 2018 Mar;22(5): 1335-38. [Internet]

59. Gerdzhikov I. Prosthetic treatment of a patient with a maxillary resection and enucleation. *J of IMAB.* 2020 Jan-Mar;26(1):3015-18. [Crossref]

60. Paul N, Augustine C, Sharma UA, Nishant K, Jyotsna S. Intensive Speech Therapy Programme Combined With a Speech Bulb Prosthesis in the Prosthodontic Rehabilitation of Velopharyngeal Dysfunction. *Cureus.* 2020 Feb;12(2):e6951. [PubMed]

61. Shetty NB, Shetty S, Nagraj E, D'Souza R, Shetty O. Management of Velopharyngeal Defects: A Review. *J Clin Diagn Res.* 2014 Mar;8(3):283-7. [PubMed]

62. Turner GE, Williams WN. Fluoroscopy and nasoendoscopy in designing palatal lift prostheses. *J Prosthet Dent.* 1991 Jul;66(1):63-71. [PubMed]

63. Bohle G, Rieger J, Huryn J, Verbel D, Hwang F, Zlotolow I. Efficacy of speech aid prostheses for acquired defects of the soft palate and velopharyngeal inadequacy-clinical assessments and cephalometric analysis: a Memorial Sloan-Kettering Study. *Head Neck.* 2005 Mar 27;(3):195-207. [PubMed]

64. Britt CJ, Hwang MS, Day AT, Boahene K, Byrne P, Haughey BH, et al. A Review of and Algorithmic Approach to Soft Palate Reconstruction. *JAMA Facial Plast Surg.* 2019 Jul;21(4):332-9. [PubMed]

65. Ohno T, Hojo K, Fujishima I. Soft Obturator Prosthesis for Postoperative Soft Palate Carcinoma: A Clinical Report. *J Prosthet Dent.* 2018 May;119(5):845-7. [PubMed]

66. Amin BM, Aras MA, Chitre V, Rajagopal P. The Role of Nasendoscopy in the Fabrication of a Palatopharyngeal Obturator - A Case Report. *J Clin Diagn Res.* 2014 Aug;8(8):12-4. [PubMed]

67. Soltanzadeh P, Su JM, Habibabadi S, Kattadiyil M. Obturator Fabrication Incorporating Computer-Aided Design and 3-dimensional Printing Technology: A Clinical Report. *J Prosthet Dent.* 2019 Apr;121(4):694-7. [PubMed]

68. Brucoli M, Boffano P, Pezzana A, Corio C, Benech A. The Use of Optical Scanner for the Fabrication of Maxillary Obturator Prostheses. *Oral Maxillofac Surg.* 2020 Jun;24(2):157-61. [PubMed]

69. Elbashti ME, Sumita YI, Hattori M, Aswehlee AM, Taniguchi H. The Role of Digitization in the Rapid Reproduction of an Obturator in a Frail Elderly Patient. *Int J Prosthodont.* 2016 Nov-Dec;29(6):592-4. [PubMed]

70. Sumita YI, Otomaru T, Taniguchi H. Effects of a denture adhesive in edentulous patients after maxillectomy. *Gerodontology.* 2012 Jun;29(2):645-9. [PubMed]

Please cite this article as: Gerdzhikov I. Opportunities for Speech Restoration in Patients with Maxillectomy. Literature review. *J of IMAB.* 2023 Apr-Jun;29(2):4967-4973. [Crossref - https://doi.org/10.5272/jimab.2023292.4967]

Received: 01/02/2023; Published online: 07/06/2023

Address for correspondence:
Dr Ivan Gerdzhikov
Department of Prosthetic Dental Medicine, Faculty of Dental Medicine, Medical University - Sofia;
1, St. G. Sofiyski Blvd., 1431 Sofia, Bulgaria.
E-mail: ivan_ger1971@abv.bg