



## EVALUATION OF THE EFFECTS OF PROSTHESIS ON THE PHONETICS IN MAXILLECTOMY PATIENTS- AN IN VIVO STUDY

Dr.Selvamani (PG), Dr.Meenakshi(Prof),

Corresponding author :Dr.V.Harishnath(Sr.Asst.Prof.),

Dept. of Prosthodontics, Tamil nadu government dental college & hospital

### ABSTRACT:

Most prevalent oral carcinomas results with maxillary defects, unilaterally and bilaterally. In our study patients suffered from unilateral Carcinoma given with obturator prosthesis. Total number of 30 patients participated in our study and the aim of this study is to evaluate the effective speech of maxillectomy patients wearing obturator prosthesis after one month post insertion.

**KEY WORDS;** obturator prosthesis, speech air volume, Impression, casting

### INTRODUCTION

Maxillofacial prosthetics is the art and science of anatomic, functional or aesthetic reconstruction by nonliving substitutes to those regions in the maxilla, mandible and face that are defective or missing because of surgery, trauma, pathology or developmental or congenital malformation. Congenital and acquired defects are the most common causes of maxillary defects<sup>1</sup>. 90% of all head and neck cancers were diagnosed as cases of squamous cell carcinoma<sup>2,3</sup>. Most of the tumors in the palate and paranasal sinus region were found to be squamous cell carcinoma<sup>4</sup>.

The maxillofacial prosthodontist usually encounters patients referred from the department of Oncology or (ENT) after their surgical resection of maxilla or mandible as a part of cancer therapy. Maxillofacial defects results in the functional deficiencies such as mastication, swallowing and speech, fluid leakage into the nasal cavity leading to considerable psychological morbidity<sup>5,6</sup>. Aramany MA in 1978 classified maxillectomy defects into six types according to the relationship of defect to the remaining natural teeth.

Class I – Midline defect

Class II- Unilateral Defect

Class III- Central Defect, but no involvement of teeth.

Class IV- Defect crosses the midline and involves both sides of the maxilla.

Class V- Bilateral posterior defect, remaining teeth is present anteriorly.

Class VI- Maxillary defect anterior to the remaining abutment teeth.

Aramany class I is the most common defect with the percentage of 70%<sup>7</sup>. An obturator is considered to be one of the best rehabilitation tools in maxillary resections. The name obturator is derived from the Latin verb "obturare" which means close or to shut off. According to the glossary of prosthodontic terms obturator is defined as prosthesis used to close a congenital or acquired tissue opening, primarily of hard palate and or contiguous alveolar structures. An obturator will provide an artificial barrier between the oral and nasal cavities thereby enhancing the functional capabilities of speech, mastication and deglutition<sup>8</sup>.

The airway of the patient gets compromised whenever there is an velopharyngeal defect congenitally or acquired which leads to an undesirable coupling between the oral and nasal cavities reduces intraoral air-pressure during speech production causing imprecise articulation, hyper-nasal speech, nasal air emission, and decreased vocal loudness, which interferes with the quality of life<sup>9</sup>.

The pharyngeal airway is an intricate structure, which in conjunction with its surrounding structures; it is responsible for the physiologic processes of swallowing, vocalization, and respiration. The airway is subdivided into three anatomical regions: The Nasopharynx, Oro pharynx, and Hypopharynx. The Nasopharynx is the area between the Nasal turbinate's and the hard palate. The oropharynx contains two areas: retro palatal (from the hard palate to the tip of the soft palate) and retroglossal (from the tip of the soft palate to the epiglottis). The hypopharynx extends from the epiglottis to the esophagus<sup>10</sup>.

The purpose of this study to evaluate speech intelligibility during spontaneous speech, reading and number, type, severity of articulatory errors assessed by Tamil articulation test in maxillectomy patients without and with use obturator prosthesis.

### AIM

To evaluate the speech of maxillectomy patients before and after insertion of obturator prosthesis.

### OBJECTIVES

1. To assess the number and severity of articulatory errors in maxillectomy patients before and after wearing the obturator prosthesis using TAMIL articulation test.

2. To assess the type of articulatory errors (distortion, substitution, addition and omission) in maxillectomy patients before and after wearing the obturator prosthesis using TAMIL articulation test.

3. To assess speech intelligibility during reading and spontaneous speech of maxillectomy patients before and after wearing obturator prosthesis

#### **MATERIALS AND METHODS**

The subjects for this study were selected from the outpatient department, Department of Prosthodontics and Crown and Bridge, Tamilnadu Government Dental College and Hospital, Chennai - 600003. This present study was performed for phonetic evaluation by speech intelligibility and Tamil articulation test before and after obturation of maxillectomy defects.

##### **Selection Criteria:**

##### **Inclusion criteria:**

Patients within age group of 30-65 years, after one year of completion of maxillectomy surgery, signed informed consent.

Absence of any pathology around area of interest.

##### **Exclusion criteria:**

Patients immediately after surgery with acute infection and medically compromised

Pregnancy or lactation at the time of inclusion.

#### **MATERIALS AND METHODS**

1. Impression material: Aliginate---Algitec, Rubber base material ---aquasil

2. Lab material: Pearl stone and Uniwax

3. Retraction cord: (#00) Displacement Cord Ultradent Products.

4. Metal casting machine: BEGO

5. Heat cure resin ---HIFLEEX

6. digital voice recorder -512MB

#### **METHODOLOGY**

##### **STUDY DESIGN**

Ten patients with maxillectomy defects, age ranging from 30 to 70 years were taken for this study. Eight female patients and two male patients, who require definitive obturator prosthesis, were selected after proper inclusion and exclusion criteria. After proper examination and diagnosis, first CBCT scan was taken to determine the airway volume, followed by fabrication of definitive obturator prosthesis and insertion of obturator. One month later, speech intelligibility was measured during spontaneous speech and reading. Number and type of articulatory errors before and after insertion of obturator was assessed using Tamil Articulation Test at Institute for the rehabilitation of Speech and hearing handicapped, Madras Medical College.

##### **FABRICATION OF DEFINITIVE OBTURATOR**

Definitive obturator fabrication begins with case history intra oral and extra oral examination of the patient. After thorough examination, proper size stock tray was selected and modified according to the defect. Preliminary impression was made using irreversible hydrocolloid impression material. Diagnostic casts were made with dental stone. Diagnostic cast was surveyed with surveyor to determine the path of insertion, height of contour and favorable undercuts. Custom tray fabricated with auto polymerizing acrylic resin. Mouth preparation was carried out, followed by tray extension was verified in patient's mouth and border molding the defect area with low fusing compound. Tray adhesive was applied and master impression was made using putty and light body elastomeric impression material. Master cast was properly oriented in the surveyor, similar to diagnostic cast using the tripod marks. After surveying, block out procedure was carried out using block out wax. Design of wax pattern was drawn with appropriate color pencils and cast partial denture wax pattern was done using CPD wax. Finished cast partial denture tried in patients mouth to check for fit, occlusal harmony. After metal try-in, occlusal rim fabricated with modeling wax. Jaw relations were recorded and face bow registration was done, which was transferred to the semi adjustable followed by mounting of maxillary cast.

By using centric inter occlusal record mandibular cast mounted to the maxillary cast followed by programming of articulator with protrusive inter occlusal record. Teeth arrangement was carried out and wax try-in done in patient's mouth. Esthetics, occlusion were checked in patients mouth. After getting approval from the patient, try-in denture was processed.

To reduce the weight of obturator prosthesis, hollow bulb obturator was decided and to avoid the fluid collection in hollow portion, bad odor; closed hollow bulb obturator was planned.

Insertion of obturator prosthesis was carried out and patients are instructed to maintain proper oral and denture hygiene. Patient reviewed after 24 hours, 72 hours, 1 week and one month.

##### **SPEECH ANALYSIS**

Speech analysis was carried out in Institute for the rehabilitation of Speech and hearing handicapped, Madras Medical college. All the speech recordings done with creative digital

voice recorder -512MB and stored in audio data file in PC using hi speed USB 2.0 and all the speech recordings were made in a sound proof room. Two type of tasks were given to each patient.

1. Tamil articulation test (TAT)

2. Speech intelligibility (Selective reading, Spontaneous speech)

Speech recordings were done in the following order

1. Without obturator prosthesis

2. One month after the insertion of obturator prosthesis.

##### **Speech analysis**

Subjective analysis was done by speech pathologist in the Institute for the Rehabilitation of the Speech and Hearing Handicapped, Madras Medical College. Articulation was assessed by Tamil articulation test which was given by USHA.D (1986)<sup>13</sup>. Tamil articulation test used to assess the type of articulatory errors like distortion, substitution, addition and omission. Patient was instructed to repeat 66 words in Tamil language which was specifically designed by the speech pathologist to assess number and type of articulation errors without obturator prosthesis. Similarly the same procedure was repeated again with obturator prosthesis. All the parameters were assessed by speech language pathologist in a grade of four.

GRADE 1 - MINIMUM (0 -1)

GRADE 2- MILD (1-2)

GRADE 3- MODERATE (3-5)

GRADE 4- SEVERE (ABOVE 5)

Speech intelligibility was assessed during spontaneous speech and selective reading in a sound proof room. The speech samples were recorded in a computer, which was assessed by speech language pathologist using PRATT software. Patients are instructed to speak about themselves and read a paragraph from the newspaper when they are not wearing an obturator and similarly same procedure was carried out one month later with obturator prosthesis. Speech intelligibility was measured on a scale of 5 by speech pathologist.

GRADE 1 - EXCELLENT (95-100%)

GRADE 2- GOOD (90-95%)

GRADE 3- NORMAL (80-90%)

GRADE 4- MODERATE (60-80%)

GRADE 5- POOR (40-60%).



**RESULTS**

Ten maxillectomy patients including 8 females and 2 males were provided with definitive obturator. Speech evaluation done at Institute for the rehabilitation of the speech and hearing handicapped, Madras Medical College and Rajiv Gandhi General Hospital, Chennai. Evaluation of speech was done without obturator prosthesis and one month later insertion of obturator prosthesis.

Study samples were divided into two categories

Category I - Without obturator

Category II - With obturator

SPSS 16.0 version was used for analyzing the collected data. To describe about the data descriptive statistics mean and standard deviation (S.D) were used. To analyze qualitative data between two groups, chi-square test is used. Paired sample t test used for quantitative analysis of data between two groups. Probability value (p value) 0.05 considered as statistically significant.

**COMPARISON OF SEVERITY OF ERRORS USING CHISQUARE TEST**

SCORING	GROUPS (FREQUENCY)		P VALUES
	CATEGORY 1	CATEGORY 2	
MINIMUM (0 -1)	0	10	0.0001 <sup>s</sup>
MILD (1-2)	0	0	
MODERATE (3-5)	6	0	
SEVERE (>5)	4	0	

Table shows comparison of severity of articulatory errors was tested with chi square test. In category 1, six patients are moderately affected and four patients are severely affected. For category 2, all the patients are mildly affected.

Results of this study show that comparison of severity of articulatory errors between two categories was highly statistically significant with P value of 0.0001.

**DISCUSSION**

A rewarding area of prosthodontics is the rehabilitation of patients with acquired maxillary defects. Restoring function to within normal limits should be the goal for management of maxillary defects<sup>14</sup>. The main aim of obturator prosthesis is to obliterate the undesired communication between the oral and nasal cavities created by the tumor resection surgery, and to improve speech intelligibility and swallowing.<sup>10, 15</sup> Voice is produced by modification of the airstream by the tongue and hard palate.

An inaccurately produced speech sound/s is called misarticulation which is characterized by the substitution, omission, distortion, and addition of phonemes<sup>16</sup>. Tamil Articulation Test (TAT) used to assess the number, severity, type of articulatory errors (substitution, omission, distortion, and addition)<sup>13</sup> and speech intelligibility was assessed by spontaneous speech and selective reading. Criteria for selecting the patients for this study were adhered properly. Ten patients with maxillectomy defects requiring definitive obturator prosthesis were included in the study. Out of ten patients, eight female patients with percentage of 80 and two male patients with percentage of 20 and age group of patients were 32 to 67 years with mean age of 46.5 years. Aramany class I defect occurred in frequency of 90% and class II with frequency of 10%. Aramany class I is the most frequent defect<sup>7, 17</sup>. CBCT was taken to measure Airway area and volume and phonetics was tested using Tamil articulation test and speech intelligibility during spontaneous speech and reading before fabricating an obturator prosthesis followed by fabrication of definitive hollow bulb obturator prosthesis. To create hollow bulb, we followed lost salt technique. Prosthesis was inserted and reviewed. After one month of obturator insertion, again CBCT was taken to measure the airway volume and phonetics was tested. In our study, in analysis by chi square test the following results were obtained. Speech intelligibility for maxillectomy patients was compared without obturator and provided with obturator prosthesis. Results of this study show that comparison of speech intelligibility during spontaneous speech between two categories was highly statistically significant with P value of 0.0001 (P<0.05). This shows providing obturator prosthesis improves the speech intelligibility.

**Speech intelligibility during selective reading;**

Speech intelligibility for maxillectomy patients was compared without obturator and provided with obturator prosthesis. Results of this study show that comparison of speech intelligibility during selective reading between two categories was highly statistically significant with P value of 0.0001. This shows providing obturator prosthesis improves the speech intelligibility.

**Number of articulatory errors;**

Number of articulatory errors for maxillectomy patients was compared without obturator and provided with obturator prosthesis. Results of this study show that comparison of number of articulatory errors between two categories was highly statistically significant with p value of 0.0001. Number of articulatory errors was reduced with obturator prosthesis.

**Severity and Grading of articulatory errors;**

Severity and grading of articulatory errors was compared without obturator and provided with obturator prosthesis. Results of this study show that comparison of severity and grading of articulatory errors between two categories was highly statistically significant with p value of 0.0001. Obturator prosthesis reduces the severity of articulatory errors.

**Type of articulatory errors;**

Type of articulatory errors (substitution, omission, distortion, and addition) for maxillectomy patients was compared without obturator and provided with obturator prosthesis. Results of this study show that distortion and substitution was common, followed by omission.

Substitution is the replacement of one standard speech sound by another such as /θ/for/s/or replacement of one standard speech sound by a non-standard speech sound<sup>16</sup>. In our study most frequently substituted sounds were /l/ for /d/, /l/ for /n/, /t/ for /r/, /l/ for /r/, /tr/ for /d3/.

Distortion is the approximation of a phoneme in the same manner which renders it acoustically unacceptable. Results of this study show that, following sounds are frequently distorted in Tamil phonemes like /r/, /k/, /g/, /d/, /t/, /f/, /dz/, /tr/. Distortions were associated with the extensive resection of the palate and it was due to the inability of the tongue to articulate with the palate. It causes distortion of sounds and because of the missing palate; the tongue is not able to articulate due to the resected palate causing an escapement of air through the nasal cavity which causes difficulty in pronunciation of Tamil phonemes. After providing obturator to the patient, it was possible for the tongue to articulate with the acrylic palate, which helped in decreasing both distortion and substitution but the tongue had still not adapted to the obturator palate. After a period of one month, there was betterment in speech, with less distortion and substitution which suggests that the articulation is completely a matter of the tongue and hard palate and their co-ordination<sup>16</sup>.

Omission consists of omitting certain sounds in words, for example, a-le for apple<sup>16</sup>. Results show that omission of /t/, /r/ is common.

Addition is insertion of sounds, but not a part of the word itself, for example, animamal for animal<sup>16</sup>. On analyzing the speech, addition was absent in our study.

After providing obturator prosthesis, no articulatory errors were noted. This shows providing obturator prosthesis is valuable tool in improving the speech and quality of life of patients. So it became evident from the study, after maxillectomy airway of the patients gets compromised. With the use of definitive obturator prosthesis, it significantly improves the airway of the patients by restoring the contours and original anatomy of palate and adjacent tissues. Improvement in airway greatly influences the speech also. Speech intelligibility of the patients was improved, and reduction in number, severity and type of articulatory errors (distortion, substitution, omission, addition) also. Finally patients were return to their near normal level and improved the quality of life.

#### **SUMMARY AND CONCLUSION**

According to the results it was concluded that,

- i) With obturator prosthesis, Speech intelligibility during spontaneous speech and reading was highly significant.
- ii) With obturator prosthesis, number and severity of articulatory errors was significantly reduced.
- iii) Distortion, substitution, omission and addition errors are significantly reduced with obturator prosthesis.
- iv) There was a significant improvement in airway volume, which also influences the improvement of speech.

Thus it was finally concluded that providing definitive obturator prosthesis is useful in improving the airway, speech, function, esthetics as well as quality of life of maxillectomy patients.

Further studies can be made by extending this study using a large sample size to rule out variations involved in small sample size. Further studies can be made by assessing the presurgical level of patient's phonetics and airway volume which can be compared with postoperative level in a large sample size

#### **BIBLIOGRAPHY**

1. Curtis TA, Beumer J. Restoration of acquired hard palate defects, aetiology, disability, and rehabilitation. In: Beumer J, Curtis TA, Firtell, DN, editors. Maxillofacial rehabilitation: prosthodontic and surgical consideration. St. Louis: CV Mosby; 1979: 90-187.
2. S. Warnakulasuriya, "Global epidemiology of oral and oropharyngeal cancer," Oral Oncology 2009;45:309-316.
3. K. Alibek, A. Kakpenova, and Y. Baiken, "Role of infectious agents in the carcinogenesis of brain and head and neck cancers," Infectious Agents and Cancer 2013;8:7-10.
4. Spiro RH, Strong EW, Shah JP. Maxillectomy and its classification. Head and neck 1997;19:309-314.

5. Glossary of prosthodontic terms, J Prosthet Dent 2005; 94: 10-92.

6. R. Michael, Arcuri, and T. D. Taylor, Clinical management of the dentate maxillectomy patient. Clinical maxillofacial prosthetics: 1st Quintessence Publishing Co, Inc, 2000.

7. Azad AA, Amjad A, Shariff M, Ibrahim A, Hasan SH. Pattern of acquired post surgical maxillectomy defects for prosthodontic rehabilitation in patients at AFID. J PakDentAssoc 2011;20:35-9.

8. Varoujan A. Chalian, Joe B. Drane [and] S. Miles Standish. Maxillofacial prosthetics, Williams & Wilkins Co. Baltimore 1972;133-157.

9. Plank DM, Weinberg B, Chalian VA. Evaluation of speech following prosthetic obturation of surgically acquired maxillary defects. J ProsthetDent 1981;45(6):625-638.

10. Schwab RJ, Goldberg AN. Upper airway assessment: Radiographic and other imaging techniques. OtolaryngolClin North Am 1998;31:931-968.

13. Usha D. Test for articulation in Tamil. Dissertation submitted to the University of Madras for completion of Master of Science; 1986.

14. Jana M Reiger, Judith A. Lam Tang, Johan Wolfaardt, MDent, Jeffrey Harris, HadiSeikaly. Comparison of speech and esthetic outcomes in patients with maxillary reconstruction versus maxillary obturators after maxillectomy. J Otolaryng-Head & Neck Surgery 2011; 40 (1): 40-47.

15. Viviane de CARVALHO-TELES, Maria Ines PEGORARO-KROOK, José Roberto Pereira LAURIS. Speech evaluation with and without palatal obturator in patients submitted to Maxillectomy J Appl Oral Sci. 2006;14(6):421-6.

16. Kumar P, Jain V, Thakar A. Speech rehabilitation of maxillectomy patients with hollow bulb obturator. Indian J palliat Care. 2012;18:207-12.

17. Arigbede AO, Dosumu OO, Shaba OP, Esan TA. Evaluation of speech in patients with partial surgically acquired defects: pre and post prosthetic obturation. J Contemp Dent Pract 2006;7:89-96.