Influences of Size and Form of Maxillectomy Defect, and Remaining Maxillary Teeth on Oral Functions of Patients Receiving Prosthetic Therapy with Obturator

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Abstract: Background: Maxillectomy defect causes an oro-nasal opening affecting oral functions; inability to chew and swallow disorders in phonation, aesthetics and psychological depression of patients. Obturator prosthesis can result improvement in oral functions by re-establishing oro-nasal separation. Objectives: The study was done to investigate the effects of maxillary defect form, size, and remaining maxillary teeth on oral functions in post-maxillectomy patients. Materials and Methods: The study was conducted over 16 post-maxillectomy patients, age (mean±SD = 37.56±13.07 years) ranged from 18 to 70 years, male 9(56.20%) and female 7(43.80%), partially dentate, treated with obturator prosthesis at the prosthodontic department of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. All patients had continuously worn the obturator prostheses for at least 3 months during the study. Data of each patient were recorded on the basis of size and form of maxillary defect, and remaining maxillary teeth, and mastication, speech and swallowing. The data were tested with statistical software (SPSS V.19). Results: Form and size of the maxillectomy defect has significant relationship with the masticatory performance (P=.007 for defect form & .003 for defect size) and articulation of speech (P=.003 for defect form & 0.001 for defect size). Remaining maxillary teeth has no significant relation to masticatory performance (P = .66) and articulation of speech (P = .386). Form and size of the maxillectomy defect, and remaining maxillary teeth has no significant relationship with the swallowing obturator function (P-value=.13 for defect form .09 for defect size and .49 for remaining teeth). Conclusion: Size and form of maxillary defect significantly influence the masticatory performance and articulation of speech, they also affect in swallowing efficacy but it is not statistically significant. Remaining maxillary dentition has not significant effects on oral function of obturator.

Keywords: Maxillectomy Defect, Maxillary Teeth, Oral Functions, Prosthetic Therapy, Obturator

1. Introduction

The maxillae are important structure for both function and cosmetic appearance of the face. It maintains phonation, mastication and swallowing, and aesthetics of facial contour. The maxilla may be defective due to congenital or acquired causes. Acquired causes for maxillary defect are usually resulting from surgery or trauma.¹ Almost all acquired maxillary defects caused by resection of oral neoplasm. Oral malignant tumor is the eleventh most common cancer in the world; third most in Indian sub-continent² and 20% of all cancer in Bangladesh,³ among them, 17.5% is maxillary lesion.⁴
Maxillectomy defect causes a communication between the oral and nasal cavities affecting oral function,\(^5\); inability to chew and swallow, disorders in phonation, aesthetics and psychological depression of patients.\(^7\) Maxillary defect can be restored with either tissue grafting or using prosthesis. Although, surgical reconstructions have some advantages but it is not always possible because of the condition of the patient.\(^9\) So, prosthetic reconstruction may be one of the possible solutions.

An obturator is a prosthesis which closes an opening or defect of the maxilla as a result of a cleft palate, trauma or removal of the maxilla due to pathologic mass.\(^10\) Obturator can result improvement in speech, mastication, swallowing and aesthetic by re-establishing oro-nasal separation.\(^11\) Furthermore, it is suggested that obturator prosthesis may improve the psychological status of the patients as well as their quality of life.\(^12,13\)

Factors concerning obturator functions are- retention, stability and support of obturator. Retention and stability of obturator is gained from remaining teeth by placement of direct retainer. Residual maxillary arch, palatal structures and tissue undercut around the defect are also act as indirect retainer, and take part in stability and support.\(^14\)

The structures in the remaining maxilla provide retention. The teeth are the great asset for providing retention of the obturator prosthesis as they receive the direct retainer. The number, position, and periodontal status of the remaining teeth are the most critical factors of retention, stability and support.\(^11\) There are some factors such as residual soft palate, residual hard palate, anterior nasal aperture, and lateral scar band, height of lateral wall of the defect that may provide retention, stability and support to the obturator itself.\(^15\)

Preservation and treatment of remaining teeth and residual structures may provide a better retention and stability of the prosthesis. With proper patient preparation, oro-facial prosthesis may prove to be a significant and positive factor in the physiologic and psychological rehabilitation for the patient with acquired defects.\(^16\) However, there is a lack of evidence correlating oral function with maxillary defect size, form, and remaining teeth in post-maxillectomy patients. The aim of this study was to investigate the maxillary defect form, size, and remaining teeth in relation to oral functions in post-maxillectomy patients.

2. Materials and Methods

The cross-sectional study was conducted over 16 post-maxillectomy patients, age (mean±SD = 37.56±13.07 years) ranged from 18 to 70 years, male (56.20%) and female (43.80%), partially dentate, treated with obturator prosthesis (table-I) at the prosthodontic department of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, from January 2009 to December 2010. Patients with congenital maxillary defect, debilitated patients, extreme xerostomia, restricted mouth opening, sever periodontal disease, and patients with other intraoral surgery along with maxillectomy were excluded from the study. All patients had been rehabilitated with obturator prostheses. Prosthodontic procedures were carried out by a well-trained prosthodontist.

No surgical reconstruction was performed. Status of the opposing teeth were evaluated. Decayed or missed teeth were restores or replaced accordingly. All patients had continuously worn the obturator prostheses for at least 3 months during the study. The study was undertaken with the understanding and consent of each subject. Data of each patient were recorded from medical and dental history, diagnostic casts, and clinical examinations. The patients were interviewed for the survey by a prosthodontist who was not involved in these prosthetic treatments.

2.1. Evaluation of Remaining Structures

The maxillary defect form was assessed according to the Aramany’s classification of acquired maxillary defect. Aramany\(^3,17\) classified maxillectomy defects into six classes. These are- class I: the midline resection of the maxilla, the teeth are maintained on one side of the arch; class II: the unilateral defect, retaining the anterior teeth on the contra lateral side up to 2nd pre-molar; class III: the defect occurs in the central portion of the hard palate and may involve part of the soft palate; class IV: the defect crosses the midline and involves both sides of the maxilla up to 2nd pre-molar on contra lateral side; class V: the bilateral defect and lies posterior to the remaining abutment teeth; class VI: the bilateral defect and lies anterior to the remaining abutment teeth.

The size of the defect area in each patient was assessed as resection less than half of hard palate, half of hard palate and more than half of hard palate.\(^18\) Remaining maxillary teeth were recorded as their number and position. Position of existing teeth are divided according to Eichner’s classification.\(^19-21\) This method classify the teeth as A-four supporting zone, B1- three supporting zone, B2- two supporting zone, B3-one supporting zone and B4 no supporting zone but occlusal contact on anterior teeth, and C-no occlusal contact.

2.2. Prosthetic Procedures

Patients were examined in seating upright position; special attention was given to the healing surface, size of the defect, scar tissue band and remaining teeth. A gauze piece was tied with thread and dipped with petroleum jelly, and packed into the defects. Primary impression was made with stock tray and irreversible hydrocolloid impression material. Primary cast was prepared with dental stone. Special tray was prepared with auto cure acrylic resin. Final impression was made by silicon impression material and special tray. Master cast was prepared with dental stone. Unfavorable undercut was blocked out, and the prosthetic design was done. Trial base was prepared by auto cure acrylic resin. Wax pattern and record block was prepared with modeling wax. Jaw registration was done. Teeth were arranged. Try-in was performed. Half flasking, full flanking, dewaxing, and deflasking was done sequentially. Separating media (cold
mold seal) was applied on the master cast and plaster surface. Mould space was packed with heat activated acrylic resin. Curing was done. Trimming, finishing and polishing of obturator denture was done. The obturator was inserted into patient’s mouth. The patient was instructed for maintenance points scale such as good, clear speech with no nasality; fair, basis of Listener Judgments. Three healthy and sound foods were masticated and reported by patient as- easy to masticate. The masticatory performance was recorded as the relationship between form and size of maxillary defect, and remaining maxillary teeth for swallowing are 0.13, 0.09 and 0.49 respectively (table-IV).

Swallowing integrity of liquid was checked. In case of improper swallowing, liquid came out through the nasal cavity. Responses were recorded according to different grading such as good, no leaking of liquid through nasal cavity; and poor, leaking of liquid through nasal cavity.

Data Analysis: The data were tested with statistical software (SPSS V.19). χ² test was done to detect the relationship between form and size of maxillary defect, and remaining maxillary teeth and oral function. P-values <0.05 were deemed statistically significant.

3. Results

Form of the maxillectomy defect has significant relationship with the articulation of speech of obturator (P = .003). Class III & II defect has the highest influence on good speech. Class I defects have same effects on good and fair speech. In class IV defects, patient speaks poor with obturator. Size of the maxillectomy defect has significant relation to articulation of speech of obturator functions (P = .001). As the size of the defect increases speech articulation decreases from good to poor. Location of remaining maxillary teeth has no significant impact on swallowing of obturator function. P-value of form of the defect, size of the defect and remaining maxillary teeth for swallowing are 0.13, 0.09 and 0.49 respectively (table-IV).

Table I. Characteristics of the patients (n=16).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Group</td>
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<tr>
<td>≤ 20 years</td>
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<td>12.5</td>
</tr>
<tr>
<td>21 to 30 years</td>
<td>3</td>
<td>18.8</td>
</tr>
<tr>
<td>31 to 40 years</td>
<td>5</td>
<td>31.3</td>
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<td>Total</td>
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<td>100.0</td>
</tr>
<tr>
<td>Sex</td>
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<td></td>
</tr>
<tr>
<td>Male</td>
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<td>56.3</td>
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<tr>
<td>Female</td>
<td>7</td>
<td>43.8</td>
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<tr>
<td>Therapy Taken</td>
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<tr>
<td>Surgery only</td>
<td>7</td>
<td>43.8</td>
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<tr>
<td>Surgery + radiotherapy</td>
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<tr>
<td>Total</td>
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<td>Number of Remaining Teeth</td>
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<td>12.5</td>
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<td>7</td>
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<td>8</td>
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<td>Total</td>
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<td>Used Obturator</td>
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<td>43.8</td>
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<td>Interim + Definitive</td>
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<td>43.8</td>
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<tr>
<td>Definitive only</td>
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<td>12.5</td>
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<tr>
<td>Total</td>
<td>16</td>
<td>100.0</td>
</tr>
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</table>

Table II. Distribution of patients according to masticatory performance (n=16).

<table>
<thead>
<tr>
<th>Masticatory Performance</th>
<th>Total n(%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to masticate n(%)</td>
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</tr>
<tr>
<td>Difficult to masticate n(%)</td>
<td>2(12.5)</td>
<td>0.007</td>
</tr>
<tr>
<td>Unable to masticate n(%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total n(%)</td>
<td>8(50)</td>
<td></td>
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</table>
4. Discussion

This study results revealed that form and size of the maxillectomy defect significantly correlate with oral function of patients treated with obturator, and remaining maxillary dentition also influence the obturator functions for post maxillectomy patients. Sema et al.28 and Keyf11 stated that the residual maxillary structures have an impact on the degree of obturator movement during functions. The abutment teeth essentially absorb the stress generated by functional movement of the obturator prosthesis and play an important role in retention and stability of the prosthesis. When dealing with extensive and unfavorable defects, the prosthesis is extended more into the defect, and therefore might be heavier. It exert continuous force to tissues, and affects their health, compromises the function of the prosthesis and patients may feel discomfort.29-31 Hüseyin et al32 added that, not only the location, extension and design, and volume of surgical resection of maxilla but also the status of unresected structure around the defect and distribution of remaining teeth are important factors for regulation oral function with obturator.

This study found form and size of the maxillectomy defect significantly affect the masticatory performance, but remaining maxillary teeth has no significant relation to masticatory performance of obturator function. These are may be due to various degrees of obturator’s movement...
depending on the residual maxillary structures such as configuration and size of the defect, amount and contour of the remaining palatal shelf, height of the residual alveolar ridge, and the undercuts. The post-maxillectomy patients presents different type of defect configuration and size of defect area, and number and position of teeth. So, prosthesis movement can be reduced by preservation of remaining teeth for using direct retainer, utilizing the remaining palatal structures for to stabilize the prosthesis and achieve support from around the defect area.

Koyama et al. reported that the presence of teeth, the size and configuration of the defect influence the masticatory function of post-maxillectomy patients treated with obturator prostheses. They found the masticatory function scores are differed significantly with the different types of defect configurations and significant correlation between the masticatory function score and the size of the defect area, and there was no significant correlation between the masticatory function score and the number of remaining teeth. Takahiro et al. found that extent of the hard palate defect has high correlation with masticatory function. Masticatory functions have a tendency to increase above the range of average when defects size tends to decrease. Takahiro et al. showed in another report that there are strong correlation between masticatory performance, and extent of hard palate and posterior maxillary teeth.

In this study, it was observed that, form and size of the maxillectomy defect has significant relationship with the articulation of speech of obturator functions. Remaining maxillary teeth influence the articulation of speech of obturator but not significantly. Adisman stated that the defect limited to the hard palate area, is sufficient to cover the defect and create a seal by engaging a minimal amount of undercuts. Aramany and Drane indicated that the use of small nasal extension sections in hollow obturators in patients with large palatal defects tends to improve voice quality, but with smaller defects, the size of the nasal extension section has little effect on voice quality. The degree of extension into the defect varies depending upon the configuration of the defect, healing surface, and functional requirements for retention, support, and stabilization of the prosthesis. In large defects with lacking palatal support, the obturator is mostly extended vertically and horizontally to engage the surgical defect. So, it expands of its size and heavy in weight as a results it less effective in functions.

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5. Conclusion

Within the limits of this study, it can be concluded that size and form of maxillary defect significantly influence the masticatory performance and articulation of speech, they also affect in swallowing efficacy but it is not statistically significant. The presence of teeth in the maxillary dentition has not significant effects onoral function of obturator.

Authors’ Contributions

All authors designed the study; S. Islam, M. Rahman, P. Islam & Hayet conducted the study and collected data; S. Islam analyzed data; S. Islam, A. Rahman & Azam drafted the paper, and all authors read and approved the manuscript.

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