Evaluation of Zygomatic implant retained obturator in rehabilitation of partial palato-maxillectomy patients

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Abstract

Objectives: To evaluate clinically, radio-graphically and electro-myographically the added value after converting conventional obturator to implant retained one using Zygomatic implant for patients with acquired partial palatomaxillary defect, as regards residual tissue preservation, masticatory muscle activity and quality of the life.

Methods: Eight patients were selected form Prosthodontic Clinic of the Faculty of Dentistry, Tanta University with palatomaxillary defects. The conventional hollow type obturator was fabricated for each patient. After 6 months of obturator insertion, each patient received tapered threaded implant at the Zygomatic bone of the resected side. During Osseointegration period, all patients continued using the conventional hollow obturators. After another 6 months the obturator was connected to the implant by ball and socket attachment. Clinical and radiographic evaluation of the abutment teeth in addition to Electromyographic evaluation of masseter and temporalis muscles and assessment of the oral health related quality of life were done.

Results: For the abutment teeth, there was no statistically significant difference in gingival index, tooth mobility, and bone level in comparison between conventional obturator and implant retained obturator. Implant retained obturator showed significant improvement over conventional obturator in patient quality of life. In addition, increase of muscle activity of the masseter and temporalis muscles in patients with implant retained obturator was recorded.

Conclusion: The implant retained obturator highly improved the masticatory function and Oral Health Related Quality of Life (OHRQOL) in comparison to conventional obturator.

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Keywords: Zygomatic implant; Retained obturator; Partial palato-maxillectomy

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1. Introduction

The term maxillectomy refers to surgical removal of a part or all of the maxilla [1]. Maxillary defect creates dysfunction of stomatognathic system such as mastication, speech, bolus transportation and various degrees of cosmetic deformity. Moreover, the negative psychological impact is tremendous [2]. The main objective for treating such patients with obturators is to achieve closure of the defect area and to separate the oral cavity from the sinus and nasal cavities [3]. Rehabilitation of this defect is important not only in function and aesthetics, but also in patient re-socialization [4]. Stability and retention of the obturator is governed by the location and size of the defect, the number of remaining teeth, and the supporting surface of the remaining palate [5]. Stability and retention of the obturator will affect the mastication and other functions later on [6]. The required retention and stability of the obturator with implants is achieved with less complication, time, and discomfort than with other surgical procedures [7]. The larger the surgical resection, the greater the loss of support, which in turn results in increased unfavorable forces acting on the remaining abutment teeth. Positive support within the defect prevents rotation of the obturator into it. This support can be achieved by contact of the prosthesis with any anatomic structures that provides firm base. A more recent approach is the use of osseointegrated implant in zygomatic bone [8]. Most of studies on maxillary obturators retained by osseointegrated implants were isolated patient reports providing minimal data on long-term implant status and survival rates. There is no exact estimation of the added value of the implant retained obturator for acquired maxillary defect. Therefore, more studies are still important in determining the specific applications and limitations of the Zygoma implant in rehabilitation of this complex and challenging patients.

2. Patients and methods

Eight patients (5 females–3 males) were selected from the Outpatient Prosthodontic Clinic of the Faculty of Dentistry, Tanta University, ranging in age from 20 to 58 years old. Every patient was examined to meet the inclusion criteria of the study and was informed about the aim of the study and agreed to participate in this study. The selected patients had the following criteria: Acquired partial palato-maxillary defect Fig. 1. Almost healthy remaining maxillary teeth, Almost completely dentulous mandibular arch, Relatively good oral hygiene, Did not receive radiotherapy, did not had any systemic disease that may interfere with implantation procedure and non-Smokers.

After construction of Metal framework, the Hollow bulb type of obturator was processed according to the technique of Habib and Driscoll [9] Fig. 2. After 6 months of obturator insertion, each patient received one fixture 4 16 mm length, and 3.7 mm diameter at the Zygomatic bone of the resected side. During Osseointegration period, all patients continued using the conventional hollow obturators after modification. After another 6 months and assurance of good Osseointegration Fig. 3, second stage surgery was performed. The obturator was modified and connected to the implant by ball and socket attachment Fig. 4.

2.1. Patient evaluation

The Abutment teeth evaluations were carried out at conventional obturator insertion, 6 and 12 months after its insertion. Also at implant retained obturator insertion, 6 and 12 months after its insertion. Clinical evaluation by gingival index was carried out according to Loe and Silness [10], Tooth mobility was tested according to Lindhe [11]. Radiographic evaluation of the bone height around the abutment teeth by Serial standardized Peri-apical radiographs were made for all abutment teeth using long cone paralleling technique and Rinn XCP5 film holder. The peri-apical radiographs were digitalized to computer

4 Zimmer Dental Inc., Carlsbad, CA, USA.
5 Rinn Corporation Elgin, Company, Rochester, NY, USA.
by digital camera then software ImageJ 1.42\(^6\) was used to measure the linear distance in pixels between two marked points (at the alveolar crest and the root apex) of mesial and distal sides of each abutment teeth. The mean of the marginal bone loss on both mesial and distal surfaces of each abutment tooth was calculated, after that the mean of loss of the whole abutment teeth for each patient was calculated Fig. 5. Electromyographic evaluations were carried out at 12 months of using conventional obturator and 12 months of using implant retained-obturator. Electromyography signals were recorded on right and left sides during maximum voluntary clenching at centric occlusion by surface electrode to Masseter and Temporalis muscles, the amplitude of the interference pattern of each muscle is recorded. Assessment of the quality of life by a short-version of a questionnaire (translated into Arabic)\(^{12}\) that measures oral health related quality of life [OHRQoL].

The questionnaire was completed by the patient without any obturator, after using the conventional obturator by 12 months and after using implant retained obturator by 12 months. The recorded results were collected, tabulated and evaluated statistically using paired \(T\)-test. These analyses were performed using statistical software SPSS\(^7\)\(^{13}\).

3. Results

From Tables 1 and 2 the gingival index (GI) and Tooth Mobility (M) of the abutment teeth at, after 6 and 12 months of conventional and implant retained obturator insertion were not statistically significant.

3.1. Radiographic evaluation

From Table 3 the bone loss of the abutment teeth after 6 and 12 months of conventional obturator and implant retained obturator insertion were not statistically significant.

3.2. Electromyographic results

The EMG activity was measured during maximum voluntary clenching at centric occlusion. The sum of both mean values amplitude of the left and right masseter and temporalis muscles activity were recorded in Tables 4 and 5. The mean value EMG amplitude of the masseter and temporalis muscles activity of patients with conventional obturator was significantly increased when the patients used implant retained obturator.

3.3. OHRQoL

Table 6 and Graph 1 showed the OHRQoL score of maxillectomy patients without any prosthesis was significantly improved when the patients were wearing conventional obturator, in addition to further significant improvement on using.

4. Discussion

The great variety of maxillectomy defects and low patient numbers are usually presented as case reports. Therefore, prosthetic treatment decisions on this patient group usually based on low levels of evidence. For this, management of maxillectomy patients was the aim of this study. The conventional obturator has been primarily used successfully with variable results in patients with partial and total maxillectomy for many years\(^{14}\). However, the prosthetic rehabilitation of maxillary defects is a significant challenge in terms of creating retention and preserving existing dentition in an environment of expanded functional stress. In addition to the high risk of many problems such as poor function that may include loosening of the obturator; mastication problems; leakage of liquid, and/or food; and problems with speech, aesthetics, and social integration, with psychological sequel, could also be

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\(^6\) Imag x system, de Gotezen, Italy.

\(^7\) Version 11.0; SPSS Inc., Chicago, Ill.
present [15]. Since the introduction of a method that uses implants in the zygoma obturator retention has been improved [7,16,17], with better stability and retention [15,18]. Accordingly, this study aimed to evaluate clinical, radiographical and electromyographical the added values after converting conventional obturator to implant retained one, using dental implant in the zygoma. In this study to avoid personal differences between patients, the conventional obturator and implant-retained obturator were compared on the same individual. So, the size of the defect and the number of remaining teeth were not considered. The present study showed no statistically significant differences in clinical parameters including gingival index and tooth mobility for the abutment teeth and bone

![CT scan showing osseointegrated implant.](image)

**Fig. 3.** CT scan showing osseointegrated implant.

![O-ring attached to the implant retained obturator.](image)

**Fig. 4.** O-ring attached to the implant retained obturator.

![Periapical X-ray analysis by Imaj J soft-wear showing marked points (at the alveolar crest and the root apex).](image)

**Fig. 5.** Periapical X-ray analysis by Imaj J soft-wear showing marked points (at the alveolar crest and the root apex).

<table>
<thead>
<tr>
<th>Time of assessment</th>
<th>Conventional obturator</th>
<th>Implant retained obturator</th>
<th>Paired T-test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6 months</td>
<td>0.08 ± 0.07</td>
<td>0.07 ± 0.03</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>6–12 months</td>
<td>0.11 ± 0.02</td>
<td>0.11 ± 0.03</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1**

Comparison between GI difference of the abutment teeth on using conventional and implant retained obturators at different follow up periods.
levels around the abutment teeth in and between conventional obturator and implant retained obturator over the whole follow up periods. This may be explained on the basis that patients were instructed to properly use tooth pastes, brushes, and dental floss to remove food particles and dental plaque. In addition, the using of well-designed conventional obturator had no bad effect on the abutment teeth. The results of the present study revealed that rehabilitation of maxillectomy patients with conventional or implant retained obturator showed significant improvement in the general Oral health related quality of life (OHRQoL) including functional impairment, psychological disability, and social disability in comparison to patients without obturator. Moreover, there was a significant improvement in (OHRQoL) after converting the conventional obturator to implant retained obturator. This result is in agreement with Habib and Driscoll, Davo et al. [19,20]. This change may be due to the improvement of retention of the obturator, which gained by the implant leading to oral functions improvements. Additional retention prevents noticeable obturator movement during speech that improved psychological and social disabilities. The results of the present study revealed that significant increase in muscle activity of masseter and temporalis muscle after converting the conventional obturator to implant retained obturator was noted. Higher muscle activity may be considered as regards preservation of a healthy functioning muscle and good masticatory efficiency. None of the previously published researches studied the muscle activity in maxillectomy patient.

### Table 2
Comparison between mobility difference of the abutment teeth on using conventional and implant retained obturators at different follow up periods.

<table>
<thead>
<tr>
<th>Time of assessment</th>
<th>Conventional obturator</th>
<th>Implant retained obturator</th>
<th>Paired T-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6 months</td>
<td>0.57 ± 0.49</td>
<td>0.27 ± 0.41</td>
<td>0.29</td>
<td></td>
</tr>
<tr>
<td>6–12 months</td>
<td>0.60 ± 0.45</td>
<td>0.55 ± 0.51</td>
<td>0.18</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3
Bone loss (pixels) on using conventional and implant retained obturators at different follow up periods.

<table>
<thead>
<tr>
<th>Time of assessment</th>
<th>Conventional obturator</th>
<th>Implant retained obturator</th>
<th>Paired T-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–6 months</td>
<td>72.8 ± 48.3</td>
<td>58.3 ± 55.6</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>6–12 months</td>
<td>115.4 ± 64.3</td>
<td>87.1 ± 66.2</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

*Statistically significant at P ≤ 0.05.

### Table 4
Mean values of EMG amplitude of masseter muscle activity (microvolt) on using conventional and implant retained obturators.

<table>
<thead>
<tr>
<th></th>
<th>Conventional obturator</th>
<th>Implant retained obturator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>62.0 ± 20.3</td>
<td>115.4 ± 26.0</td>
</tr>
<tr>
<td>Paired T-test</td>
<td>0.003*</td>
<td></td>
</tr>
<tr>
<td>P-value</td>
<td></td>
<td></td>
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</table>

*Statistically significant at P ≤ 0.05.

### Table 5
Mean values of EMG amplitude of temporalis muscle activity (microvolt) on using conventional and implant retained obturators.

<table>
<thead>
<tr>
<th></th>
<th>Conventional obturator</th>
<th>Implant retained obturator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>62.25 ± 15.09</td>
<td>144.1 ± 42.0</td>
</tr>
<tr>
<td>Paired T-test</td>
<td>0.002*</td>
<td></td>
</tr>
<tr>
<td>P-value</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Statistically significant at P ≤ 0.05.

### Table 6
Oral Health Related Quality of Life score of the patients without obturator, with conventional obturator and with implant retained obturator.

<table>
<thead>
<tr>
<th></th>
<th>Without obturator</th>
<th>Conventional obturator</th>
<th>Implant retained obturator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>2.55 ± 0.392</td>
<td>0.519 ± 0.168</td>
<td>0.173 ± 0.187</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without obturator and conventional obturator</td>
<td>&lt;0.01*</td>
<td>&lt;0.01*</td>
<td>&lt;0.01*</td>
</tr>
<tr>
<td>Without obturator and implant retained obturator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional obturator and implant retained obturator</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

*Statistically significant at P ≤ 0.05.
5. Conclusion

The implant retained obturator highly improved the masticatory function and OHRQOL in comparison to conventional obturator.

References