

Quality of life after prosthodontic rehabilitation in patients with bilateral total maxillectomy due to COVID-19-associated mucormycosis of the maxilla

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Background: Coronavirus disease 2019 (COVID-19)-associated mucormycosis of the maxilla emerged as a significant concern in India during the second wave of the pandemic, necessitating surgical interventions such as maxillectomy. This study investigated the quality of life following prosthodontic rehabilitation with interim obturators in patients who underwent bilateral total maxillectomy due to COVID-19-associated mucormycosis of the jaws.

Methods: The study was conducted using questionnaire-based interviews administered by a single investigator employing the Oral Health Impact Profile-14 (OHIP-14) and Obturator Functioning Scale (OFS) questionnaires. Responses were evaluated on a Likert scale. All statistical analyses were performed using SPSS version 21.0 for Windows. A significance level of 5% was applied to all tests. The Wilcoxon signed-rank and chi-square tests were utilized to compare categorical and quantitative variables across groups. Responses to the questionnaires were recorded on numerical Likert scales ranging from 1 to 5 for OFS and 0 to 4 for OHIP-14. The mean OHIP-14 and OFS scores were compared between the pre-rehabilitation and post-rehabilitation stages.

Results: A comparison between the pre-rehabilitation and post-rehabilitation scores from the OHIP-14 questionnaire revealed a significant difference ($p=0.001$). The OFS results indicated significant improvements across all domains following the use of obturators.

Conclusion: Interim obturators play a vital role in improving speech, swallowing, and mastication during the recovery period for patients who have undergone bilateral total maxillectomy. Despite the altered anatomy resulting from the resection, patients adapted effectively and exhibited improvements in their social, psychological, and mental health.

Abbreviations: COVID-19, coronavirus disease 2019; OFS, Obturator Functioning Scale; OHIP, Oral Health Impact Profile; QOL, quality of life

Keywords: Bilateral maxillectomy / COVID-19 / Maxillofacial prosthesis / Mucormycosis / Obturator

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INTRODUCTION

Coronavirus disease 2019 (COVID-19)-associated mucormycosis emerged as a significant concern in India during the second wave [1]. Factors such as hypoxia, hyperglycemia from uncontrolled diabetes, elevated ferritin levels, weakened immunity, prolonged hospital stays, and the presence of other comorbidities were the primary contributors to the development of this

condition [2]. The maxillary antrum was the most commonly affected area, leading to erosion, perforation, or necrosis of the tissue [3,4]. Surgical interventions like maxillectomy impact not only the aesthetic and functional aspects but also have profound psychological effects on the social and mental health of the patient. These changes substantially alter the individual's overall quality of life (QOL) [5].

In a few cases where the disease had spread extensively and affected both sides, a bilateral total maxillectomy was performed. Since this was a relatively uncommon issue, maxillofacial prosthodontists faced challenges in effectively rehabilitating these defects with prostheses such as obturators [6]. Issues such as insufficient retention, support, and stability of the obturators must be addressed during their fabrication for these patients [7].

To improve these patients' well-being, oral function, and QOL in the recovery phase, rehabilitation with obturators was necessary.

The assessment of clinically significant changes in a patient's health-related QOL following prosthodontic rehabilitation can be effectively conducted using specific and sensitive questionnaires [8,9].

The Oral Health Impact Profile (OHIP)-14 is a concise adaptation of the OHIP-49, designed to capture an individual's perception of how oral problems affect their health. This index measures the dysfunction, discomfort, disability, and handicap resulting from oral issues [10,11]. The Obturator Functioning Scale (OFS) is a self-reported questionnaire developed by Kornblith et al. [12] to assess the functionality of an obturator. It was created at the Memorial Sloan Kettering Cancer Center in New York, NY, USA.

This study aimed to assess the QOL following prosthodontic rehabilitation with interim obturators in patients who underwent bilateral total maxillectomy due to COVID-19-associated mucormycosis of the jaws. The assessment utilized the OHIP-14 and OFS questionnaires. The hypothesis posited that QOL would improve after the prosthodontic rehabilitation.

METHODS

Ethical approval for this study was obtained from the Institutional Human Ethics Committee, and strict ethical principles were adhered to throughout the research process. The study screened a total of 32 patients with COVID-19-associated mucormycosis of the maxilla who had undergone maxillectomy. Of these, six patients who had bilateral total maxillectomy, involving both hard and soft tissue defects, were included in the study. The defects were left open, not closed with soft tissue.

Participants were fitted with an interim maxillary obturator between the 12th and 15th postoperative days. Their QOL was evaluated after using the prosthesis for 3 to 6 months. To take preliminary impressions of the maxillary arch, a stainless-steel edentulous perforated stock tray and irreversible hydrocolloid (Plastalgin Chromatic, Septodont) were used. Stone casts were then produced from these impressions using a class III dental stone (Kaldent, Kalabhai Karson Pvt. Ltd.). A single layer of modeling wax was adapted onto the maxillary cast, covering the entire hard palate, and then processed into heat-polymerized acrylic resin (DPI, Dentsply). Wherever possible, hollow obturators were fabricated to reduce weight and enhance retention. The prosthesis was finished and polished in the usual manner. After the prosthesis was delivered, patients received instructions on maintaining oral hygiene. Initially, all six participants were fed using a Ryle's tube. However, with the insertion of the obturators, they were able to start oral feeds, and the Ryle's tubes were removed. Participants were instructed to wear the obturators continuously, removing and thoroughly cleaning them with water every 2 hours and after meals. The patients were carefully followed up for 3 to 6 months, with adjustments made to the obturators as needed.

All participants were recruited between December 2021 and March 2022. Prior to rehabilitation, informed consent was obtained from each participant. The study included adults of any sex who had undergone bilateral total maxillectomy due to COVID-19-associated mucormycosis. Exclusion criteria were unwillingness to consent, known cognitive impairments, and severe complications that limited rehabilitation potential, such as trismus.

A single investigator conducted questionnaire-based interviews with all participants to gather sociodemographic details such as age, sex, marital status, education level, and occupation. The OHIP-14 and OFS questionnaires were utilized to document the challenges participants experienced before and after rehabilitation with obturators.

The OHIP-14, developed by Locker and Slade, is a self-administered questionnaire designed to assess seven dimensions of impact: functional limitation (questions 1 and 2), physical pain (questions 3 and 4), psychological discomfort (questions 5 and 6), physical disability (questions 7 and 8), psychological disability (questions 9 and 10), social disability (questions 11 and 12), and handicap (questions 13 and 14). Responses are recorded using a 5-point Likert scale, which is coded as follows: never (score 0), hardly ever (score 1), occasionally (score 2), fairly often (score 3), and very often (score 4).

The OFS, developed by Kornblith et al. [12], evaluates patients' mastication ability, verbal communication, and aesthetics

following rehabilitation with an obturator. It utilizes a 5-point Likert scale for patients to rate their experiences, where higher scores indicate greater difficulty with obturator function. For analysis, responses were coded as follows: 1 (not at all difficult), 2 (a little difficult), 3 (somewhat difficult), 4 (very difficult), and 5 (extremely difficult).

The statistical software program SPSS Statistics (IBM Corp.), version 21.0 for Windows, was utilized for analysis. A significance level of 5% was applied to all tests. The Wilcoxon signed-rank and chi-square tests were employed to assess and compare groups for categorical and quantitative variables, respectively. The mean scores of OHIP-14 and OFS were compared between the pre-rehabilitation and post-rehabilitation stages.

RESULTS

A total of six participants (four men and two women) were included in this study, with ages ranging from 50 to 70 years. All participants were married and had education up to primary school. Among them, two female participants were housewives, three male participants were laborers, and one was retired (Table 1).

The OHIP-14 questionnaire (Table 2) was used to compare the scores before and after rehabilitation, revealing a significant difference ($p = 0.001$). Initially, over 90% of participants reported experiencing problems “fairly often” or “very often” across all domains. Following prosthetic rehabilitation with obturators, the frequency of responses indicating “fairly often” or “very often” decreased to 33.3% in the domains of functional limitation and physical pain, 25% in psychological disability, and 16.6% in psychological discomfort, physical disability, and social disability. There was an overall improvement of 69.5% across all domains of the OHIP-14.

The results from the OFS, as presented in Table 3, indicate

that only 16.6% of participants reported very much or extreme difficulty in chewing. None of the participants experienced very much or extreme problems with leakage while swallowing food, nor did they report any difficulty with their voices prior to surgery. A total of 33.2% of respondents reported very much or extreme difficulty when speaking in public. Over 75% felt they had no or little nasal speech. Additionally, 33.3% of participants reported very much or extreme difficulty in pronouncing words. Only 16.6% felt that their speech was very difficult to understand, and 50% reported significant difficulty when speaking on the telephone. Dry mouth was described as very much or extreme by 16.6% of respondents. None of the respondents were extremely dissatisfied with their appearance. Since the obturators fabricated lacked clasps, no issues were reported concerning the visibility of clasps on the anterior teeth. No re-

Table 1. Characteristics of participants

Variable	No. (%)
Sex	
Male	4 (66.6)
Female	2 (33.3)
Age of participants	
50–59 yr	4 (66.6)
60–70 yr	2 (33.3)
Marital status	
Unmarried	0
Married	6 (100)
Education	
Primary	6 (100)
High school	0
Graduate	0
Occupation	
Labor	3 (50.0)
Housewife	2 (33.4)
Retired	1 (16.6)

Table 2. Pre-rehabilitation and post-rehabilitation in scores on the OHIP-14 questionnaire (n=6)

Domains	Pre-rehabilitation		Post-rehabilitation		p-value	% difference
	%	Mean ± SD	%	Mean ± SD		
Functional limitation (Q1, Q2)	100	8.00 ± 0.00	33.3	2.83 ± 0.98	0.000	66.7
Physical pain (Q3, Q4)	100	7.16 ± 1.60	33.3	2.50 ± 0.83	0.005	66.7
Psychological discomfort (Q5, Q6)	100	7.83 ± 0.40	16.6	3.16 ± 1.83	0.001	83.4
Physical disability (Q7, Q8)	100	8.00 ± 0.00	16.6	3.50 ± 1.87	0.002	83.4
Psychological disability (Q9, Q10)	91.6	7.50 ± 1.22	25.0	3.16 ± 2.40	0.002	66.6
Social disability (Q11, Q12)	91.6	7.50 ± 1.22	16.6	3.16 ± 1.83	0.001	75.0
Handicap (Q13, Q14)	100	8.00 ± 0.00	25.0	3.50 ± 2.66	0.009	75.0
Total	97.2	54.00 ± 3.34	27.7	21.83 ± 11.58	0.001	69.5

OHIP, Oral Health Impact Profile; SD, standard deviation; Q, question number; %, percentage of participants who had answered “fairly often” or “very often” in OHIP-14 questionnaire; % difference, difference between pre-and post-rehabilitation scores.

Table 3. Response to Obturator Functioning Scale

Variable	Not at all	A little difficult	Somewhat difficult	Very difficult	Extremely difficult
Difficulty in chewing food	1 (16.6)	1 (16.6)	3 (50.0)	0	1 (16.6)
Leakage when swallowing food	3 (50.0)	1 (16.6)	2 (33.3)	0	0
Voice different from before surgery	0	3 (50.0)	3 (50.0)	0	0
Difficulty talking in public	1 (16.6)	1 (16.6)	2 (33.3)	1 (16.6)	1 (16.6)
Speech is nasal	1 (16.6)	4 (66.6)	1 (16.6)	0	0
Difficulty pronouncing words	1 (16.6)	2 (33.3)	1 (16.6)	0	2 (33.3)
Speech is difficult to understand	1 (16.6)	3 (50.0)	1 (16.6)	1 (16.6)	0
Difficulty talking on phone	1 (16.6)	2 (33.3)	0	3 (50.0)	0
Mouth feels dry	2 (33.3)	2 (33.3)	1 (16.6)	1 (16.6)	0
Dissatisfaction with looks	4 (66.6)	1 (16.6)	1 (16.6)	0	0
Clasp on front teeth noticeable	6 (100)	0	0	0	0
Area feels numb	3 (50.0)	3 (50.0)	0	0	0
Avoidance of family or social events	3 (50.0)	2 (33.3)	1 (16.6)	0	0
Difficulty to insert or remove obturator	3 (50.0)	2 (33.3)	1 (16.6)	0	0
Upper lip looks funny	3 (50.0)	1 (16.6)	1 (16.6)	1 (16.6)	0

Values are presented as number (%).

spondents reported very much or extreme numbness. Similarly, no respondents reported very much or extreme problems with avoiding family or social events, or difficulty with the insertion and removal of the obturator. Only 16.6% of the respondents felt that their upper lip “looked funny.”

DISCUSSION

This study evaluated the QOL following prosthodontic rehabilitation with interim obturators in patients who underwent bilateral total maxillectomy due to COVID-19-associated mucormycosis of the jaws. The assessment utilized the OHIP-14 and OFS questionnaires. The study results support the null hypothesis, indicating a statistically significant improvement in QOL after the fabrication of obturators.

Maxillectomy, typically unilateral in patients with mucormycosis, often required a bilateral total maxillectomy in cases of COVID-19-associated mucormycosis. This was due to the challenges in clinically predicting the progression of the fungal infection [13]. However, since bilateral total maxillectomy is a relatively rare surgical procedure, effectively fitting a prosthesis to provide obturation proved to be difficult [6].

Few case reports have been published on the rehabilitation of bilateral maxillectomy in patients with mucormycosis [13-17]. However, studies assessing the QOL impacts of prosthodontic rehabilitation with interim obturators in patients who underwent bilateral total maxillectomy due to COVID-19-associated mucormycosis are scarce.

This study is the first to evaluate the impact of prosthodontic

rehabilitation using interim obturators on patients who have undergone bilateral total maxillectomy due to COVID-19-associated mucormycosis. Given the rarity of the disease and the surgical procedure, only six participants were included in the study. These individuals had presented to our department with a need for prosthodontic rehabilitation to obturate bilateral maxillectomy defects, where no soft tissue closure had been performed.

Obturators were fabricated solely from heat-polymerized acrylic resin (DPI, Dentsply). While soft liners can cushion the hard acrylic prosthesis against the underlying mucosa and enhance prosthesis retention [18], their use is not recommended for patients with a history of mucormycosis [19]. This is due to the heightened risk of contamination by fungi and bacteria compared to polymethyl methacrylic resins [20].

The OHIP-14 is a streamlined version of the OHIP-49 questionnaire, containing fewer questions. This makes it simpler and more effective for recording data and measuring impact levels [21]. In this study, a comparison of scores before and after rehabilitation revealed a significant improvement ($p=0.001$), with an overall enhancement of 69.5% across all domains of the OHIP-14. The OFS [12] evaluates self-reported obturator function and its correlation with QOL in patients who have undergone maxillary resection. Our findings indicate that only 16.6% of participants reported significant issues with chewing, speech, appearance of the upper lip, and mouth dryness. Additionally, 50% of respondents experienced difficulties when talking on the phone, while 33.3% faced challenges with public speaking and word pronunciation.

A recent study by Kondaka et al. [17] explored the use of patient-specific implants for the prosthetic rehabilitation of non-standard defects. They observed enhanced retention and improved maintenance of the prosthesis. However, they noted that the increased weight of the definitive prosthesis and a higher likelihood of implant rejection could contribute to failure. They suggested that further research is necessary to reduce the weight of the framework. Gaur et al. [14] described a clinical report on a graft-less approach using implant-supported prosthetic rehabilitation for a patient with a bilateral subtotal maxillectomy defect resulting from rhino-orbital-cerebral mucormycosis. They found that this technique enhanced patient satisfaction, masticatory function, speech, and aesthetics. However, they emphasized that this method of prosthetic rehabilitation should only be undertaken after the complete healing of the surgical site.

As part of the interdisciplinary team managing patients with COVID-19-associated mucormycosis, prosthodontists play a crucial role. Their prostheses are vital for restoring lost oral and maxillofacial structures, significantly improving the patients' QOL [22]. Prosthetic rehabilitation offers an advantage over surgical reconstruction in these cases, as it allows for ongoing monitoring of the surgery site for potential reinfection and helps prevent further complications [23]. Additionally, surgical reconstruction may pose increased risks due to the comorbid conditions present in patients with COVID-19-associated mucormycosis.

Many challenges have been observed in the prosthetic rehabilitation of maxillectomy defects due to COVID-19-associated mucormycosis. Issues such as insufficient retention, support, and stability, reduced interarch distance, scar tissue formation, decreased amounts of keratinized tissue, fewer anatomical undercuts, and limited mouth opening must be addressed during the fabrication of obturators for these patients [7]. To address these issues, a lighter obturator (either a closed or open hollow bulb) should be fabricated. This design improves suspension cantilever mechanics, prevents overstressing the remaining support structures, and enhances retention from the soft tissue undercuts [24]. A prolonged period for mucosal healing was noted in these patients, as the defects were more extensive and the tissue margins more friable. Impression-making proved challenging due to the absence of reference points. In some cases, the preservation of the maxillary tuberosity on one or both sides aided in improving denture support. However, when the tuberosity was absent, reliance on soft tissue undercuts was necessary. Soft liners were avoided to prevent fungal growth. Making preoperative impressions was impossible for most patients, as they required urgent surgical intervention and imme-

diately transfer to the operating theatre. Additionally, bone density was not suitable for the early placement of implants, necessitating prolonged use of obturators. Long-term follow-ups are essential for patients with COVID-19-associated mucormycosis to monitor for recurrence of the primary mycosis and potential bacterial superinfection by oral and respiratory commensals [25].

The primary limitation of the current study was its small sample size. However, several additional factors should be considered: (1) COVID-19-associated mucormycosis of the maxilla is a relatively new condition with a low incidence rate; (2) the recent increase in cases of COVID-19-associated mucormycosis has resulted in 20 to 25 patients undergoing maxillectomy between 2021 and 2022, including six cases of bilateral total maxillectomy; or (3) depending on the outcomes of this study, a larger, multi-institutional study could be organized to provide a more substantial sample size and enhance the statistical power of the research.

This subjective analysis, utilizing OHIP-14 and OFS, demonstrated that interim obturators play a crucial role in enhancing speech, swallowing, and mastication during recovery. Despite the altered anatomy post-resection, patients adapted effectively, showing improvements in their social, psychological, and mental health. Given that the retention of the obturator relies solely on soft tissue undercut, it is essential to minimize the weight of the prosthesis. A significant benefit of this prosthesis is improved oral hygiene and the facilitation of early inspection for recurrence, attributable to its removable nature.

NOTES

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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Ethical approval

The study was approved by the Institutional Human Ethics Committee of All India Institute of Medical Sciences Bhopal (IHEC No. IHEC-LOP/2021/IM0423) and performed in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained.

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