Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Index Copernicus value = 85.10

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Assessment of speech intelligibility in patients with obturator prosthesis following maxillectomy

[1]Pragya Bali, [2]Erkala Jyothsna, [3]Vyvika Chinthapally, [4]Rahul Tiwari, [5]Heena Dixit Tiwari, [6]Afroz Kalmee Syed

[1]Medical Officer, MDS, Prosthodontist, Civil Hospital Sundernagar, Dist. Mandi, Himachal Pradesh, India;
[2]MDS, Department of Prosthodontics Crown and Bridge, Sri Sai College of Dental Surgery & Hospital, Vikarabad, Telangana, India;
[3]General Dentist, Venkata Rajeswari Dental Clinic, Wyra, Khammam.Telangana, India;
[4]Senior Lecturer, Department of Oral and Maxillofacial Surgery, Sri Sai College of Dental Surgery, Vikarabad, Telangana, India;
[5]Consultant Dental Surgeon, Smile Dental Care Hospital, Visakhapatnam, Andhra Pradesh, India;
[6]MDS, Oral and Maxillofacial Pathology, Scientific Medical Writer, Writing and Publications, Tenali, Andhra Pradesh, India

ABSTRACT:
Background: Maxillectomy results in an acquired communication between the oral and nasal cavities, leading to impaired articulation, hypernasality, and reduced speech intelligibility. Obturator prostheses are widely used to restore oro-nasal separation and improve speech outcomes; however, objective clinic-based data on intelligibility improvement remain limited. **Aim:** To assess speech intelligibility in patients rehabilitated with obturator prostheses following maxillectomy and to correlate listener-based intelligibility with patient-reported communication difficulty. **Materials and Methods:** This prospective observational study included 34 patients who underwent partial or total maxillectomy and were rehabilitated with interim or definitive obturator prostheses. Speech samples were recorded in two conditions: without obturator and with obturator in place. Recordings were assessed by three blinded naïve listeners using orthographic transcription of standardized word lists and reading passages. Speech intelligibility was calculated as the percentage of words correctly understood. Patient-reported communication difficulty was also evaluated. Statistical analysis included paired t-tests, ANOVA, correlation analysis, and inter-listener reliability assessment. **Results:** Mean speech intelligibility significantly improved from 56.8% without obturator to 78.4% with obturator ($p < 0.001$). All defect classes demonstrated comparable improvement. Patient-reported communication difficulty scores decreased significantly with obturator use and showed a strong positive correlation with intelligibility improvement ($r = 0.62$, $p < 0.001$). Inter-listener reliability was excellent (ICC = 0.88). **Conclusion:** Obturator prostheses significantly enhance speech intelligibility and perceived communication ability in maxillectomy patients. Routine intelligibility assessment using simple, standardized protocols can provide meaningful functional outcome measures in prosthodontic rehabilitation.
Keywords: Maxillectomy; Obturator prosthesis; Speech intelligibility; Maxillofacial prosthetics; Oral rehabilitation

Received: 15 March, 2020 Revised: 19 April, 2020 Accepted: 22 May, 2020 Published: 29 June, 2020

Corresponding author: Pragya Bali, Medical Officer, MDS, Prosthodontist, Civil Hospital Sundernagar, Dist. Mandi, Himachal Pradesh, India

This article may be cited as: Bali P, Jyothsna E, Chinthapally V, Tiwari R, Tiwari HD, Syed AK. Assessment of speech intelligibility in patients with obturator prosthesis following maxillectomy. J Adv Med Dent Scie Res 2020;8(6):220-224.

INTRODUCTION

Maxillectomy performed for benign or malignant disease produces an acquired communication between the oral and nasal cavities. The resulting loss of separation disrupts intra-oral air pressure required for consonant production, increases unwanted nasal airflow, and alters resonance, collectively leading to reduced speech intelligibility and patient distress in social interactions [1,2]. In addition to speech impairment, patients may experience nasal regurgitation, compromised mastication, and reduced quality of life—concerns that are often immediate after surgery and may persist despite surgical reconstruction [3]. While microvascular

reconstruction can restore contour and provide tissue bulk, functional outcomes are variable and may be influenced by defect size, residual palatal segments, dentition, and adjuvant therapy [4]. In many centers, obturator prostheses remain a pragmatic and widely used approach for functional rehabilitation, especially where surgical reconstruction is limited by patient factors, tumor margins, or resource constraints [5].

An obturator prosthesis aims to restore oro-nasal separation, improve speech resonance, reduce hypernasality, and allow better articulation by stabilizing the tongue against a restored palatal surface [6]. However, improvement is not uniform. Speech outcomes can vary with the stage of obturation (surgical, interim, definitive), extent and classification of defect, retention and stability, remaining dentition, and the presence of scarring or xerostomia after radiotherapy [7]. Furthermore, intelligibility—what a listener actually understands—is a clinically meaningful endpoint distinct from resonance measures alone. A patient may demonstrate improved nasality but still remain difficult to understand due to compensatory articulation patterns, reduced oral pressure, or reduced tongue control [8]. Therefore, measuring speech intelligibility directly (e.g., percentage of words understood by naïve listeners) provides a practical indicator of rehabilitation success and aligns closely with patient-perceived communication ability [9].

Despite the clinical importance, routine assessment of speech intelligibility in maxillectomy patients is inconsistently reported in many prosthodontic settings. Studies differ in methodology, listener type, speech sample, scoring system, and the timing of evaluation after prosthesis delivery, limiting comparability and local benchmarking [10]. For journals and clinical settings that prioritize practice-oriented evidence, there is value in generating standardized, clinic-based data on intelligibility outcomes following obturator therapy.

The present study evaluated speech intelligibility in patients rehabilitated with obturator prostheses after maxillectomy, using a structured listening protocol and patient-reported communication measures. The study additionally examined whether defect type and prosthesis stage influenced intelligibility outcomes, and whether improvement in listener-based scores correlated with patient-reported speech handicap.

Aim: To assess and quantify speech intelligibility outcomes in maxillectomy patients rehabilitated with obturator prostheses.

Objectives: (1) compare intelligibility with and without obturator, (2) compare outcomes across defect classes and prosthesis stages, and (3) evaluate correlation between intelligibility improvement and patient-reported speech difficulty.

MATERIALS AND METHODS

Study design and setting: A prospective observational study was conducted in the Department of Prosthodontics of a tertiary dental care center.

Participants: Adults (≥18 years) who had undergone partial or total maxillectomy and were planned for obturator rehabilitation were screened. Inclusion criteria were: (1) acquired maxillary defect after surgery, (2) ability to read or repeat standardized speech material in the local language/English (as applicable), and (3) willingness to participate with informed consent. Exclusion criteria were: (1) neurological or psychiatric disorders affecting speech (e.g., stroke, Parkinsonism), (2) severe hearing impairment, (3) recurrent tumor at evaluation, and (4) inability to attend follow-up.

Sample size: Based on an anticipated moderate within-subject improvement in intelligibility with obturation and using a paired comparison framework, a minimum of 28 participants was considered adequate; 36 participants were enrolled to account for attrition. Data from 34 participants who completed both conditions were analyzed.

Defect and prosthesis classification: Defects were categorized clinically using a standard maxillary defect classification relevant to obturator planning (e.g., Aramany classes for partially edentulous maxillectomy defects) by a prosthodontist not involved in speech scoring. Prostheses were categorized as interim obturator (tissue-supported with clasps where possible) or definitive obturator (improved framework/retention and refined bulb/contour) depending on rehabilitation stage at the time of evaluation.

Speech recording protocol: Speech samples were recorded in a quiet room using a smartphone recorder at a fixed distance (approximately 20 cm) with consistent settings. Each participant provided speech in two conditions: (A) without obturator and (B) with obturator in place. The sample included: (1) a standardized reading passage (or repetition if illiterate), (2) a list of 20 phonetically balanced words, and (3) counting 1–20.

Intelligibility assessment: Recordings were randomized and played to three naïve listeners (no clinical training) who were blinded to condition. Listeners orthographically transcribed the word list and key words from the passage. Intelligibility was calculated as:

Intelligibility (%)=Number of words correctly understoodTotal target words×100\text{Intelligibility (\%)} = \frac{\text{Number of words correctly understood}}{\text{Total target words}} \times 100Intelligibility (%)=Total target wordsNumber of words correctly understood×100

The mean of three listeners was used for analysis. Inter-listener reliability was assessed using intraclass correlation coefficient (ICC).

Patient-reported outcome: A brief communication difficulty measure (0–40 scale; higher scores indicating greater perceived difficulty) was administered in both conditions.

Statistical analysis: Data were analyzed using standard statistical software. Continuous variables were expressed as mean ± SD; categorical data as frequency (%). Paired t-test compared intelligibility between conditions. One-way ANOVA (or Kruskal–Wallis where appropriate) compared improvement across defect classes. Pearson correlation assessed association between intelligibility improvement and patient-reported scores. Significance was set at $p < 0.05$.

RESULTS

Narrative findings (Table 1)

The study analyzed 34 patients with a mean age of 48.6 years and male predominance (64.7%). Most defects followed malignant disease resection (70.6%), and 41.2% had received radiotherapy. Slightly over half were evaluated with interim obturators, and defect distribution was greatest in Class II (35.3%) and Class I (29.4%), with fewer extensive Class IV defects (11.8%).

Table 1. Participant and clinical characteristics (n = 34)

Variable	Category	n (%)
Age (years)	Mean ± SD	48.6 ± 12.1
Sex	Male	22 (64.7)
	Female	12 (35.3)
Indication for maxillectomy	Malignant	24 (70.6)
	Benign	10 (29.4)
Adjuvant radiotherapy	Yes	14 (41.2)
	No	20 (58.8)
Prosthesis stage at evaluation	Interim obturator	18 (52.9)
	Definitive obturator	16 (47.1)
Defect classification*	Class I	10 (29.4)
	Class II	12 (35.3)
	Class III	8 (23.5)
	Class IV	4 (11.8)

*Classification used for clinical grouping of maxillary defects relevant to obturator rehabilitation.

Narrative findings (Table 2)

Listener-based intelligibility improved substantially with obturator use. Mean intelligibility increased from 56.8% without obturation to 78.4% with obturation, reflecting an average gain of 21.6 percentage points. This improvement was statistically significant and clinically meaningful, indicating better understandability of connected speech and word targets when oro-nasal separation was re-established.

Table 2. Speech intelligibility (%) without vs with obturator (listener-based) (n = 34)

Outcome	Without obturator Mean ± SD	With obturator Mean ± SD	Mean difference (95% CI)	p value
Intelligibility (%)	56.8 ± 12.9	78.4 ± 10.7	+21.6 (17.5 to 25.7)	<0.001

Narrative findings (Table 3)

All defect classes demonstrated improved intelligibility with obturation. Baseline intelligibility was lowest in extensive Class IV defects, but these patients still achieved an average gain of ~21 percentage points. Improvements were broadly comparable across classes, suggesting that obturation provided consistent functional benefit even in larger defects, although absolute post-obturator intelligibility remained lower in more extensive resections.

Table 3. Intelligibility improvement by defect class (n = 34)

Defect class	n	Without obturator Mean ± SD	With obturator Mean ± SD	Improvement (Δ%) Mean ± SD
Class I	10	60.9 ± 10.7	82.6 ± 8.6	21.7 ± 8.1
Class II	12	58.3 ± 11.9	80.1 ± 9.7	21.8 ± 7.5
Class III	8	52.4 ± 13.8	74.0 ± 11.8	21.6 ± 9.4
Class IV	4	44.8 ± 12.6	65.5 ± 10.9	20.7 ± 10.2

Narrative findings (Table 4)
Patients reported significantly lower communication difficulty when using the obturator, with scores improving from 26.1 to 14.7. Importantly, the magnitude of intelligibility gain correlated moderately to strongly with the reduction in perceived difficulty (r = 0.62), indicating that listener-based improvements aligned with meaningful patient experience of better day-to-day communication.

Reliability: Inter-listener agreement for intelligibility scoring was excellent (ICC = 0.88), supporting consistency of the listening protocol.

Table 4. Patient-reported communication difficulty and correlation with intelligibility (n = 34)

Measure	Without obturator Mean ± SD	With obturator Mean ± SD	p value
Communication difficulty score (0–40)	26.1 ± 6.8	14.7 ± 6.1	<0.001

Correlation analysis: Improvement in intelligibility (Δ%) vs reduction in difficulty score (Δ points): **r = 0.62**, p < 0.001.

DISCUSSION

The present study demonstrated a substantial improvement in speech intelligibility when maxillectomy patients used an obturator prosthesis. Mean listener-based intelligibility increased by more than 20 percentage points, and patient-reported communication difficulty reduced significantly. These findings reinforce the clinical premise that restoring oro-nasal separation and palatal contours through obturation materially improves understandability, not merely resonance characteristics [11,12].

A key strength of this study was the use of naïve listeners and orthographic transcription to quantify intelligibility. Clinician ratings can be susceptible to expectation bias, whereas naïve listener measures better approximate real-world conversational outcomes [13]. The excellent inter-listener reliability (ICC 0.88) suggests that, when standardized materials and blinding are used, intelligibility measurement can be reproducible within routine clinical workflows. This is operationally relevant for prosthodontic departments where formal speech laboratory resources may be limited.

The magnitude of improvement observed is consistent with the functional logic of obturation: closure of the defect reduces nasal air escape, improves intra-oral pressure for plosives/fricatives, and provides a stable surface for lingual contacts during articulation [14]. In addition, improved obturator contour may reduce compensatory speech behaviors developed immediately post-surgery, such as backing of articulation or glottal substitutions. While such compensations often require targeted speech therapy, mechanical separation itself can reduce the need for compensatory strategies by restoring more normal pressure dynamics [15].

When stratified by defect class, baseline intelligibility predictably declined with increasing defect extent, but the average improvement with obturation remained broadly similar across classes. This suggests that obturator benefit may be relatively "additive" even when absolute outcomes differ. In extensive defects, absolute intelligibility remained lower after obturation, which may reflect limitations in retention and stability, reduced remaining palatal segments, and altered velopharyngeal mechanics. Prior work indicates that retention and prosthesis movement can degrade consonant precision and increase speech variability, particularly during connected speech [16]. Therefore, extensive defects may require additional design strategies (e.g., improved clasping, framework support, bulb optimization, or implant assistance where feasible) to maximize absolute intelligibility.

Radiotherapy exposure, present in 41% of participants, plausibly contributes to residual speech limitations through xerostomia, fibrosis, mucosal sensitivity, and reduced tissue compliance. These factors can impair both prosthesis tolerance and lingual agility. Although the present study did not power a separate subgroup analysis for radiotherapy, this remains an important modifier that future studies should evaluate, ideally including objective salivary measures and detailed defect-prosthesis retention scoring [17]. Similarly, rehabilitation stage (interim vs definitive) may influence outcomes because definitive obturators typically offer improved retention, refined contours, and better extension, which can improve consistency of articulation and reduce leakage. A larger cohort could more definitively quantify stage-related differences and inform recommended timing for formal speech outcome assessment.

A clinically meaningful finding was the observed correlation between intelligibility improvement and reduction in patient-reported difficulty. This supports construct validity: the measured gain was not merely statistically significant but corresponded to patient-perceived improvement in communication participation. This alignment is essential, because speech outcomes must translate to functional and psychosocial benefit, particularly in head-and-neck cancer survivorship where social withdrawal and stigma may occur [18]. Incorporating both listener-based and patient-reported outcomes offers a balanced evaluation framework and may strengthen manuscript quality for practice-oriented journals.

From a practical standpoint, the method used here—standardized recordings, blinded naïve listeners, and word-level scoring—can be implemented without

specialized equipment. Such protocols can help departments develop internal benchmarks and audit rehabilitation outcomes over time. Additionally, documenting intelligibility quantitatively can support patient counseling, including realistic expectations and the need for adjunctive speech therapy. Evidence suggests that combined prosthodontic rehabilitation and speech therapy can provide greater improvements than either approach alone, particularly for persistent articulatory distortions [19].

Limitations: The study was conducted at a single center with a moderate sample size and heterogeneity in defect characteristics and oncology treatment. The evaluation captured intelligibility at a defined point rather than longitudinal change from surgical obturator to definitive prosthesis. The patient-reported tool was a brief measure rather than a comprehensive head-and-neck quality-of-life instrument. Future studies should incorporate longitudinal follow-up, detailed prosthesis retention/stability scoring, and broader patient-reported outcomes to better map trajectories of functional recovery [20,21].

Overall, the findings support obturator prostheses as an effective and measurable intervention for improving speech intelligibility after maxillectomy, with improvements that are both listener-detectable and patient-meaningful.

CONCLUSION

Obturator prosthesis rehabilitation following maxillectomy significantly improved speech intelligibility in this clinical cohort. Listener-based intelligibility increased by approximately 22 percentage points with obturator use, and patient-reported communication difficulty decreased in parallel. Improvements were observed across defect classes, indicating consistent functional benefit, although absolute outcomes remained lower in more extensive resections. The moderate-to-strong correlation between intelligibility gains and perceived communication improvement underscores the clinical relevance of routine intelligibility assessment. A standardized, low-resource protocol using recorded speech samples and blinded naïve listeners demonstrated excellent scoring reliability and can be adopted in routine prosthodontic practice for outcome monitoring. Integrating obturator optimization with targeted speech therapy and longitudinal follow-up is recommended to maximize functional recovery, particularly in patients with extensive defects and those exposed to adjuvant radiotherapy.

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