



Trismus in Oral Cancer Patients: Incidence, Determinants and Preventive Strategies in a Tertiary Care Centre

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Abstract

Background Trismus is a debilitating complication in oral cancer patients undergoing multimodal treatment, affecting quality of life and functional recovery. This study evaluates the incidence, determinants, and preventive strategies for trismus in a tertiary cancer care setting.

Methods A prospective observational study was conducted on 99 surgically treated oral squamous cell carcinoma patients. Maximum mouth opening (MMO) was assessed preoperatively and at defined intervals post-treatment. Trismus was defined as $MMO \leq 35$ mm and graded into three severity levels. Patient demographics, tumour subsite, staging, surgical details, reconstruction type, adjuvant therapy, and physiotherapy compliance were analysed.

Results Trismus prevalence increased from 35% preoperatively to 55% following surgery and 56% after radiotherapy, with a slight decline to 52% at six months. Submucous fibrosis was a significant preoperative predictor (OR: 7.61; $p=0.039$). Composite resection consistently elevated trismus risk compared to wide local excision (OR range: 3.52–3.82; $p<0.005$). Reconstruction type was the strongest postoperative factor, with locoregional flaps associated with higher odds than microvascular flaps (OR: 2.70). Poor physiotherapy compliance markedly increased trismus at 1 and 3 months (OR: 4.86 and 11.39; $p<0.01$). Radiotherapy showed no significant association.

Conclusion Trismus is prevalent and multifactorial in oral cancer patients. Surgical extent, reconstruction technique, and physiotherapy adherence significantly affect outcomes. Early identification and structured rehabilitation are essential for improving functional recovery and quality of life.

Keywords Oral cancer · Trismus · Oral submucous fibrosis · Reconstructive surgery · Physical therapy modalities · Rehabilitation · Functional outcome

Introduction

Oral cancer is the sixth most common cancer across the globe and the second highest in India [1, 2]. A majority of patients are diagnosed at an advanced stage requiring multimodality treatment in the form of surgery and adjuvant therapy. Curative-intent treatment is primarily aimed at providing locoregional control with acceptable functional outcomes. Oral function plays a critical role in the quality of life of oral cancer survivors and indirectly affects survival outcomes [3].

Trismus is a common, underrecognized complication in patients undergoing treatment for oral cancers, with a reported prevalence ranging from 40% to 80% [4–7]. Trismus is defined as a maximum mouth opening (MMO) of less than 35 mm. Trismus in oral cancer arises from surgical trauma and radiotherapy-induced fibrosis affecting

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the masticatory muscles and surrounding tissues, leading to restricted mouth opening due to scarring and collagen deposition. In oral submucous fibrosis (OSMF), areca nut alkaloids trigger fibroblast proliferation and inhibit collagen degradation, causing progressive mucosal fibrosis and trismus [7, 8].

It negatively affects daily activities such as chewing, swallowing, and speech, leading to poor oral hygiene and malnourishment. Trismus may also limit adequate clinical assessment, thereby increasing the risk of missing early signs of local recurrence and second primary malignancies.

Several studies assessing quality of life have shown detrimental effects in patients with trismus [8, 9]. Hence, functional outcomes should be given equal emphasis as oncological outcomes in treatment planning. The aim of this study is to assess the incidence and factors associated with trismus in oral cancer patients receiving surgery with or without adjuvant radiotherapy, and to evaluate the role of physiotherapy in preventing or reducing the severity of trismus [10–13].

Materials and methods

This prospective clinical observational study was conducted at the Department of Head and Neck Surgical Oncology, Malabar Cancer Centre, Thalassery, Kerala. Institutional Ethics Committee and Review Board approval was obtained

prior to study initiation. Informed written consent was acquired from all participants.

A total of 112 patients diagnosed with primary oral cavity squamous cell carcinoma and undergoing surgical treatment, with or without adjuvant radiotherapy, were sequentially enrolled. Inclusion criteria included adult patients treated surgically with curative intent and those who were available for regular follow-up. Exclusion criteria included patients with recurrent disease, second primary tumours and those with non-oncological causes of trismus such as Trauma, Ankylosis and other temporomandibular joint disorders.

Patient data included: Patient Demographics, Tumour site and AJCC staging, Surgical intervention details, Reconstruction method, Radiotherapy details and compliance to physiotherapy (Table 1, 3).

All patients underwent an institutional anti-trismus rehabilitation protocol involving patient education and jaw-opening exercises (Table 2). Physiotherapy compliance was monitored weekly during the first month and then monthly for six months by the physiotherapy team during follow-up visits. Compliance with physiotherapy was assessed based on a combination of patient self-reports and attendance at scheduled follow-up visits. Patients who consistently performed prescribed exercises as reported during follow-up assessments and attended more than 75% of the planned physiotherapy sessions were categorized as compliant, while others were considered non-compliant.

Table 1 Preoperative trismus data

Pre-operative trismus by subsite				
Subsite	Present	Absent	<i>P</i> -value	
Buccal mucosa	12	16	0.026	
Tongue	12	29		
RMT	3	0		
Maxillary alveolus	0	1		
Mandibular alveolus	7	6		
Floor of mouth	0	5		
Hard palate	0	5		
Lip	1	2		
Pre-operative trismus and its association with submucous fibrosis				
Submucous fibrosis	Patients with trismus (<i>n</i> =35)	Patients without trismus (<i>n</i> =64)	Total	<i>P</i> -value
Present	17	0	17	0.001
Absent	18	64	82	
Total	35	64	99	
Pre-operative trismus by tumour staging				
Tumour staging	Present	Absent	<i>P</i> -value	
T1	1	11	0.251	
T2	13	18		
T3	7	16		
T4a	8	13		
T4b	7	5		

Table 2 7-step institutional anti-trismus protocol for oral cancer patients

1. Pre-Treatment Preparation
Initiate early intervention. Begin jaw mobility exercises and patient education prior to cancer treatment to support long-term oral function
2. Regular Mouth Opening Assessment
Measure interincisal distance (in mm):—Normal:> 35 mm
- Mild (Grade 1): 26–35 mm
- Moderate (Grade 2): 16–25 mm
- Severe (Grade 3): <15 mm
Assess before, during, and after treatment
3. Early Exercise Implementation
Start within the first week of treatment. Perform exercises 3–5 times daily:
- Jaw Opening/Closing—10 reps
- Lateral (Side-to-Side) Movements—10 reps—Protrusion (Forward Movement)—10 reps
4. Progressive Stretching with Tongue Depressors
Use stacked tongue depressors (ice cream sticks):
- Gradually increase number
- Hold for 30 s, repeat 5 times per session, 5 sessions daily
5. Reinforce Functional Movements
Continue or increase frequency of:—Open/Close—10 reps
- Side-to-Side—10 reps
- Forward Protrusion—10 reps
6. Pain Management and Monitoring
Utilize analgesics to support adherence
Monitor weekly: measure progress, adapt as needed with input from the care team
7. Establish Long-Term Adherence
Encourage patients to treat exercises as a daily routine for up to 6 months postop
Monitor progress weekly initially, then monthly as appropriate

Maximum mouth opening (MMO) was measured at diagnosis (MMO-0), 1 month post-surgery (MMO-1), after completion of radiotherapy (MMO-2), and at 6 months post-op (MMO-3) using a digital Vernier calliper by a single observer.

Trismus was defined as $MMO \leq 35$ mm and graded as: Grade I: 26–35 mm, Grade II: 16–25 mm, Grade III: ≤ 15 mm.

Statistical Analysis

Data were analysed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY). The association between trismus and various clinical or treatment parameters was evaluated using the Mann–Whitney U test (for two groups) and the Kruskal–Wallis test (for more than two groups). Fisher's exact test was applied for categorical comparisons of trismus incidence across tumour subsite groups.

Univariate logistic regression was initially performed to identify potential predictors of trismus. Variables with p -values < 0.10 in univariate analysis were subsequently entered into a multivariate logistic regression model to

identify independent predictors. Statistical significance was set at $p < 0.05$. Adjustments for multiple comparisons were not applied considering the exploratory nature of this analysis [23]. This approach allows identification of potential clinical trends and hypothesis-generating associations without overcorrection that may obscure meaningful signals in smaller datasets, as recommended in exploratory clinical research (26).

Results

Patient Demographics and Clinical Characteristics

Of the 112 patients initially enrolled, 13 were excluded from the final analysis due to incomplete follow-up, local recurrence, metastatic disease, or death related to other causes. The remaining 99 patients comprised 69 males (69.7%) and 30 females (30.3%), with a mean age of 58 ± 12 years, reflecting a predominantly middle-aged to elderly population. A significant association of disease with tobacco use was observed in 88% of patients, predominantly in chewable forms (79%).

The most common subsite of disease within the oral cavity was the tongue (41%), followed by buccal mucosa (28%), lower alveolus (13%), floor of mouth (5%), upper alveolus (5%), hard palate (5%), retromolar trigone (3%), and lip (3%). Advanced-stage disease (T4a and T4b) was present in 33% of patients, with 21 cases classified as T4a and 12 as T4b. The remaining cases were staged as T2 (31%), T3 (23%), and T1 (12%). Oral submucous fibrosis (OSMF) was identified in 17 patients (Table 1).

Preoperative trismus in oral cancer patients showed significant associations with both anatomical subsite and submucous fibrosis. It was most prevalent in tumours involving the buccal mucosa, retromolar trigone and tongue, with a statistically significant correlation to subsite ($p = 0.026$). Submucous fibrosis emerged as a strong independent predictor, with all affected patients exhibiting trismus ($p = 0.001$). While higher tumour stages showed a trend toward increased trismus, this did not reach statistical significance ($p = 0.251$). These findings emphasize the need for early trismus evaluation, especially in patients with high-risk subsites and submucous fibrosis.

Surgical Treatment and Reconstruction

Composite resection was performed in 57% of patients, involving bony resections of the mandible and/or maxilla. Specifically, 50% underwent mandibular resections and 28% underwent maxillary resections, either independently or in combination. Reconstruction methods included local

Table 3 Association of trismus with clinical risk factors

Sl.no	Variables	Post op 1 month (post-surgery)		P value	Post op 3 months (post- RT)		P value	Post op 6 months		P value	
		Trismus	Absent		Trismus	Absent		Trismus	Absent		
1.	Surgery type	Wide local excision	Present	Absent	0.004	Present	Absent	0.002	Present	Absent	0.0003
			16	26		16	26		13	29	
2.	Surgical site	Composite resection	39	18	0.479	40	17	0.485	39	18	0.813
		Maxilla	16	12		16	12		15	13	
3.	Type of reconstruction	Mandible	23	27	0.0127	24	26	0.0071	24	26	0.0056
		(a) Primary closure(*)	6	16		6	16		5	17	
4.	Adjuvant therapy	(b) Locoregional flap	37	25	NA	38	24	0.400	37	25	0.2959
		(c) Microvascular free tissue transfer	12	3		12	3		10	5	
		(a) No adjuvant	NA(**)	NA		18	18		16	20	
5.	Anti trismus physiotherapy compliance	(b) Radiotherapy	NA	NA	NA	38	25	0.4194	36	27	0.0005
		Radiotherapy involving ITF	NA	NA		11	10		15	6	
		Complaint	37	40		0.0068	36		41	0.0002	
	Non-complaint	18	4		20	2		19	3		

*Early tongue lesions

**NA-Not Applicable (adjuvant therapy not assessed at 1 month)

Table 4 Evolution of trismus grades at different clinical timepoints

Time point	No trismus (MMO > 35 mm) n (%)	Grade 1 n (%)	Grade 2 n (%)	Grade 3 n (%)	P-value
Pre-op (baseline)	64 (64.6%)	19 (19.2%)	9 (9.1%)	7 (7.1%)	0.0685
1 month post-op	44 (44.4%)	27 (27.3%)	19 (19.2%)	9 (9.1%)	
3 months post-op	43 (43.4%)	31 (31.3%)	17 (17.2%)	8 (8.1%)	
6 months post-op	47 (47.5%)	39 (39.4%)	7 (7.1%)	6 (6.1%)	

*No Trismus defined as maximum mouth opening (MMO) > 35 mm. Percentages calculated out of total study population (n = 99)

flaps (33%), pedicled locoregional flaps (29%), primary closure (22%), and microvascular free tissue transfer (15%) (Table 3).

Adjuvant Therapy

Adjuvant therapy, in the form of radiation alone or chemotherapy, was administered to 63 patients. Among these, 21 received radiation targeting the masticatory muscles, primarily in cases involving the retromolar trigone, posterior buccal mucosa, and alveolus (Table 3).

Trismus Incidence, Prevalence and Severity

Trismus was observed in 35% of patients at diagnosis (35/99), increasing to 55% post-surgery (55/99), 56% post-radiotherapy (56/99), and slightly decreasing to 52% at the 6-month follow-up (52/99). The postoperative increase in trismus incidence was statistically significant ($p < 0.05$).

Trismus severity was categorized into three grades: Grade I (26–35 mm), Grade II (16–25 mm), and Grade III (≤ 15 mm). While a clinical trend toward improvement was

noted over time, the association between trismus grade and postoperative time points did not reach statistical significance ($\chi^2 = 8.72$, $p = 0.0685$). Notably, Grade I trismus cases increased from 27 at 1 month to 39 at 6 months, indicating a downward migration from more severe grades (Table 4).

Preoperative Predictors of Trismus

Multivariate logistic regression identified submucous fibrosis as a significant independent predictor of preoperative trismus. Patients with submucous fibrosis had significantly higher odds of presenting with trismus compared to those without (OR: 7.61; 95% CI: 1.10–52.61; $p = 0.039$).

Postoperative Predictors of Trismus

Surgical Procedure

The incidence of trismus was significantly higher in patients who underwent **composite resection** compared to **wide local excision (WLE)** at all follow-up intervals: 1 month ($p = 0.005$), 3 months ($p = 0.002$), and 6 months ($p = 0.0004$).

Multivariate analysis confirmed composite resection as an independent predictor of trismus:

- OR: 3.52 (95% CI: 1.52–8.13; $p=0.003$) at 1 and 6 months.
- OR: 3.82 (95% CI: 1.65–8.88; $p=0.0018$) at 3 months.

Surgical Site

No significant association was observed between surgical site (maxillary vs. mandibular) and trismus at any timepoint:

- 1 month ($p=0.478$), 3 months ($p=0.590$), 6 months ($p=0.813$).

Reconstruction Method

Trismus incidence was significantly lower in patients who underwent **primary closure** (for early tongue lesions) or **microvascular free tissue transfer**, compared to those who received **locoregional flap reconstruction**:

- 1 month ($p=0.005$), 3 months ($p=0.0037$), 6 months ($p=0.0033$).

In multivariate analysis, locoregional flaps were associated with higher odds of trismus compared to microvascular reconstruction:

- OR: 2.70 (95% CI: 0.69–10.56), not statistically significant.

Adjuvant Therapy

Radiotherapy, including cases involving the **infratemporal fossa (ITF)**, was not significantly associated with trismus at:

- 3 months ($p=0.432$), 6 months ($p=0.313$).

Multivariate analysis indicated that patients who received radiotherapy had higher—but statistically non-significant—odds of developing trismus compared to those with no adjuvant therapy:

- OR: 1.52 (95% CI: 0.67–3.47; $p=0.32$) at 3 months.
- OR: 1.67 (95% CI: 0.73–3.80; $p=0.23$) at 6 months.

Physiotherapy Compliance

Adherence to the anti-trismus physiotherapy protocol was significantly associated with lower trismus incidence:

- 1 month ($p=0.010$), 3 months ($p=0.005$), 6 months ($p=0.0007$).

Multivariate regression confirmed non-compliance as a strong predictor of trismus:

- OR: 4.86 (95% CI: 1.51–15.71; $p=0.008$) at 1 month.
- OR: 11.39 (95% CI: 2.49–52.12; $p=0.0017$) at 3 months.
- Although the trend persisted at 6 months, it did not reach statistical significance.

These findings highlight the multifactorial nature of trismus in oral cancer patients, with surgical extent, type of reconstruction, and physiotherapy compliance emerging as key determinants of long-term functional outcomes.

Discussion

Trismus remains an underrecognized yet significant complication in patients undergoing multimodal therapy for head and neck cancers, particularly oral cavity malignancies [1, 2]. It has a profound impact on patients' functional outcomes, including eating, speech, swallowing, oral hygiene, and overall quality of life [3–5]. Despite its clinical importance, literature on trismus remains sparse, particularly in the context of clearly delineated risk factors, anatomical subsites, and preventive strategies [6, 7].

In our prospective observational study, we evaluated 99 patients treated for oral cavity malignancies, assessing the incidence and contributory factors associated with trismus over a six-month postoperative period. The patient demographic reflected known epidemiological trends, with a predominance of males in the fifth to sixth decade of life and a strong association with tobacco use in chewable forms [8, 9]. The most commonly affected subsites were the tongue and buccal mucosa, consistent with regional variations in oral cancer prevalence [10, 11].

The incidence of trismus increased significantly following surgery, from 35% at baseline to 55% at one month and 56% post-radiotherapy. This is in line with previous findings, such as those reported by Padmanidhi Agarwal et al. [12], who demonstrated a sharp postoperative rise in trismus which gradually declined over time. Our study also documented a reduction in moderate and severe trismus grades over six months, although the association was not statistically significant, suggesting a clinical trend toward functional recovery in compliant patients.

Comparison with prior studies highlights both similarities and distinctions. Gouri Pantvaidya et al. [13], in their large prospective series, reported a 72% trismus prevalence and identified oral submucous fibrosis, adjuvant therapy,

and bialveolar resections as key risk factors. Our findings corroborate these, with composite resections showing a significantly higher incidence of trismus across all time points ($p < 0.05$). However, unlike Pantvaitya et al., we found that the type of reconstruction significantly influenced trismus development, with lower rates noted in patients who underwent microvascular free tissue transfer. Microvascular free flaps introduce well-vascularized, pliable tissue from remote donor sites, facilitating tension-free closure and reducing the risk of ischemia-driven fibrosis and contracture. In contrast, locoregional flaps often involve tethering of adjacent soft tissues, which can restrict mandibular mobility and predispose to scar-related trismus [14, 15].

The anatomical site of surgery (maxillary vs. mandibular) did not significantly impact trismus incidence, supporting the idea that the extent and complexity of resection are more critical than the location per se [16]. Furthermore, our data indicated that adjuvant radiotherapy, including infratemporal fossa (ITF) targeting, did not show a statistically significant correlation with trismus at three or six months. This contrasts with certain earlier studies [17–19], but may reflect evolving radiotherapy techniques that minimize exposure to masticatory muscles [4]. However, detailed dosimetric data on radiotherapy field planning and muscle dose distribution were not collected, which limits the ability to precisely correlate radiotherapy parameters with trismus outcomes.

A particularly important finding was the role of compliance with physiotherapy. Patients who adhered to the institutional anti-trismus protocol demonstrated significantly reduced incidence of trismus at all time points ($p < 0.05$) [5, 11, 20]. This aligns with previous literature and reinforces the necessity for structured rehabilitation protocols as a standard part of postoperative management. There is a clear need for expanded use of jaw-stretching devices and the development of additional, evidence-based rehabilitation strategies to optimize patient outcomes. The use of jaw stretching devices such as the TheraBite® or Dynasplint® systems has demonstrated efficacy in improving mandibular mobility by promoting passive stretching and reducing muscle contracture [2, 8]. A randomized trial by Pauli et al. reported significant improvements in mouth opening among head and neck cancer patients using jaw mobilizing devices compared to standard physiotherapy alone [22]. In resource-constrained tertiary centers, high costs and limited availability of commercial jaw-stretching devices may hinder their routine use. Simple, low-cost alternatives such as tongue depressors or wooden spatulas can serve as effective substitutes for passive mouth-opening exercises. Furthermore, patient adherence to home-based protocols is crucial; integrating education and supervised follow-up improves compliance and clinical outcomes. Initiating physiotherapy

before the onset of fibrosis and maintaining regular follow-up during radiotherapy are essential components of an effective trismus prevention strategy [21].

Limitations of this study include its single-centre design and potential variability in radiotherapy planning and delivery. Although MMO was assessed by a trained evaluator, some measurement bias cannot be ruled out. Additionally, self-reported physiotherapy compliance may be subject to recall bias. Nevertheless, the study's prospective design, structured follow-up, and comprehensive analysis offer valuable insights into the multifactorial nature of trismus. Additionally, as a single-center study, the generalizability of findings may be limited. Future multi-center studies incorporating varied patient populations and treatment protocols are warranted to validate these findings.

Conclusion

Trismus prevalence and severity increased from baseline after surgery and radiotherapy, with only partial recovery on follow-up despite a gradual reduction in grades. Submucous fibrosis was a key baseline predictor, while surgical extent, reconstruction type, and physiotherapy compliance influenced postoperative outcomes. Early identification and sustained, structured rehabilitation are crucial to restore function and minimize long-term morbidity.

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