Original Article

Trismus in oral cancer patients undergoing surgery and radiotherapy

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ABSTRACT

Objective: The aim of this study was to determine the incidence of trismus before and after surgery and subsequent radiotherapy for patients of oral cancer and to determine the risk factors for the same.**Methods:** 30 patients diagnosed with oral cancer were included. Maximum mouth opening was measured for each patient as the inter incisal distance and was measured on 4 occasions – preoperatively at the time of diagnosis, post-operatively at discharge from the hospital, post-radiotherapy and at 6 months follow-up. The site of cancer, staging and grading of the malignancy, the surgical treatment performed, method of reconstruction, details of radiotherapy and compliance to physiotherapy were recorded, to evaluate the risk factors for developing trismus.**Results:** Trismus was observed in 53.3% patients at the time of diagnosis which increased significantly post-surgery (86.7%) and post-radiotherapy (85.7%) and gradually decreased (65.4%) at 6 months. The use of flaps for reconstruction, delay in radiotherapy post-surgery and non-compliance of patients to physiotherapy were the risk factors for developing trismus, showing statistical significance ($p < 0.05$).**Conclusion:** Trismus is a significant complication of oral malignancies or its surgical and radiotherapy treatment, or both. Consideration must be given to its early diagnosis, to help in timely intervention and planning of preventive strategies.

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1. Introduction

Oral cancer is becoming a global health concern. It accounts for over 30% of all cancers in India with a rate of 20 per 100,000 population.¹ Treatment is aimed at maximizing survival and loco regional control while trying to preserve normal oral function and quality of life.² Despite progress in oral oncology a number of patients have diminished or lost oral functions and suffer from complications due to surgery, radiation and/or chemotherapy.³ These side effects are under recognized, under treated and under reported. It is increasingly realized that aggressive management of early and late oral complications after oral cancer treatment is needed to ensure optimal long-term oral and general health.⁴

Trismus is a symptom related to the treatment of head and neck cancer, which previously has not been paid much attention.⁵ Trismus in oral cancer is defined as a tonic contraction of the muscles of mastication resulting from any abnormal condition or

disease with mouth opening of ≤ 35 mm.⁶ It may be a result of tumour growth, infection, surgery or radiation. Its incidence varies greatly and results in difficulty in activities such as biting, chewing, swallowing and speaking and may further lead to poor oral hygiene, pain, weight loss and even depression.⁷ It causes a detrimental impact on quality of life and function and should be a focus in the post-operative management of patients with oral cancer.⁸ This study was aimed to note the incidence of trismus in patients of oral cancer before and after surgery and radiotherapy and to determine the risk factors for the same.

2. Methods

This prospective clinical observational study was approved by the institutional ethical committee and review board. Sequential enrolment of 30 patients was done after taking written informed consent. Patients reporting to the Department of Oral and Maxillofacial Surgery, Bapuji Dental College and Hospital, Davangere, Karnataka, diagnosed with oral cancer, willing for surgery and subsequent radiotherapy and follow-up, were included. They were free from other causes of trismus like trauma, TMJ disorders, infection or congenital anomalies.

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Patients treated previously for head and neck cancer, those who would be treated with only radiotherapy and/or chemotherapy, edentulous patients, those suffering from Oral Submucous Fibrosis and those with significant medical co-morbidities not fit for undergoing surgery were excluded.

Site of malignancy, its staging and grading, surgical treatment performed, neck dissection, method of reconstruction used, the histopathological diagnosis, details of radiotherapy and other relevant information were recorded. Patients were advised physiotherapy following surgery in the form of passive exercises, use of tongue blades, Fergusson mouth gag and Hiesters jaw opening devices and their compliance was noted.

Measurement of maximum mouth opening (MMO) was carried out for each patient on 4 occasions – pre-operatively at the time of diagnosis (MMO-0), post-operatively at the time of discharge from the hospital (MMO-1), post-radiotherapy (MMO-2) and finally at 6 months post-operative follow-up (MMO-3). The inter-incisal distance was measured as the maximum mouth opening with the patient sitting in an upright posture. MMO was measured using an LCD Aerospace Digital Vernier Caliper Micrometer Gauge, in mm, by a single observer (PA) to allow for consistent readings and less chance of clinician-related error.⁹ Mouth opening of ≤ 35 mm was labelled as trismus.

Statistical analysis was done using IBM SPSS Statistic Software version 16. Mann–Whitney *U* test was used to check the difference in dichotomous data where 2 groups were considered. Kruskal–Wallis ANOVA was used to check the difference in multiple groups. Cochran's *Q* test was performed to test the differences between two or more matched sets which showed statistical significance ($p < 0.05$). McNemar test was performed to assess whether the difference between two matched sets of proportions was significant.

3. Results

Out of 30 patients, 18 were male (60%) and 12 were female (40%). 9 (30%) were of the age group of 25–50 years, 20 (66.7%) between 51 and 75 years and 1 (3.3%) was above 75 years (mean age = 56.8).

7 (23.3%) patients had malignancy involving the mandibular alveolus and gingivobuccal sulcus (GBS), 14 (46.7%) on the buccal mucosa, 4 (13.3%) on tongue, 2 (6.7%) involving the retro molar trigone (RMT) and 3 (10%) involving the maxillary alveolus and GBS. All patients were diagnosed with squamous cell carcinoma out of which 17 (56.7%) were well differentiated, 7 (23.3%) were moderately differentiated, 2 (6.7%) were poorly differentiated and 4 (13.3%) were of the infiltrative type. 26 (86.7%) patients had T₁–T₂ lesions and 4 (13.3%) had T₃–T₄ lesions. No nodal involvement (N₀) was seen in 2 (6.7%) while 28 (93.3%) patients had nodal involvement (N₊). 27 (90%) patients had Grade III tumour, 2 (6.7%) patients had Grade II while 1 (3.3%) patient had Grade I tumour.

Wide resection of tumour was performed for all cases with hemi-mandibulectomy in 40% patients, marginal mandibulectomy in 23.3%, maxillectomy in 10%, segmental mandibulectomy in 3.3% patients and no bony resection was performed in 23.3% patients. 43.3% had supraomohyoid neck dissection performed, 33.3% underwent radical neck dissection (RND), and 6.7% underwent modified RND whereas 16.7% patients did not have their necks

addressed. 40% patients underwent reconstruction using regional flaps, 20% using local flaps, 13.3% using split thickness skin grafts, 3.3% using abdominal dermal fat graft whereas 23.3% patients had primary closure performed.

27 (90.0%) patients underwent radiotherapy while 3 (10.0%) patients did not, due to severe debilitation or death. 15 (55.6%) patients underwent RT within 6 weeks of surgery (early) while 12 (44.4%) underwent RT after 6 weeks of surgery (late) due to initial reluctance, delayed wound healing and other personal reasons. 14 (51.8%) patients had their muscles of mastication in the field of radiation whereas 13 (48.2%) did not.

2 patients expired following surgery. Physiotherapy was undertaken by 28 patients, out of which 20 (71.4%) showed compliance and 8 (28.6%) did not. 2 patients expired 3 months post-surgery. Incidence of trismus was 53.3% (16/30) at the time of diagnosis, 86.7% (26/30) post-surgery, 85.7% (24/28) post-radiotherapy and 65.4% (17/26) at 6 months follow-up. Occurrence of trismus was significantly high post-operatively ($p < 0.05$) (Table 1).

Among the factors considered for the development of trismus, the use of flaps for reconstruction, undergoing radiotherapy late post-surgery and the non-compliance of patients to physiotherapy showed statistical significance ($p < 0.05$) whereas other factors did not show significance (Table 2).

4. Discussion

The ability to predict which patients will develop trismus could have a strong bearing on their dental management prior to or at the time of their oncology treatment. They may benefit from radical dental management with extraction of posterior teeth to reduce the cost of their oral maintenance.¹⁰ No relationship between trismus and gender was observed although females have been reported to have more trismus because of a smaller maximal mouth opening than men.⁷ No association was found between the patient age and reduction in mouth opening.

No significance was found between the site of cancer and trismus. In contrast, trismus has been shown to result from invasion of the tumour into the muscles of mastication or the TMJ, be a consequence of muscular fibrosis or due to formation of scar tissue post-operatively. Immobilization of the TMJ after surgery for long also has been shown to compound the problem.⁵ Our patients with lesions of the buccal mucosa, maxilla and RMT region developed trismus more. Cancers in such regions are known to trigger reflexes in the maxillofacial area, activate the efferent part of the tonic reflex arch of the muscles of mastication resulting in an increased tonus, developing trismus.¹¹ Lesions involving the lower alveolus, GBS and tongue led to lesser trismus, as in literature, and better results observed with involved floor of mouth or anterior 2/3 tongue.

No statistically significant relationship between the histopathological diagnosis and trismus was found. Neck node status did not seem significant to the development of trismus, but it has been observed that the presence of lymph node metastasis can predict the pre-radiotherapy mouth opening ($p = 0.006$).¹² Although the size of tumour and the development of trismus did not show a significant relationship, most patients with T_{3–4} lesions had

Table 1
Incidence of trismus.

Time of evaluation	Total patients	Trismus present	Trismus absent	
Pre-treatment	30	16	14	Cochran's <i>Q</i> = 18.09
Immediate post-surgery	30	26	4	
Immediate post-radiotherapy	28	24	4	
6 months post-operative	26	17	9	

Table 2

Trismus and risk factors.

Parameter assessed	Variable	Pre-operative			Post-op			Post-RT			6 months post-op		
		Trismus		<i>p</i>	Trismus		<i>p</i>	Trismus		<i>p</i>	Trismus		<i>p</i>
		Present	Absent		Present	Absent		Present	Absent		Present	Absent	
Sex	Male	9	9	0.55*	15	3	0.51*	14	3	0.53*	11	5	0.65*
	Female	7	5		11	1		10	1		6	4	
Age	25–50	5	4	0.32#	9	0	0.32	9	0	0.28	7	1	0.19#
	51–75	10	10		16	4		14	4		9	8	
	>76	1	0		1	0		1	0		1	0	
Site	GBS	2	5	0.32#	5	2	0.55#	3	2	0.36#	2	3	0.27#
	Buccal mucosa	8	6		13	1		13	1		10	3	
	Tongue	1	3		3	1		3	3		3	2	
	RMT	2	0		2	0		2	0		1	1	
	Maxillary alveolus	3	0		3	0		3	0		3	0	
HP type of SCC	Well differentiated	9	8	0.86#	14	3	0.76#	13	3	0.78#	9	6	0.84#
	Moderately differentiated	4	3		6	1		6	1		5	2	
	Poorly differentiated	2	0		2	0		2	0		1	0	
	Infiltrative	1	3		4	0		3	0		2	1	
Tumour staging	T ₁ –T ₂	12	13	0.27*	21	4	0.34*	20	4	0.38*	14	9	0.18*
	T ₃ –T ₄	4	1		5	0		4	0		3	0	
	Nodes 0	14	14	0.15*	24	4	0.57*	22	4	0.55*	15	9	0.29*
	Nodes +	2	0		2	0		2	0		2	0	
Tumour grading	I	1	0	0.54#	1	0	0.78#	1	0	0.76#	1	0	0.70#
	II	1	1		2	0		2	0		1	1	
	III	14	13		23	4		21	4		15	8	
Surgery details (with wide tumour excision)	Maxillectomy	3	0	0.28#	3	0	0.99#	3	0	0.98#	3	0	0.66#
	Hemi-mandible	8	4		10	2		8	2		7	3	
	Segmental mand	0	1		1	0		1	0		1	0	
	Marginal mand	2	5		6	1		6	1		3	3	
	No resection	3	4		6	1		6	1		4	2	
Neck dissection	SOHND	7	6	0.93#	12	1	0.75#	11	1	0.74#	6	4	0.58#
	RND	4	6		8	2		7	2		5	4	
	Modified RND	2	0		2	0		2	0		2	0	
	No dissection	3	2		4	1		4	1		4	1	
Method used to reconstruct	Dermal fat	0	1	0.02#	1	0	0.54#	1	0	0.53#	–	–	0.08#
	Regional flap	7	5		10	2		8	2		7	3	
	Local flap	4	2		6	0		6	0		4	1	
	Skin graft	4	0		4	0		4	0		4	0	
	Primary closure	1	6		5	2		5	2		2	5	
RT	Not undergone	1	2	0.91*	3	0	0.48*	1	0	0.68*	0	0	–
	Undergone	15	12		23	4		23	4		17	9	
Time of RT	Early	6	9	0.21*	11	4	0.05*	11	4	0.05*	8	7	0.13*
	Late	8	4		12	0		12	0		9	2	
Masticator muscles	Not involved	8	6	0.81#	12	2	1.00*	12	2	1.00*	8	5	0.68*
	Yes involved	7	7		12	2		12	2		9	4	
Physio-therapy	Not compliant	6	2	0.60*	8	0	0.18*	8	0	0.18*	8	0	0.01*
	Compliant	9	11		16	4		16	4		9	9	

*: Mann Whitney U test was used to check the difference in dichotomous data; #: Kruskal Wallis ANOVA was used to check the difference in multiple groups.

trismus as compared to T_{1–2} lesions. Larger tumours are associated with a higher risk of developing trismus.¹⁰

The type of bone resection did not show statistical significance but all patients who underwent maxillectomy developed trismus post-surgery, correlating that maxillectomy does contribute greatly to trismus.¹³ Treatment coupled with coronoidectomy with release of temporalis tendon, when carried out, did not show significant improvement.¹⁴ The type of neck dissection performed along with the primary surgery seems to have no bearing on the eventual mouth opening.

Patients having laser excisions, primary closure, or split skin grafting have been proved to be able to open their mouths better than patients having soft-tissue flaps or composite flaps.¹⁰ Similar significant adverse results were observed with the use of local or regional flaps for reconstruction. Lesser reduction in mouth opening was seen with the use of skin or dermal grafts or when only primary closure was performed. A significant difference was observed in our study with regards to the incidence of trismus pre-operatively and immediate post-operatively when substantial functional deficit was observed at presentation, which persisted

and even increased following treatment causing functional morbidity, which needs to be anticipated.

Radiotherapy is recognized as one of the risk factors for development of trismus. The primary factor in limiting jaw motion in the irradiated patient is the rapid formation of collagen secondary to radiation damage. The limitation of mouth opening may occur in the course of radiotherapy due to stiffening of the epidermal and dermal layers. The incidence of radiation-induced trismus depends on total dose of radiation, fractionation, overall treatment time, and treatment techniques.¹⁵ Patients treated by a combination of surgery and radiotherapy report poorer quality of life and had worse clinical function.¹⁶

All patients underwent radiotherapy and received a radiation dose in the range of 40–50 Gy fractionated in 20–30 doses. Patients who received a higher radiation dose showed higher incidence of trismus.⁸ The probability of developing trismus is reported to increase 24% for every 10 Gy of additional radiation over 40 Gy delivered to the pterygoid muscles.¹⁷ Although a few authors state that restriction of mouth opening may occur even at low doses of irradiation,¹⁸ a steep dose effect relationship between radiation

dose to the masticatory apparatus and trismus has been noted.^{19,20} The high incidence of trismus in our study can be attributed to the use of external beam radiotherapy because trismus with conventional radiotherapy is reported to be 25.4%. It is only 5% for those given intensity modulated radiotherapy as patients treated with brachytherapy received a lower dose in masticatory muscles.^{5,21} No statistically significant difference was found between those who did or did not have an inclusion of their muscles of mastication in the radiation field which could be attributed to our small sample size. It has been vastly reported that the irradiation of the masseter and pterygoid muscles appears critical in the development of trismus.^{5,22} Irradiation of the pterygoids alone has been found to induce trismus due to the late tissue reaction called radiation induced fibro atrophic activity.²³ The T allele at 509 of the TGF β 1 gene has shown significant variation in mouth opening and has been suggested as a genetic link in the development of post-radiation trismus. Patients lacking the variant allele can be given an increased dose of radiation while it has to be avoided in those with the T variant or made to undergo early intervention for trismus management.¹²

No significant reduction in mouth opening post-RT as compared to post-surgery was seen. There is also evidence that trismus evolves most rapidly during the first 9 months after treatment and then stops progressing in most patients.⁵ A statistical significance was observed in the time of undergoing RT. 73% (11/15) of patients who underwent RT early and 100% (12/12) patients who underwent RT late ended up with trismus. This highlights the importance of undergoing radiotherapy early after surgery. This needs further detailed evaluation.

The high incidence of trismus in our study post-radiation (85.7%) which reduced at 6 months post-operative (65.4%) can partially be explained by the fact that some patients improved and few patients died during follow-up. The presence of trismus post-radiotherapy could not clearly indicate the contribution of RT in reduction in mouth opening of the patients since a large proportion of patients already had trismus preoperatively.⁷

Trismus, when present at the time of discharge after surgery and after radiation therapy, is a potential problem worthy of intervention at an early stage so physical therapy can be started. Treatment that incorporates motion of the joint also has been shown to be more efficacious than other treatments that simply stretch connective tissue.¹⁶ Time appropriate for intervention and compliance to treatment are important issues for consideration. The final mouth opening is related to self-management and forbearance of individuals during the mouth opening exercises.¹³

Our study proves that mouth opening values show statistically significant changes with good patient compliance to physiotherapy ($p = 0.02$), and the gains that can be made when patients are motivated. Various methods of treatment of trismus that have been reported include use of supportive measures like regular use of muscle relaxants or hot fomentation, hyperbaric oxygen or oral medication such as pentoxifylline,¹⁷ isometric and range of motion exercises, use of mechanical aids like rubber plugs, wooden tongue blades, spatulas, the TheraBite device,^{14,24} and dynamic splinting. Passive exercises had better role in the management and prevention of trismus than active exercises as seen in literature.²⁰

The strength of this study was its prospective study design. Data collected before the treatment began ensured that differences observed were attributed to the treatment given and not the tumour or other confounding factors. The failure of trismus to improve post-operatively, even slowly, ought to create a strong suspicion of residual tumour.²⁵ A persistence of trismus is another way in which recurrent tumour may present so all cancer patients should always be followed up.

The use of flaps, time of undergoing radiotherapy and physiotherapy compliance were delineated as risk factors for

the development of trismus. The role of the histopathological nature of the SCC, type of hard tissue resections and neck dissection methods used were assessed but no statistical significance was found. Future research into modifications of the delivery of radiotherapy, together with appropriate post-radiation trismus management, including the use of jaw opening devices like TheraBite, may significantly reduce the morbidity due to oral oncological management.

5. Conclusion

Trismus in oral cancer has a profound effect on the quality of life of the patients, reducing the effects of rehabilitation and well-being. It is a significant complication of oral malignancies or its surgical and radiotherapy treatment, or both. Consideration must be given to its early diagnosis, to help in timely intervention and planning of preventive strategies.

Probably a longitudinal study with a larger sample size is required to delineate risk factors better. Trismus in oral cancer is generally influenced by the involvement of specific anatomic structures which could then be categorized as site specific influences. These could statistically influence restricted mouth opening, for which a larger volume of subjects need to be evaluated.

Ethical approval

This study was approved by the institutional ethical committee and review board. Sequential enrolment of patients was done after taking their written informed consent.

Conflicts of interest

The authors have none to declare.

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