IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 21, Issue 9 Ser.8 (September. 2022), PP 64-74
www.iosrjournals.org

A subjective evaluation of radiation induced xerostomia in patients who had undergone radiotherapy using linear accelerator and IMRT with parotid sparing in head and neck cancer - a prospective study.

Dr Midhun Sai E[1], Dr Johnson A G[2],Dr Soumithran C S[3], Dr K S Ravi Nair[4], Dr Sandeep Madhu[5]

[1](Craniomaxillofacial Trauma Fellow, Rajagiri Hospital, Kerala, India)
[2](Consultant, Oral & Maxillofacial Surgery, Kozhikode, Kerala, India)
[3](Principal, Professor, Dept of Oral and Maxillofacial Surgery Government Dental College, Kozhikode, India)[4](Professor & Head, Dept of Oral & Maxillofacial Surgery, Government Dental College,Kozhikode, India)
[5](Senior Lecturer,Dept of Oral & Maxillofacial Surgery, Manipal College of Dental Sciences, Mangalore, India)

Abstract:
Background*: .Head and neck cancer in India is a major public health problem. The management usually include surgery, radiotherapy and chemotherapy. Selection of treatment mainly depends on tumour site, size, and histologic features, as well as depth of invasion, stage, previous treatment, need for reconstructive surgery, impact on quality of life (QOL) and patient preferences. Irradiation causes both quantitative and qualitative change in salivary gland function and saliva. At present, advanced techniques like intensity modulated radiotherapy (IMRT) focus on sparing the major salivary glands from the line of radiation and thus reducing the incidence of xerostomia.*
Materials and Methods*: The details of patients who had undergone radiotherapy for head and neck cancer using intensity modulated radiotherapy technique (IMRT) with parotid sparing was takenusing a questionnaire and was evaluated at 3, 6, 9, and 12 months after radiotherapy.*
Results*:The findings here suggest that there is a reduced incidence of subjective complaints related to xerostomia using Intensity Modulated Radiotherapy Technique (IMRT) with parotid sparing.*
Conclusion:*.Even though there are incidence of xerostomia even with intensity modulated radiotherapy technique with parotid sparing, the complaints of the subjects related to xerostomia are also seen to improve over the period of time especially between 6 months and 1 year.*
Key Word*: Intensity Modulated Radiotherapy (IMRT), Xerostomia, Parotid glands, Linear Accelerators*

Date of Submission: 15-09-2022 Date of Acceptance: 30-09-2022

I. Introduction

Head and neck cancers are the ninth most common malignancy in the world, with unacceptably high mortality rates in the developing countries. Head and neck cancer, which is usually squamous cell carcinoma, may affect the oral cavity, pharynx, paranasal sinuses, larynx, and salivary glands. Nearly two thirds of oral cancers are located in the buccogingival sulcus. The classical risk factors for head and neck cancers were smoking and excessive alcohol use.[1,2]

The main objective of the treatment is cure with preservation of organ function and the therapeutic options include surgery, radiotherapy, and chemotherapy. Surgery, radiotherapy, or both are used for most patients, because control of the primary disease and regional nodal metastases is essential. Selection of treatment mainly depends on tumour site, size, and histologic features, as well as depth of invasion, stage, previous treatment, need for reconstructive surgery, impact on quality of life (QOL) and patient preferences.[3]

Limited or early-stage disease (stage I and II) is the presenting stage in approximately 40% of patients and is usually treated with surgery or radiation alone. For most patients with locally advanced disease (stage III and IV a/b), resectable or unresectable, treatment entails platinum-based chemoradiation, with or without induction chemotherapy as a sequential therapy. The dose of radiation for head and neck cancer varies from 60Gy to 70Gy, depending on timing of treatment and whether treatment is adjuvant or definitive treatment. The risk of long-term toxicity from radiation therapy increases with delivery of doses exceeding 55Gy to the salivary

glands, pharyngeal constrictor muscles, and thyroid gland, leading to xerostomia, dysphagia, percutaneous endoscopic gastrostomy tube dependence, chronic aspiration, and hypothyroidism.

Xerostomia is a very common and distressing side effect of radiotherapy for head and neck cancer, occurring to some degree in up to 100% of patients undergoing such treatment.

Human salivary glands in the path of tumour-suppressing ionizing radiation undergo progressive glandular atrophy, fibrosis, and reduction in output beginning shortly after the initial exposure.[4]Damage to the salivary glands results in decreased salivary flow, the subjective perception of oral dryness , changes in the electrolyte and immunoglobulin composition of saliva, reduction of salivary pH, and repopulation of the mouth by cariogenic microflora.[4] The magnitude of salivary flow reduction is primarily in conjunction with the radiation dosage and the amount of salivary gland tissue included in the irradiation fields.

Xerostomia results in difficulty in chewing and swallowing dry food, impaired phonation, a continuous parched feeling and burning sensation of the oral cavity, and dysgeusia. Patients describe a feeling of thickened saliva and often always carry water bottles with them. The chewing of dry foods may be very painful for them, and physical examination may reveal a dry oral cavity mucosa, angular cheilitis, fissuring of the tongue and lips, accelerated dental caries, oropharyngeal candidiasis, or halitosis. The patient may experience loss of taste, mucosal sensitivity to acidic or spicy foods, or loss of appetite and weight loss.

At present advanced techniques like three-dimensional conformal radiation therapy (3DCRT) and intensity modulated radiotherapy (IMRT) focus on sparing the major salivary glands from the line of radiation and thus reducing the incidence of xerostomia.

The main aim of this study is to subjectively analyze the occurrence of xerostomia in patients with head and neck cancer who had undergone radiotherapy with linear accelerators and IMRT technique with parotid sparing. The objectives are to assess effect of radiation induced xerostomia and its effect on quality of life.

II. Material And Methods

An observational prospective study with subjective analysis of occurrence of xerostomia and it's effect on quality of life in patients with head and neck cancer who had undergone radiotherapy with linear accelerators and IMRT technique with parotid sparing was conducted after obtaining approval from the institutional ethical committee. Details of the patients who had undergone radiotherapy for head and neck cancer using linear accelerators and IMRT technique with parotid sparing was taken from the Radiotherapy department, Government Medical College, Calicut. Study period ranged from 1st Jan 2018 to 31st Mar 2019. Sample size was calculated using the formula n =4pq/ d2 with P = 755, q = 25, d = 8.66. Substituting therefore we get a sample size (n) of 100.

Inclusion criteria

•Patients who had undergone radiotherapy for carcinoma of nasopharynx, oropharynx, anterior two thirds of tongue and buccal mucosa by using linear accelerators and IMRT technique with parotid sparing.

Exclusion criteria

- Carcinomas of regions of head and neck other than specified in the first inclusion criteria
- Terminally ill patients undergoing palliative treatment
- Surgery involving parotid glands
- Patients reporting with a complaint of dry mouth prior to radiotherapy
- Medications causing dry mouth

All the subjects were treated with CLINAC IX linear accelerator (Varian Medical Systems, California, USA). Then the patients were evaluated at 3, 6, 9 and 12 months after radiotherapy. The patients were evaluated with a questionnaire to assess xerostomia subjectively. Questionnaire was initially developed by developed by Oda B Wijers MD et al[5], which has 3 sections. The first section is of administrative data; second section relates to housing, occupation and general health. The third section addresses the specific xerostomia related issues particularly its effects on speech, swallowing, eating and dentition. Patients were asked to select the answers of section three which were graded from 1 to 4. In addition to the questionnaire, linear visual analogue scale (VAS) was used to indicate the overall severity of their xerostomia problem. Here a 10-point scale reflecting the severity of the dry mouth syndrome is used; zero equals no complaints; 10 reflect severe complaints of a totally dry mouth. The VAS score is arbitrarily translated into a 4 grades of xerostomia scale:

- Grade 1 (G1) = VAS score of 2.4 or less
- Grade 2 (G2) = VAS score between 2.5 and 4.9
- Grade 3 (G3) = VAS score between 5.0 and 7.4
- Grade 4 (G4) = VAS score of 7.5 and above

Statistical analysis

Data was analyzed using SPSS version 20 (SPSS Inc., Chicago, IL)andassessesd using the nonparametric counterpart of ANOVA, Friedman's test. The level $P < 0.05$ was considered as the cutoff value or significance.

III. Result

A total of 100 patients were selected from the department of radiotherapy for the study. The patients were evaluated at 3,6,9 and 12 months after radio therapy with a xerostomia questionnaire and subjective problems of dry mouth was assessed. There was a total loss of follow up of 10 subjects in the entire study.

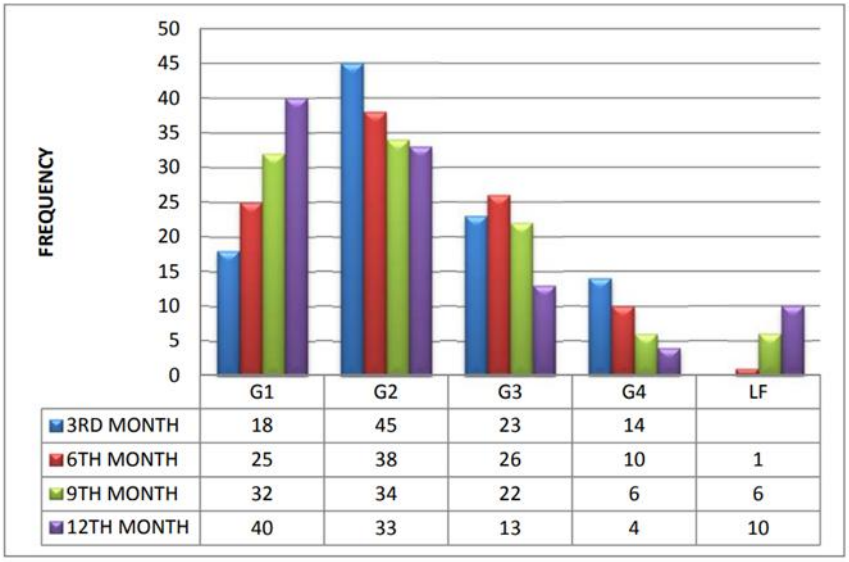
Severity of Dry Mouth

During the 3rd month 18%, 45%, 23% and 14% of patients had grade 1 (G1), grade 2 (G2), grade 3 (G3) and grade 4 (G4) level of dry mouth respectively. In the sixth month the total G1, G2, G3 and G4 scores were 25%, 38%, 26% and 10% respectively. By the 9th month the total G1 score was raised to 32% of the total patients and 34%, 22% and 6% were the total G2, G3 and G4 scores respectively. At one year of follow up the total G1, G2, G3 and G4 scores were 40%, 33%, 13% and 4% respectively. (Table 1)

Severity of Dry Mouth				
	3rd month	6th month	9th month	12th month
G1	18	25	32	40
G2	45	38	34	33
G3	23	26	22	13
G4	14	10	6	4
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – Normal, same as before
- G2 – Somewhat more complaints than before
- G3 – Considerably more complaints than before
- G4 – Permanent complaints of a very dry mouth
- LF – Lost follow up

Table 1: Severity of Dry Mouth



Graph 1 : Severity of Dry Mouth

Dry mouth in various circumstances

Regarding the number of patients who experienced dry mouth problem in the open air it was found that Of the total 100 patients only 11% of the patients experienced problems in open air and 79% of the patient did not have significant dry mouth problem in open air in the third month. 10 % of the patients answered as not applicable, as these patients usually stayed in closed surroundings. In the sixth month the number of people having dry mouth in open air reduced to 10. It further reduced to 8 and 6 during the 9th month and 12th month follow up respectively.

The number of patients who had a dry mouth problem in open air in case of wind and cold was 58 during the 3rd month follow up. This reduced to 53, 44 and 39 patients during 6th, 9th and 12th month of follow up respectively.

The number of patients who had a dry mouth problem in air-conditioned spaces was 14, 12, 9, and 7 during 3rd, 6th, 9th and 12th months of follow up respectively. This was not applicable to 48 patients. The number of patients who experienced dry mouth occurring especially during day time was 21, 18, 12, and 12 at 3rd, 6th, 9th and 12th months of follow up respectively.The number of patients who experienced dry mouth occurring especially during night time were 38, 37, 33, and 27 at 3rd, 6th, 9th and 12th months of follow up respectively.
The number of patients who experienced dry mouth both day and night were 40, 37, 28, and 23 at 3rd, 6th, 9th and 12th months of follow up respectively.
The number of patients who experienced dry mouth especially during meals were 39, 36, 30, and 27 at 3rd, 6th, 9th and 12th month of follow up respectively.(Table 2)

Dry Mouth and Circumstances					
Circumstance	Response	3rd month	6th month	9th month	12th month
In Open Air	Yes	11	10	8	6
	No	79	79	76	74
	NA	10	10	10	10
	LF	0	1	6	10
	TOTAL	100	100	100	100
In open air in case wind and cold	Yes	58	53	44	39
	No	32	36	40	41
	NA	10	10	10	10
	LF	0	1	6	10
	TOTAL	100	100	100	100
In air-conditioned spaces	Yes	14	12	7	5
	No	38	39	42	41
	NA	48	48	45	44
	LF	0	1	6	10
	TOTAL	100	100	100	100
Especially at Day Time	Yes	21	18	12	12
	No	79	81	82	78
	LF	0	1	6	10
	TOTAL	100	100	100	100
Especially at Night Time	Yes	38	37	33	27
	No	62	62	61	63
	LF	0	1	6	10
	TOTAL	100	100	100	100
Always during Day and Night	Yes	40	37	33	27
	No	60	62	61	67
	LF	0	1	6	10
	TOTAL	100	100	100	100
Especially during meals	Yes	39	36	28	23
	No	61	63	66	67
	LF	0	1	6	10
	TOTAL	100	100	100	100

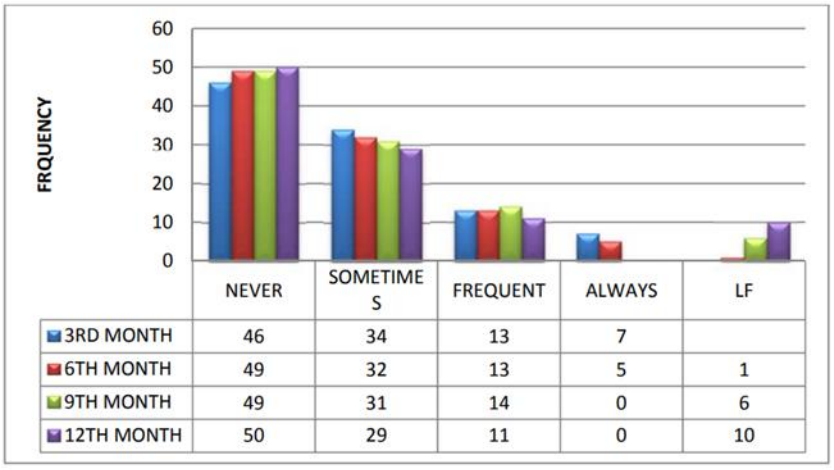
Table 2: Dry Mouth and Circumstances

Dry mouth and Insomnia

In three months, of the total 100 patients, 46% patients never had to wake up at night due to dry mouth, (G1) while 34 %patients sometimes woke up due to dry mouth (G2), 13% patients frequently woke up at night due to dry mouth (G3) and 7% patients always woke up due to similar complaint (G4). In six months, and nine months G1,G2,G3,and G4 scores were 49% , 32%, 13% and 5% respectively . The G1, G2, G3, G4 scores in twelve months was 50%, 29%, 11% and 0% respectively. (Table 3)

Dry mouth and Insomnia				
	3rd month	6th month	9th month	12th month
Never	46	49	49	50
Sometimes	34	32	31	29
Frequent	13	13	14	11
Always	7	5	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

Table 3: Dry mouth and insomnia



Graph 2: Dry mouth and insomnia

Quality of Saliva

Of the total 100 patients, 66% had normal, watery saliva (G1), 26% had normal watery saliva but too little in volume (G2), and 8% patients had sticky saliva (G3) in three months. In six months and in nine months G1 ,G2,G3 values were 71% ,21%, 6% patients and 70%,19% and 5% respectively.By twelve months the G1, G2, G3 scores were 73%, 15% and 2% respectively. (Table 4)

Quality of Saliva				
	3rd month	6th month	9th month	12th month
G1	66	71	70	73
G2	26	22	19	15
G3	8	6	5	2
G4	0	0	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – Normal, watery
- G2 – Normal watery but too little volume
- G3 – Sticky saliva
- G4 – No saliva at all
- LF – Lost follow up

Table 4: Quality of Saliva

Dry mouth and speech

In three months, of the total 100 patients, 42% did not have difficulty in speech due to dry mouth (G1), 35% patients occasionally had difficulty in speech due to dry mouth (G2), 17

%of the patients frequently had similar complaints (G3), 4% of them always had difficulty in speech due to dry mouth (G4) and 2% patients always had major speech problems (G5). In six months G1,G2,G3,G4,G5 values were 47% , 33%, 13%, 6% and 0% respectively . In nine months, 47% patients had score G1, 31% had score G2, 12% had score G3, 4% had score G4 and none had score G5. By twelve months, the G1, G2, G3, G4, G5 scores were 50%, 29%, 10%, 1% and 0% respectively. (Table 5)

Difficulty in speech due to dry mouth				
	3rd month	6th month	9th month	12th month
G1	42	47	47	50
G2	35	33	31	29
G3	17	13	12	10
G4	4	6	4	1
G5	2	0	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – No Problem
- G2 – Occasionally some difficulty with speech
- G3 – Frequently speech problems
- G4 – Always difficulty with speech
- G5 – Always major speech problems
- LF – Lost follow up

Table 5: Difficulty in speech due to dry mouth

Intake of water to facilitate speech

Of the total 100 patients, in three months, 30% of patients never had to sip water to facilitate speech (G1), 41% patients occasionally had to sip water to facilitate speech (G2), 25% patients frequently had to sip water to facilitate speech (G3), and 4% of them always had to sip water to facilitate speech (G4). In six months, ,G1,G2,G3, G4 scores were 37%, 40%, 21% ,1% and in nine months 45%, 35%, 13%, and 1% respectively. In twelve months G1, G2, G3 and G4 scores were 57%, 28%, 5% and 0% respectively. (Table 6)

Intake of water to facilitate speech				
	3rd month	6th month	9th month	12th month
G1	30	37	45	57
G2	41	40	35	28
G3	25	21	13	5
G4	4	1	1	0
G5	0	0	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – Never
- G2 – Occasionally
- G3 – Frequently
- G4 – Always
- G5 – Had to interrupt speech to take a sip of water
- LF – Lost follow up

Table 6: Intake of water to facilitate speech

Dry mouth and deglutition

Of the total 100 patients, during three months, 29% patients had no difficulty in swallowing due to dry mouth (G1), 45% patients occasionally had difficulty in swallowing due to dry mouth (G2), 17% patients frequently had similar complaints due to dry mouth (G3), 7% patients always had complaint of difficulty in swallowing due to dry mouth (G4) and in 2% of them, swallowing was seriously impaired due to dry mouth (G5). In six months and in months the G1, G2, G3, G4, G5 scores were 39%,39%,13%,8% and 0% and 47%, 28%, 13%, 6% and 0% respectively. In twelve months, 56% patients had score G1, 20% patients had score G2, 10% patients frequently had difficulty in swallowing due to dry mouth, 4% of the patients always had swallowing complaints and none of them had score G5.(Table 7)

Dry mouth and deglutition				
	3rd month	6th month	9th month	12th month
G1	29	39	47	56
G2	45	39	28	20
G3	17	13	13	10
G4	7	8	6	4
G5	2	0	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – No problem
- G2 – Occasionally some difficulty in swallowing
- G3 – Frequent problems in swallowing
- G4 – Always swallowing difficulties
- G5 – Swallowing seriously impaired because of dry mouth
- LF – Lost follow up

Table 7 :Dry mouth and deglutition

Dry mouth and mastication

Of the total 100 patients, 30% had no negative influence of dry mouth in chewing (G1), 52% patients occasionally had difficulty in chewing due to dry mouth (G2), 14% patients had frequent difficulty in chewing (G3) and 4% patients always had difficulty in chewing(G4) in a period of 3 months. In six months, the G1, G2, G3, G4 scores were 40%, 44%, 12%,3% respectively. By nine months, G1 was 43% patients G2 was 39% G3 was 10% and G4 was 2% . In a period of twelve months, the G1, G2, G3, G4 scores were 45%, 35%,9% and 1% respectively. (Table 8)

Dry mouth and mastication				
	3rd month	6th month	9th month	12th month
G1	30	40	43	45
G2	52	44	39	35
G3	14	12	10	9
G4	4	3	2	1

G5	0	0	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – No problem
- G2 – Occasionally some difficulty in chewing
- G3 – Frequent problems in chewing
- G4 – Always chewing difficulties
- G5 – chewing seriously impaired because of dry mouth
- LF – Lost follow up

Table 8: Dry mouth and mastication

Change in feeding habits

In three months period, of the total patients, 34% had no change in feeding habits (G1), whereas 52% patients made minor changes in feeding habits like avoiding some food (G2), 11% patients were able to eat only mashed food (G3), and 3% patients were able to consume only liquid food (G4). By a period of six months, the G1, G2, G3, G4 scores were 42%, 46%, 9% and 2% respectively and in nine months, 46% , 38% ,10% and 0% was the scores respectively. In a period of twelve months, the G1, G2, G3, G4 scores were 47%, 36%, 7%, 0 respectively. (Table 9)

Change in feeding habits				
	3rd month	6th month	9th month	12th month
G1	34	42	46	47
G2	52	46	38	36
G3	11	9	10	7
G4	3	2	0	0
G5	0	0	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – No change
- G2 – Minor changes such as avoiding some food
- G3 – Can eat only mashed food
- G4 – Can eat only liquid food
- G5 – Tube feeding
- LF – Lost follow up

Table 9: Change in feeding habits

Occurrence of painful, dry or crusted lips

In three months, out of the total sample size, 65% of them never had painful, dry or crusted lips (G1), 27% patients sometimes had similar complaints depending on weather and environmental conditions (G2), and 8% of them frequently had painful, dry or crusted lips (G3). By six months G1,G2.G3 scores were 66% , 27%, 6% and and in nine months 65%, 25% and 4% respectively. In twelve months, the G1, G2, G3 scores were 64%, 23%, and 3% respectively. (Table 10)

Occurrence of painful, dry, or crusted lips				
	3rd month	6th month	9th month	12th month
G1	65	66	65	64
G2	27	27	25	23
G3	8	6	4	3
G4	0	0	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – No never
- G2 – Sometimes depending on weather and environmental conditions
- G3 – Frequently
- G4 – Always day and night
- LF – Lost follow up

Table 10: Occurrence of painful, dry, or crusted lips

Occurrence of sore or painful mouth

Of the total 100 patients, in three months, 24% of them never had a sore or painful mouth (G1), while 45% occasionally had a sore or painful mouth (G2), 30% patients frequently had sore or painful mouth (G3) and 1% of them very often had sore or painful mouth (G4). In a period of six months, G1 was 28% and the G2, G3 scores were 49% and 21% respectively. None of the patients gave very often complaint of sore or painful mouth. By nine months,G1,G2 ,G3 and G4 were 28%, 56% ,10% and 0% . In twelve months, the G1, G2, G3, G4 scores were 30%, 52%, 8%, 0% respectively. (Table 11)

Occurrence of sore or painful mouth				
	3rd month	6th month	9th month	12th month
G1	24	28	28	30
G2	45	49	56	52
G3	30	21	10	8
G4	1	0	0	0
G5	0	0	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – Never
- G2 – Occasionally
- G3 – Frequently
- G4 – Very often
- G5 – Always
- LF – Lost follow up

Table 11: Occurrence of sore or painful mouth

Change in taste

Of the total 100 patients, 46% of them experienced no change in taste (G1), while 36% of them had some reduction in taste discrimination and sensation(G2), 14% had no considerable change in taste sensation (G3) and 4% of them had no taste sensation at all (G4) by three months. In six months the G1, G2, G3, G4 scores were 51%, 32%, 13% ,3% respectively and in the ninth month, they were 49% , 32% , 11% and 2% . In twelve months, the G1, G2, G3, G4 scores were 50%, 30%, 10%, 0 respectively. (Table 12)

Change in taste				
	3rd month	6th month	9th month	12th month
G1	46	51	49	50
G2	36	32	32	30
G3	14	13	11	10
G4	4	3	2	0
G5	0	0	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – No change
- G2 – Some reduction in taste discrimination and sensation
- G3 – Considerable change in taste
- G4 – No taste sensation at all
- G5 – Always a bad taste in mouth
- LF – Lost follow up

Table 12: Change in taste

Occurrence of infected oral mucosa and gums

Of the total 100 patients, 68% of them never had complaints of infected oral mucosa or irritated gums (G1), 22% of them occasionally had complaints of infected oral mucosa or irritated gums (G2), 10% frequently had similar complaints during three months. During a period of six months, the G1, G2, G3, scores were 70%,21%,8% respectively. By nine months, the G1, G2, G3 scores were 69%, 19%, 6% respectively. By the end of twelve months there was no significant difference in the scores, with G1, G2, and G3 being 67%, 19% and 4% respectively. (Table 13)

Occurrence of infected oral mucosa and gums				
	3rd month	6th month	9th month	12th month
G1	68	70	69	67
G2	22	21	19	19
G3	10	8	6	4
G4	0	0	0	0
LF	0	1	6	10
TOTAL	100	100	100	100

- G1 – No never
- G2 – Occasionally
- G3 – Frequently
- G4 – Very often
- LF – Lost follow up

Table 13: Occurrence of infected oral mucosa and gums

Deterioration of teeth

Of the total 100 patients, 90% patients had no complaints of deterioration of teeth whereas 10% of them had complaints deteriorated tooth at the end of third month. 87% patients had no such complaints while 12% had some deterioration during 6 months. During 9 months 79% patients had no complaints of deterioration of teeth and 15% patients had complaints. At the end of 12 months a total of 74% patients presented with no complaints of deterioration of teeth while 16% patients had such complaints. (Table 14)

Tooth Deterioration				
	3rd month	6th month	9th month	12th month
Yes	90	87	79	74
No	10	12	15	16
LF	0	1	6	10
TOTAL	100	100	100	100

Table 14: Tooth Deterioration

IV. Discussion

In radiotherapy treatment for head and neck cancer, the major salivary glands frequently receive a very high radiation dose. This high dose on the salivary glands results in a reduction of salivary output and a change in its composition. This in turn leads to xerostomia or dry mouth which is cited by patients as a major cause of decreased quality of life. Intensity Modulated Radiotherapy (IMRT), has shown to be capable of sparing the major salivary glands in many of the situations and thereby reducing the effect of radiation on these glands. The main objectives of these efforts include sparing the major salivary glands while delivering the fully prescribed doses to the targets.

Studies by CM Van Rij et al (2008)8, and Alexander Lin et al (2003)[6]found that patients treated with IMRT reported significantly less difficulty transporting and swallowing their food and needed less water for a dry mouth during day, night and meals and that these patients also experienced fewer problems with speech and eating in public.

A similar study done by Siavash Jabbari et al(2005)[7] comparing the IMRT and standard techniques showed that xerostomia and quality of life of improved over time in IMRT patients but not in standard radiotherapy patients and the potential benefits gained from IMRT in xerostomia or in quality of life, compared with standard RT, are best reflected late (>6 months) after therapy. The findings of Jabbari et al coincided with the present study that patients who underwent radiotherapy using IMRT is improving in the different aspects of xerostomia related quality of life over the course of follow up.

In the present study, the assessment of lack of sleep showed almost half of the patients had no problems with sleep and almost 29-34% of the patients had occasional problems with their sleep.which was in accordance to the study by Van Rij et al(2008)[8].

In the present study 14% of the patients had permanent complaints of a dry mouth and 23% of the patients had considerable complaints of a dry mouth in the third month. The whole volume of the parotid cannot be always completely spared if the lesion is situated close to the tumour and if there is irradiation for the contralateral neck nodes. Another important factor is the proper immobilization of the patient while performing radiothery. These factors maybe the reason for occurrence of some permanent and considerable amount of dry mouth problem even after sparing of the parotid. At the end of follow up the total patients with permanent effects of dry mouth has been reduced to 4% and those with considerable dry mouth problem was 13%. These showed that the dry mouth problem is improving and is reversible to some extent. These findings are in line with studies of Malouf et al(2003)[9], Chao et al(2001)[10], Van Rij et al(2008)[8]and XiuhuaBian et al(2015)[11].

In this study most of the patients had an occasional difficulty in swallowing with patients experience less difficulty in swallowing and feeding habits in the course of follow up. Study by Anand et al (2008)[12], showed that there was grade 0 dysphagia in most of the patients treated with IMRT in head and neck cancer after follow up of 6 months. The study by Van Rij et al(2008)8 showed similar results. Eisbruch et al(2002)[13] found that swallowing difficulties are not caused by xerostomia alone and damage to the pharyngeal constrictors may cause dysphagia and aspiration in patients receiving intensive radiotherapy. In the present study most of the patients had occasional difficulty in swallowing which was found to be improving. By the end of twelve months only 4% patients always had swallowing difficulties.

In the present study most of the patients had an occasional difficulty of sore and painful mouth, which was suggestive of infrequent radiation mucositis. Giuseppe Sanguinetti et al(2006)[14] did a study to analyse whether there is a mucosa sparing benefit for IMRT in head and neck cancer which showed that a 30-Gy maximum dose objective on the mucosa allows more than 30% greater sparing than conventional techniques. Victor M. Duarte et al(2013)[15] found that patients who were treated with IMRT had fewer occurrences of dental disease, less occurrence of severe mucositis, more salivary flow, and fewer requisite post treatment

extractions compared with those treated with conventional radiotherapy. These findings correlated with the present study.

In the present study we found that there is less percentage of people having a dry mouth symptom at daytime compared with those having the same symptoms at night time. Tim Dijkema et al (2012)[16] indicated that dry mouth at night is a frequent problem even after parotid sparing radiotherapy for head and neck cancer probably due to by submandibular gland dysfunction.

Shao et al (2011)[17] found that IMRT reduces the severity of hyposalivation compared to conventional radiotherapy and the ecological shift of the oral microbiota is more pronounced in conventional radiotherapy than in IMRT. Jeremias Hey et al (2012)[18] postulated that irradiation damage on dental hard tissue correlates with increased mean irradiation doses as well as decreased salivary flow rates. In the present study the occurrence of radiation caries was only 16% in the last month of follow up which may account for the reduced incidence of hyposalivation and due to the higher stability of the oral ecosystem in IMRT.

In the present study at the end of one year of follow up 50% of the patients had normal taste sensation and only 10% of the patients had a considerable change in taste sensation. Most of the patients who had some changes in taste sensation and discrimination was improving over the course of follow up. These findings come in line with the study by Joel B. Epstein et al (2010)[19], that IMRT can spare high dose exposure of salivary glands and taste-receptors in part of the oropharynx.

In the present study the findings suggest the speech was seriously impaired in very few percentages of subjects in the third month and they also improved over the course of follow up. In the third month most of the patients had to occasionally sip water to facilitate speech, but after one year the proportion of patients who had to sip water to facilitate speech reduced in number. These findings are in line with studies by Van Rij et al (2008)[8]and Lin et al (2003)[6]in which most of the patients had only an occasional difficulty in speaking which improved with time.

Obinata Et al (2013)[20] in his study found out that there was a significant correlation between the reduction in saliva secretion and the visual analog scale(VAS). His study showed that the VAS, reflecting the subjective patient sensation of mouth dryness, is a useful and very concise parameter to assess xerostomia after radiotherapy. In our study most of the patients had a VAS score between 2 and 7 which suggest that still there are mild to moderate subjective symptoms occurring in the patients after parotid sparing IMRT.

In a study by Kam et al (2005)[21], the results showed that in the patients treated with IMRT, significantly lower parotid gland mean doses were achieved compared with patients treated with conventional radio therapy, and the lower doses later translated into higher stimulated salivary flow rates. Also reducing the mean dose to the parotid gland using 3D CRT or IMRT, salivary flow is partially preserved and increases over time through a compensatory response by the part of the glands that received a low dose.[10] As the parotid salivary output is partially preserved and increasing over time, it has been predicted that parallel improvements in the symptoms of xerostomia would follow.

V. Conclusion

Xerostomia is the most prevalent consequence of radiation therapy (RT) of head and neck cancer and a major cause of reduced quality of life (QOL). In addition to patient perception of dryness, diminished salivary flow and output has other effects, including making mastication and deglutition difficult, which may lead to nutritional deficiencies, predisposing the patient to mucosal fissures and ulcerations, and changing the composition of oral flora which in turn promotes dental caries.

Overall, the findings here suggest that there is a reduced incidence of subjective complaints related to xerostomia using Intensity Modulated Radiotherapy Technique (IMRT) with parotid sparing. Even though there is still incidence of xerostomia, the severity of dry mouth and related complaints are very much lessened compared with the conventional radiotherapy and the 3D- Conformal radiotherapy (3DCRT) techniques. Most of the complaintsof the subjects related to xerostomia are also seen to improve over the period of time especially between 6 months and 1 year.

Acknowledgement

Dr Bindhu, Assistant Professor, Department of Radiodiagnosis, Govt Medical College, Calicut

References

[1]. Gupta B, Johnson NW, Kumar N. Global Epidemiology of Head and Neck Cancers: A Continuing Challenge. Oncology. 2016;91(1):13–23.

[2]. Leemans CR, Snijders PJF, Brakenhoff RH. The molecular landscape of head and neck cancer. Nat Rev Cancer. 2018 May;18(5):269–82.

[3]. Chambers MS, Garden AS, Kies MS, Martin JW. Radiation-induced Xerostomia in patients with head and neck cancer: Pathogenesis, impact on quality of life, and management. Head Neck. 2004 Sep;26(9):796–807.

[4]. Chambers MS, Rosenthal DI, Weber RS. Radiation-induced xerostomia. Head Neck. 2007 Jan;29(1):58–63.

[5]. Wijers OB, Levendag PC, Braaksma MMJ, Boonzaaijer M, Visch LL, Schmitz PIM. Patients with head and neck cancer cured by radiation therapy: A survey of the dry mouth syndrome in long-term survivors. Head Neck. 2002 Aug;24(8):737–47.

[6]. Lin A, Kim HM, Terrell JE, Dawson LA, Ship JA, Eisbruch A. Quality of life after parotid-sparing IMRT for head-and-neck cancer: A prospective longitudinal study. Int J Radiat Oncol. 2003 Sep;57(1):61–70.

[7]. Jabbari S, Kim HM, Feng M, Lin A, Tsien C, Elshaikh M, et al. Matched case–control study of quality of life and xerostomia after intensity-modulated radiotherapy or standard radiotherapy for head-and-neck cancer: Initial report. Int J Radiat Oncol. 2005 Nov;63(3):725–31.

[8]. Van Rij C, Oughlane-Heemsbergen W, Ackerstaff A, Lamers E, Balm A, Rasch C. Parotid gland sparing IMRT for head and neck cancer improves xerostomia related quality of life. Radiat Oncol. 2008;3(1):41.

[9]. Malouf JG, Aragon C, Henson BS, Eisbruch A, Ship JA. Influence of parotid - sparing radiotherapy on xerostomia in head and neck cancer patients. Cancer Detect Prev. 2003 Jan;27(4):305–10.

[10]. Chao KSC, Deasy JO, Markman J, Haynie J, Perez CA, Purdy JA, et al. A prospective study of salivary function sparing in patients with head-and-neck cancers receivingintensity-modulated or three-dimensional radiation therapy: initial results. Int J Radiat Oncol. 2001 Mar;49(4):907–16.

[11]. Bian X, Song T, Wu S. Outcomes of xerostomia-related quality of life for nasopharyngeal carcinoma treated by IMRT: based on the EORTC QLQ-C30 and H&N35 questionnaires. Expert Rev Anticancer Ther. 2015 Jan 2;15(1):109–19.

[12]. Anand AK, Chaudhoory AR, Shukla A, Negi PS, Sinha SN, Babu AAG, et al. Favourable impact of intensity-modulated radiation therapy on chronic dysphagia in patients with head and neck cancer. Br J Radiol. 2008 Nov;81(971):865–71.

[13]. Eisbruch A, Schwartz M, Rasch C, Vineberg K, Damen E, Van As CJ, et al. Dysphagia and aspiration after chemoradiotherapy for head-and-neck cancer: Which anatomic structures are affected and can they be spared by IMRT? Int J Radiat Oncol. 2004 Dec;60(5):1425–39.

[14]. Sanguineti G, Endres EJ, Gunn BG, Parker B. Is there a "mucosa-sparing" benefit of IMRT for head-and-neck cancer? Int J Radiat Oncol. 2006 Nov;66(3):931–8.

[15]. Duarte VM, Liu YF, Rafizadeh S, Tajima T, Nabili V, Wang MB. Comparison of Dental Health of Patients with Head and Neck Cancer Receiving IMRT vs Conventional Radiation. Otolaryngol Neck Surg. 2014 Jan;150(1):81–6.

[16]. Dijkema T, Raaijmakers CPJ, Braam PM, Roesink JM, Monninkhof EM, Terhaard CHJ. Xerostomia: A day and night difference. Radiother Oncol. 2012 Aug;104(2):219

[17]. Shao Z-Y, Tang Z-S, Yan C, Jiang Y-T, Ma R, Liu Z, et al. Effects of Intensity modulated Radiotherapy on Human Oral Microflora. J Radiat Res (Tokyo). 2011;52(6):834–9

[18]. Hey J, Seidel J, Schweyen R, Paelecke-Habermann Y, Vordermark D, Gernhardt C, et al. The influence of parotid gland sparing on radiation damages of dental hard tissues. Clin Oral Investig. 2013 Jul;17(6):1619–25.

[19]. Epstein JB, Barasch A. Taste disorders in cancer patients: Pathogenesis, and approach to assessment and management. Oral Oncol. 2010 Feb;46(2):77–81.

[20]. Obinata K, Nakamura M, Carrozzo M, Macleod I, Carr A, Shirai S, et al. Changes in parotid gland morphology and function in patients treated with intensity-modulated radiotherapy for nasopharyngeal and oropharyngeal tumours. Oral Radiol. 2014 May;30(2):135–41.

[21]. Kam MK, Leung SF, Zee B, Choi PH, Chau RM, Cheung KY, Suen JJ, Teo PM, Kwan WH, Chan AT. Impact of intensity-modulated radiotherapy (IMRT) on salivary glandfunction in early-stage nasopharyngeal carcinoma (NPC) patients: A prospective randomized study. Journal of Clinical Oncology. 2005 Jun 1;23(16 suppl):5501

Dr Midhun Sai E, et. al. "A subjective evaluation of radiation induced xerostomia in patients who had undergone radiotherapy using linear accelerator and IMRT with parotid sparing in head and neck cancer - a prospective study.." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 21(09), 2022, pp. 64-74.