

# Management Outcomes of Maxillary Sinus Malignancies: A Fifteen Year Study at Radiotherapy Department in a Tertiary Health Facility in Ibadan, South-West, Nigeria

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## Abstract

**Introduction:** Maxillary sinus malignancies are rare worldwide. The disease usually presents at an advanced stage making its management challenging for all the medical personnel involved in its treatment. Because of its location deep within the maxilla and its proximity to critical surrounding structures, radiotherapy plays an integral role in sterilizing the area of malignant cells.

**Objective:** The aim of this study is to assess the management outcomes of maxillary sinus malignancies at the radiotherapy clinic of the University College Hospital, Ibadan.

**Methods:** A retrospective study of a total of 108 patients with histological diagnosis of maxillary sinus malignancies registered from January 1995 to December 2009 was done. The data was analysed using the Statistical Package for Social science (SPSS) version 21, and statistical significance of association between variables was assessed using Chi-square test at  $p < 0.05$ . Ethical clearance was obtained from the Health Research Ethics Committee of UCH.

**Results:** A total of 108 patients with histologically confirmed maxillary antrum malignancies were seen over the study period. The mean age of the patients was  $50.3 \pm 2.8$  years. The sex distribution showed 65 (58.3%) males and 45 (41.7%) females. Multimodality management was the primary mode of treatment. Histology and mode of treatment were found to be of prognostic significance. Only 6.4% of the patients had complete remission, while 14.8% and 50% had no remission and partial remission respectively.

**Conclusion:** Majority of the patients had partial remission or no remission in our study despite the combination of surgery and radiotherapy.

**Keywords:** maxillary sinus, malignancies, management, outcomes

## Abbreviations

LC: Local Control rates

NR: No Response

Mo: No distant metastases

M1: Distant metastases

N: Lymph Node

NR: No Response

RT: Radiation Therapy

RR: Regional Recurrence

PR: Partial remission

SPSS: Statistical Package for Social Services

NR: No Remission

CR: Complete Remission

SFI: Symptom Free Interval

T: Tumour

UCH: University College Hospital

## 1. Introduction

Malignant tumours of the maxillary sinus are rare neoplasms (Dulguerov, Jacobsen, Allal, Lehmann, & Calcaterra, 2001). However, they are the most common malignancies of the anterior base of skull and they constitute a significant cause of morbidity and mortality worldwide especially in Africa where there is limited access to medical facilities (Ogunlewe, Somefun, & Nwawolo, 2001; Vrionis, Kienstra, Rivera, & Padhya, 2004; Chan, 2010). The maxillary sinus is the most commonly affected site of the paranasal sinuses, accounting for 60%- 85% and are predominantly squamous cell carcinomas (Vrionis, Kienstra, Rivera, & Padhya, 2004). Malignant tumours of the maxillary sinus account for approximately 3% of head and neck cancers and 0.5% of all malignant diseases. The annual incidence of maxillary sinus cancer is 0.5–1.0 case per 100,000 of the population worldwide (Chan, 2010). Higher rates have been reported in Japan and parts of Africa, where the incidence is 20 per million per annum while in U.S.A and U.K. it is 10 per million population per annum (Spiro, Soo & Spiro, 1989; Arotiba, 1998). The first comprehensive work on head and neck cancers in Nigeria reported a 2.2% incidence in Ibadan, south western Nigeria four decades ago (Sigh & Martinson, 1969). Another study in Lagos, almost two decades ago reported that 28.7% of all orofacial cancers and 12.6% of all head and neck cancers were located in the maxillary sinus (Arotiba, 1998). In North Central Nigeria it is reported as the commonest malignancy over all other orofacial cancers, the second commonest head and neck cancer in North East and North Central Nigeria while in Port-harcourt in South South it has been reported as the commonest head and neck cancer (Dulguerov et al., 2001; Adesola, Obiadazie, 2006; Ahmad & Pindiga, 2004; Bhatia, 1990; Opubo, Lilly, Abayomi & Wasiu, 2009; Nwawolo, Ajekigbe, Oyenyin, Nwankwo, & Okeowo, 2001; Nwarorgu, Kokong, Onakoya, Adoga, & Ibekwe, 2007)). Other reports from West Africa have shown that maxillary sinus cancers are not uncommon (Dulguerov, Jacobsen & Allal et al, 2001)

Because of the concealment of the sinus, malignancies in this area are usually not diagnosed early until there is considerable involvement of the contiguous tissue and thus a good number of these patients present in an advanced stage (Iseh, & Malami, 2006). These tumours present both diagnostic and therapeutic problems requiring a high index of suspicion for diagnosis at the early stage (Iseh, 2004). Key indicators of malignancy are uncommon at the initial presentation and when these occur, signify advanced disease. In advanced disease, the extensive spread often makes it difficult to identify the primary site.

The standard treatment in the early stage of maxillary sinus cancer is surgical resection. However, for locally advanced maxillary sinus cancer, a multimodality treatment approach is strongly recommended to improve the survival rate and quality of life of the patient (Hye, Sang, & Bum-soo et al, 2009). The complexity of the anatomy and the proximity of the eyes, brain, and cranial nerves render the management extremely difficult with complete surgical resection often impossible which leads to local recurrence, a major cause of treatment failure (Nishino, Ichimura, Tanaka et al, 2003). Control of the primary tumour site is important in the curative treatment of patients with maxillary sinus carcinoma. Radiation plays an important role in sterilizing malignant cells that cannot be removed by surgery. The other issues pertaining to maxillary sinus cancer include the functional aspects of eyesight and the cosmetics of facial contour, which makes patients avoid surgical resection. These functional and cosmetic impairments have often led to a decreased quality of life in this group of patients.

Our study aims to show various management protocols in use, and evaluate the management outcome at the radiotherapy clinic unit.

## 2. Methods

### 2.1 Background

The study was conducted among the patients with malignant tumours of the maxillary antrum seen at the

radiotherapy department of a tertiary health facility in Ibadan, South-West Nigeria between 1995 and 2009. The health facility is located in Ibadan North Local Government Area of Oyo state. Oyo state is one of the 36 states in Nigeria. The state was created in 1976 out of the old western region, and it has an estimated population of 5.6 million (National Population Commission of Nigeria, 2006). The clinic serves as a referral centre for radiotherapy services in the south west, south east and south southern regions, and other parts of the country.

### *2.2 Inclusion Criteria*

All histologically confirmed malignancy of the maxillary antrum cases seen in the department from January 1995 to December 2009.

### *2.3 Exclusion Criteria*

Maxillary antrum malignancy cases without histological confirmation of diagnosis. Malignant tumours involving the maxillary antrum in which the primary site cannot be ascertained.

### *2.4 Study Design*

This is a cross-sectional study, fifteen years retrospective analysis of the treatment outcomes of maxillary sinus malignant cases seen and treated at the radiotherapy department of University College Hospital, Ibadan, South-West, Nigeria, from January 1995 to December 2009.

### *2.5 Patients and Data Collection*

Data extraction form was formulated and used to collect data required for this study. All available radiotherapy case files and treatment records of patients with head and neck cancer between January 1995 and December 2009 were extracted. Those with histologically confirmed primary tumours of the maxillary antrum were retrieved. Information obtained from the radiotherapy case notes and treatment records include: address, distance from hospital, occupation, number of years spent at the job, educational level, social history like smoking, snuff inhalation and alcohol ingestion. History of co-morbidities and duration of illness were taken into consideration. The radiotherapy treatment card was systematically perused to search for the site of radiotherapy, the dose and duration of radiotherapy.

A variety of chemotherapy regimes were used during the study. The number of cycles received, duration between presentation and commencement of treatment was also recorded. The treatment outcome was assessed as either partial, complete, or no response six weeks after treatment. Presence of recurrences, site and interval from treatment was recorded. The symptom free interval at 6 months and 12 months were used in assessing the response to treatment as a result of the large number of patients that defaulted from treatment.

Data was analysed using Statistical Package for Social Sciences SPSS version 17. Analysis was done using percentages, frequency charts, chart representation and inferential statistics of chi-square at 5% level of significance. Comparison of Symptom Free Interval (SFI) in relation to type of treatment, histology of the tumours and stage at presentation were also done using chi-square test for comparison of proportion.

### *2.6 Definitions of Different Types of Outcomes*

Complete Response (CR) is complete disappearance of irradiated tumour on clinical and radiological examinations, Partial Response (PR) is when there is greater than 50% reduction in size of the tumour, No Response (NR) is when the reduction in size is less than 50% of all tumour irradiated or progression of the disease. Local Recurrence (LR) is when there is recurrence of tumour at the primary site, regional recurrence (RR) is when the disease is present in the cervical lymph node, Distant metastasis (DM) is when there is presence of tumour outside the primary site and cervical lymph node, while Symptom Free Interval (SFI) is the duration that the patient stays clinically free of signs and symptoms associated with the disease after treatment.

### *2.7 Ethical Approval*

Ethical approval was obtained from the Joint Ethical Review Committee of University of Ibadan/University College Hospital, Ibadan. Serial numbers and initials of patients were used to maintain confidentiality.

### *2.8 Limitation of Study*

As with most retrospective studies, there were limitations due to incomplete data in the case notes. There was no laid down protocol for the management of this disease thereby hindering adequate comparison of the results. Also, follow up in these patients was not uniform thus outcomes could not be adequately represented.

## **3. Results**

Table 1 shows the total number of patients who presented at the radiotherapy department from January 1995 to

December 2009. The highest number of patients 17.6% was seen in 2004, while the least 1.9% was in 1999.

Table 1. Distribution of patients with maxillary sinus malignancy seen at radiotherapy clinic

Year	Number of cases	Percent %
1995	3	2.8
1996	8	7.4
1997	4	3.7
1998	6	5.6
1999	2	1.9
2000	15	13.9
2001	5	4.6
2002	4	3.7
2003	6	5.6
2004	19	17.6
2005	12	11.1
2006	13	12.0
2007	2	1.9
2008	3	2.8
2009	6	5.6
Total	108	100.0

Table 2a shows age and sex distribution of the patients. Majority of the females and males are in the age group 50-59 years. Also, majority of patients treated within the period are females (58.3%).

Table 2a. Age and Sex Distribution of the patients

Age Group(Years)	Female		Male		Total	
	N	%	N	%	N	%
10-19	2	1.9	2	1.9	4	3.7
20-29	3	2.8	3	2.8	6	5.6
30-39	6	5.6	10	9.3	16	14.8
40-49	6	5.6	9	8.3	15	13.9
50-59	19	17.6	18	16.7	37	34.3
60-69	6	5.6	9	8.3	15	13.9
70-79	3	2.8	9	8.3	12	11.1
80-89	0	0.0	3	2.8	3	2.8
Total	45	41.7	63	58.3	108	100

Table 2b shows occupation and social habits of the patients. Majority of them are traders 28(25.9%). Patients that drink alcohol alone, smoke alone, and those that drink alcohol and smoke are 51(47.2%), 30(27.8%), and 24(22.2%) respectively.

Table 2b. Occupation and Social Habits of the patients

<b>Variables</b>	<b>Frequency</b>	<b>Percent</b>
Occupation:		
Civil servant	22	20.4
Trading	28	25.9
Chemical worker	4	3.7
Bricklayer	1	0.9
Leather/Furniture worker	13	12.0
Housewives	8	7.4
Hairdresser	7	6.5
Unspecified	25	23.1
Social habits:		
Smoking only	30	27.8
Alcohol only	51	47.2
Alcohol and smoking	24	22.2
Snuff	26	24.1
Alcohol and snuff	14	12.9
Unspecified	15	13.9

Table 3 shows the distribution of maxillary sinus malignancy according to the tumour site. 15(13.9%) patients had tumours that originated in the infrastructure while in 9(8.3%) patients; the tumours were noted to have started in the suprastructure.

Table 3. Distribution according to tumour epicentre/ sites of maxillary sinus malignancies

<b>Tumour site</b>	<b>Frequency</b>	<b>Percent</b>
Superstructure	9	8.3
Infrastructure	15	13.9
Not documented	84	77.8
Right	34	31.5
Left	69	68.5
Not documented	5	4.6

Tables 4a and 4b show the various treatment combinations used for the patients. 94.4% had radiotherapy either in combination with surgery or with chemotherapy. 89(82.4%) had radical radiotherapy. Only 22(20.4%) patients had surgery, either as partial maxillectomy in 19(17.6%) or total maxillectomy in 3(2.8%).

Table 4a. Treatment combinations used for patients

Treatment offered	No of Patients	Percent
Surgery:	22	20.4
Partial maxillectomy	19	17.6
Total maxillectomy	3	2.8
Radiotherapy:	102	94.4
Radical	89	82.4
Palliative	13	12.0
Chemotherapy:	80	74.1
Neoadjuvant	7	6.7
Concurrent	37	34.3
Adjuvant	36	33.3
Surgery and Radiotherapy	20	18.5
Radiotherapy and Chemotherapy	78	72.2
Chemotherapy and Surgery	2	1.9
Surgery, Chemotherapy and Radiotherapy	20	18.5
Radiotherapy alone	4	3.7
No Treatment	4	3.7

Table 4b. Distribution of the patients that had radiotherapy

Radiotherapy	No of patients
Pre-operative	5
Post-operative	15
Concurrent Chemoradiation	78
Radiotherapy alone	4
<b>TOTAL</b>	<b>102</b>

Table 5 shows the distribution of the radiation doses given and the duration of treatment. The dose for radical radiotherapy ranged from 45Gy to 60Gy in 12- 25 fractions given over 4 to 5 weeks. Seven patients did not complete the radiotherapy treatment as they defaulted from completing their care while one patient died in between treatment.

Table 5. Treatment intent of radiotherapy amongst the 102 patients that received radiotherapy

Intent of Radiotherapy	Dose /weeks	Frequency	Percent
Palliative	25GY in 2 weeks	3	2.8
	30GY in 3 weeks	10	9.3
Radical	45GY in 4weeks	46	42.6
	50GY in 4weeks	34	31.5
	60GY in 5weeks	9	8.3
<b>Total</b>		<b>102</b>	<b>100</b>

Table 6 shows the distribution of the various chemotherapy agents used. A total of 80(74.1%) received chemotherapy, either as neoadjuvant 7(6.7%), concurrent 37(34.3%) or adjuvant 36(33.3%) therapy. The commonest regimen was the cisplatinum/5FU.

Table 6. Chemotherapy regimen of the patients with maxillary sinus malignancy

Chemotherapy Regimen	No of patients	Percent
Cisplatin/ 5fluorouracil	41	38
Vincristine, Bleomycin and Methotrexate (VBM)	15	13.9
Cyclophosphamide, Methotrexate and Vincristine (CMV)	14	13
Vincristine, Adriamycin and Cyclophosphamide (VAC)	3	2.8
Cyclophosphamide, Adriamycin, Vincristine and Prednisolone (CHOP)	2	1.8
Methotrexate/MTX	3	2.8
5Fluorouracil	2	1.8
TOTAL	80	100

Table 7 shows the duration of follow up ranged from 6 weeks to 64 months, with a mean duration of 8.7±1.7 months. Follow up was poor after 12 months during which time 35(32.4%) had treatment failure. 60% of the patients had local recurrence.

Table 7. Pattern of failures seen in patients treated for maxillary sinus malignancy

Pattern of failure	No of patients	Percent
Local	21	60.0
Regional	12	34.3
Distant metastasis	2	5.7
When:		
< 6months	20	57.1
6-12months	15	42.9
Total	35	100

Table 8 shows the symptom free interval(SFI) of patients treated for maxillary sinus malignancy over a one year period. The SFI fell drastically in stages III, IVA, IVB and IVC at one year. Most of these patients had chemotherapy and radiotherapy, as surgery could not be done due to the extent of disease and the close proximity to vital surrounding structures.

Table 8. Symptoms free interval (SFI) of patients treated for maxillary sinus malignancy

Stage	No of patients	6 months SFI		12 months SFI	
	N	N	%	N	%
II	4	3	75.0	2	50.0
III	37	21	56.8	11	29.7
IVA	53	14	26.4	9	17.0
IVB	8	2	25.0	0	0.0
IVC	6	2	33.3	1	16.7
Total	108	42		23	

Table 9 shows the association between the histology and the duration of the SFI. The p value shows that all the variables are statistically significant. In this study, only 1(25%) of lymphoma had a SFI of 12months.

Table 9. Histological presentation in patients and symptom free interval (SFI) relationship

SFI	Histology			Total	X <sup>2</sup>	P-Value
	Carcinoma	Lymphoma	Sarcoma			
0-3	69	3	6	78		
4-6	25	0	0	25		
7-9	3	0	0	3	12.345	0.00
10-12	1	1	0	2		
TOTAL	98	4	6	108		

Table 10 shows the association between the type of treatment used and the duration of the SFI. The treatment combination of surgery, radiotherapy and chemotherapy had the longest SFI duration. All the treatment options are statistically significant (X<sup>2</sup>=31.652, P=0.02)

Table 10. Type of treatment for the patients and symptom free interval (SFI) relationship

Type of treatment	SFI (Months)				Total	X <sup>2</sup>	P-Value
	0-3	4-6	7-9	10-12			
Surgery, Chemotherapy, and Radiotherapy	6	10	3	1	20		
Surgery and Chemotherapy	2	0	0	0	2	31.652	0.02
Radiotherapy and Chemotherapy	59	15	4	0	78		
Radiotherapy alone	2	1	1	0	4		
TOTAL	68	29	6	1	104		

#### 4. Discussion

A total of 1066 patients with head and neck malignancies were seen at radiotherapy department, between January 1995 and December 2009. Out of this number, 108 were diagnosed with maxillary sinus malignancies accounting for 10.1% of all head and neck cancers seen in the department. The annual incidence ranged from 2 to 15 per year, with an average of 7 cases per year. This is similar to the study by Ogunlewe et al (2001) who reported a hospital annual incidence of 7 per year, while Arotiba reported 9 per year (Arotiba, 1998). However, the incidence is lower in Caucasians, accounting for between 4-6 cases per year (Waldron, O'Sullivan, & Gullane et al, 2000).

The mean age at presentation was 50.3±2.8 and ranged from 13- 83 years. The peak incidence for both sexes was seen in the 6<sup>th</sup> decade which is similar to that reported by Ogunlewe et al. (2001). However, in their study, they reported that 73% of the female patients were above 60 years while only 27% were between 41 and 60 years. They noted that the high incidence amongst postmenopausal women could suggest that hormonal factors may be implicated in the aetiology for women. This finding was not observed in this study as only 9(8.4%) of the female patients were above 60 years. A similar study done by Campbell et al reported a peak age incidence for both sexes in the 6<sup>th</sup> decade (Campbell, Adeosun, Arotiba, Akinlade, & Obed, 2005). Males were found to be affected more with M: F ratio of 1.4:1, however, the peak age at presentation for both sexes was seen in the 6<sup>th</sup> decade. The factors that account for higher male ratio can be linked to the use of tobacco as all the patients that smoked were noticed to be male.

Various aetiological factors resulting from industrial exposure have been linked with malignancy of the maxillary sinus. Identified risk factors include nickel, chromium, wood dust, leather dust, formaldehyde, mineral oils, lacquer paints, soldering, welding, radium plant, irradiation, cigarette smoking and people who have had thorotrast injected into their sinuses (Ologe, Adeniyi, & Segun, 2005; Akinyele, Bukola, & Abideen et al, 2011, Nepal, Joshi, Chetri & Karki, 2010; Hadfield, 1970; Klintonberg, Olofson & Hellquist et al., 1984). Acheson et al. (1982) showed that skilled furniture makers particularly the machinist had a cumulative rate of at least 120:1 during their lifetime of acquiring the disease particularly adenocarcinoma of the maxillary antrum. The type of wood is



significant, the African mahogany being the most dangerous. An increased risk has also been observed in boot and shoe workers and workers involved with mustard gas, isopropyl oil and hydrocarbon gas. Snuff is a well recognized factor seen especially in the Bantus of South Africa Kondo, Ogawa, Inuyama et al, 1985). In this study, 24.1% of the patients had a positive history of the use of snuff for a period which ranged from 7-21 years and 15(57.7%) of them were women. Four patients were chemical workers exposed to hydrocarbons over a period ranged 7-19 years while 7 were hairdressers who constantly worked with dyes and hairsprays for a period range of between 11-18 years. 13 of the patients in this study were leather/furniture workers for a period range of 5-9 years.

The late presentation of these patients is associated with a higher local tumour burden and most reports show this (higher T-stage) as one of the strongest predictors of poor outcome in terms of both local control and cause specific survival. Guo et al reported that the 5 year overall survival rate for patients with stage II, III, and IV were 87.5%, 45.8% and 32.7% respectively (Guo, Yang, Xie, Chen, Wu, Ou et al., 2004). Hayashi et al. reported significant differences in 5 year OS, disease free survival (DFS) and local control rates (LC) between T2-T3 and T4. In a similar study done by Campbell et al, they reported a 5 year survival of 63% for early stage I and II disease, while stages III and IV had a poor 22% 5 year outcome (Campbell et al., 2005). This finding is not new, with virtually every series reporting an association between disease extent and outcome.

None of the cases seen presented at stage I, 4(3.7%) of the patients presented with stage II disease while 37(34.3%) presented in stage III. Most of the patients presented in stage IV, accounting for 67(62.1%), however distant metastases (stage IVc) was seen in only 6(5.6%) of the patients.

A wide variety of modalities, including surgery, radiation therapy, and chemotherapy, alone or in combination, have been used for the treatment of maxillary sinus malignancies to obtain better local control and maintain function. However, there is still much controversy with regard to the optimum treatment. In the last 30 years there has been a consistent trend toward combined treatment, especially for those patients with unfavourable prognostic factors. The concept of combining surgery and radiotherapy for this disease was first established by Ohngren (Nishino et al., 2000) in his 1933 study, in which a 5-year survival of 38.5% was achieved. Since then, various protocols have emerged in the hope of increasing both local control and overall survival rates. A meta-analysis done by (Dulguerov et al., 2001) confirmed that surgery (70%) and combined surgery and radiation (56%) offer better local control and cure rates than radiotherapy alone (33%). A high incidence of residual disease is often found after surgery, therefore, the main goal of primary radiation is to shrink the tumour so that the surgical resection is less extensive and vital structures, such as the eye, can be spared. The sequence of surgery and radiotherapy in the management of these patients has remained open to debate since the work of Jesse (Jesse, 1965), who showed no clear difference between pre-operative and post operative radiotherapy. The role of chemotherapy in the literature is inconclusive. In this study, 102 patients had radiotherapy either in combination with surgery (20.4%) or chemotherapy (74.1%) or as the sole treatment (3.7%).

Most of the patients presented at stage IVa (49.1%) where the role of surgery is limited, this would explain the greater combination with chemotherapy in an attempt to increase the local control rate. The choice of the chemotherapy was based on the histology, with the commonest chemotherapy combination being cisplatin/5FU for squamous cell carcinomas, vincristine, bleomycin and methotrexate (VBM) for adenoid cystic carcinoma. The role of chemotherapy to the treatment outcome could not be assessed as most of the patients were not consistent with the chemotherapy regimen due to financial constraints. Radiotherapy was the main modality of treatment in 102 patients, with 89(87.3%) patients receiving radical doses which ranged from 45Gy to 60 Gy over 4-5 weeks, while 13 (12.7%) were treated with palliative intent for mostly pain relief.

At six weeks post treatment, 50% of the patients had partial response, 14.8% no response and 6.4% had complete response to treatment, as evidenced by the complete disappearance of irradiated tumour on clinical and radiological examinations. This finding is similar to a report by (Tsuji et al., 1986) who noted that of the 173 patients seen, 100 (57.8%) were found to have persistent tumours after a course of combined treatment. In a similar study by (Sakata et al, 1993), of the 101 patients seen 69 (68%) were found to have persistent tumours after a course of combined treatment, and more than 50% of these developed recurrences at the primary site, while distant metastases was observed in 7 of the patients. In both studies, most of the patients studied presented with large T3 and T4 tumours, similar to what was seen in this study. Local disease extent has been identified as the strongest predictor of poor outcome in terms of local control (Kondo et al., 1985). Local control is a key factor for cure of this disease. In our study, 35(32.4%) patients present.

Our findings in this study showed there was statistical significant association between type of treatment and symptom free interval. This is similar to the findings in a study done by Campbell et al that reported a 5 year survival rate of 65% in patients treated with hemimaxillectomy and radical radiotherapy for early stage disease as

compared to 22% 5 year survival rate for stages III and IV disease that only received radiotherapy as the sole treatment<sup>20</sup>.

In general, the management of maxillary sinus malignancy still poses a great challenge as most patients present late and thus the outcome of treatment is poor. Surgery and radiotherapy are essential in achieving local control but surgery has its limitations in locally advanced disease because of the vital structures surrounding the maxillary antrum.

The limitations of this study include incomplete data in the case notes, no official protocol for the management of this disease and follow up of patients was not uniform.

## 5. Conclusion

In our study, most of the patients presented late with locally advanced disease, thus making treatment outcome poor. Tooth ache and loosening teeth should raise a high index of suspicion by the dentist and other attending physicians. There should be more enlightenment campaigns amongst the general population that will promote general knowledge and health seeking behaviours. Also, campaign against snuff inhalation and chewing should be intensified at the grass root level. Governments should provide more cancer care giving centres that are equipped with adequate diagnostic tools and modern radiotherapy equipments for adequate care. Also, health insurance scheme should be expanded to cater for chemotherapy drugs, and cancer chemotherapy subsidized in all tertiary hospitals to accommodate patients not in the national insurance scheme.

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## Competing Interests Statement

The authors declare that there is no conflict of interests regarding the publication of this paper.

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