RESEARCH ARTICLE

Oral mucositis in patients undergoing radiotherapy for head and neck cancer: An observational cross-sectional study

[version 1; peer review: 3 approved with reservations, 1 not approved]

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Abstract

Background: Radiotherapy (RT) is indispensable in the treatment of head and neck cancer (HNC). Oral mucositis (OM) is a complication in HNC patients undergoing RT. This study aimed to identify the incidence, distribution of OM, and its effect on treatment breaks in a section of HNC in patients in Iraq.

Methods: This is an observational, descriptive cross-sectional study. In total, 50 patients with primary HNC, treated with external beam RT, from 30th April to 10th September 2017 at Baghdad Radiation Oncology and Nuclear Medicine Center were included in the study. Cases of OM were graded according to the World Health Organization scale.

Results: 80% of patients were below 65 years, and the male/female ratio was 2.6:1. Tumor sub-sites were nasopharynx (36%), larynx (22%), parotid (14%) and tongue (12%). 74% were smokers during or before starting RT. 86% were in stages III or IV. Incidence of OM was 72%; 16% grade I, 40% grade II, and 16% grade III. OM occurred in 93% females and 64% males, and 79% received concurrent regimens.

Conclusions: OM occurred in HNC treated by RT, more in females, who received chemotherapy plus RT, and those with tumors of the oral cavity and nasopharynx. OM-related unplanned breaks may interrupt treatment schedule. HNC imposes a double burden in Iraq as it attacks a productive age group, and the vast majority of the patients included in this study were diagnosed in advanced stages.

Keywords

Head and neck cancer, Oral mucositis, Concurrent chemo-irradiation

Open Peer Review

Approval Status ? X ? ?

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version 1	?	X	?	?
14 Feb 2019	view	view	view	view

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Introduction

Globally, head and neck cancer (HNC) accounts for 550,000 cases and 380,000 deaths, annually¹. In the US, HNC accounts for 3% of cancers², and in Europe, it was estimated to be 4% in 2012³. Men are affected more than women with a ratio of 2:1 and 4:1 for US and Europe, respectively. In Iraq, the incidence of HNC is <2%⁴. The primary causes of HNC are tobacco and alcohol, and viral infections including Epstein-Barr virus and hepatitis virus⁵⁻⁷.

Radiotherapy (RT) plays a central and evolving role in the treatment of HNC⁸ and is used with or without chemotherapy (CT) as a definitive or adjuvant treatment⁸. The oral cavity is susceptible to direct and indirect toxic effects of cancer CT and RT⁹. This risk reflects high rates of cellular turnover for the lining mucosa, a diverse and complex micro-flora, and trauma to oral tissues during normal oral function¹⁰⁻¹². Oral mucositis (OM) is a debilitating side effect of RT¹³ and is exacerbated by concomitant CT¹⁴, which can begin 1–2 weeks after initiation of RT as asymptomatic erythema often progressing to erosion and ulceration. The ulcers are painful, covered by a white fibrinous pseudo-membrane, associated with dysphagia and decreased oral intake^{15,16}.

Radiation therapy is an important method used in the treatment of head and neck cancers and, like all other methods used in treatment, it is not without the side effects of treatment. The injuries that occur to mucous membranes of the oral cavity are only part of those effects, which we can avoid and reduce them before and during and after treatment by adhering to the recommendations of the treating physician and the work of therapeutic planning. This study aimed to identify the incidence, distribution of OM, and its effect on treatment breaks in a section of HNC in patients in Iraq.

Methods

Study design and setting

This is an observational, cross-sectional study for HNC treated by external beam radiation therapy (EBRT), which included patients 50 patients, who were patients from 30th April to 10th September 2017.

The study was conducted at Baghdad radiation Oncology and Nuclear Medicine center, Bagdad, Iraq.

Participants

Patients who fit the eligibility criteria during the study dates who were scheduled for treatment were included in the study.

Dose of EBRT: 50-70 Gray, with a standard fractionation. Each fraction is 2Gy and 5 fractions per week. Radiation delivered with 3D conformal technique, using Elekta infinity, and Elekta synergy machines.

Eligibility criteria of patients was: primary HNC; T3 or T4 disease; positive nodes; residual disease; positive margins; perineural

invasion; lymphovascular infiltration; extracapsular extension; treatment as described above.

Patients were excluded who had comorbid conditions, were treated in a palliative way, and those with metastasis or with a bad performance status.

Data collection

We conditionally collected data from patient files when they attended follow-up at the in-patient or/and out-patient clinic, or when these patients made visits to our center.

Variables collected:

Variables collected included: patient's gender, age and smoking status; tumor histopathology, stage, grade, subsites, and primary or metastases; radiotherapy dose, fractions, interpretations and oral mucositis onset.

Assessment by **World Health Organization's scale of OM** was performed as follows: Grade 0, no OM; Grade I, soreness; Grade II, erythema, ulcers, able to eat solids; Grade III, Ulcers, liquid diet only; Grade IV, alimentation not possible.

Statistical analysis

The collected data was categorized and analyzed by T-test to identify the incidence of OM and its distribution. SPSS IBM version 22 was used.

Ethical considerations

Written informed consent was obtained from the patients for the publication of their data in this article, and the study was conducted according to the ethical standards established by the 1964 Declaration of Helsinki. The Medical Ethical Committee of Baghdad University approved this study (code:611) on 18/04/2017.

Results

In the total patient population 72% were men, while 28% were women; male/female ratio was 2.5:1. The mean age was 53.3±11 years, and majority (38%) were between the ages of 55 and 64 years. Patients aged 65 years or more composed 20% of the total population (**Table 1**). In total, 76% received CT before or concurrent with RT. The vast majority (86%) had advanced stages III or IV of cancer. 74% were smokers, during or before starting RT (**Table 1**); 86% of these were men, while 43% were women. Seven sub-sites were observed. The highest was the nasopharynx, followed by the larynx, parotid, and then the tongue (**Figure 1**).

In total 72% of patients had an incidence of OM, with no patients with grade IV; 40% were grade II, and grades I and III appeared in 16% of patients (**Figure 2**). OM occurred in 100% of young patients, below 35 years, 50% among 45–54 years old, and 90% in patients ≥ 65 years. 93% of women developed OM compared to 64% of men (**Table 2**). OM appeared in 50% of patients treated

Table 1. Demographics of in patients undergoing radiotherapy for head and neck cancer in Iraq.

Age group, years	N (%)	P Value
15–24	1 (2)	< 0.001
25–34	1 (2)	
35–44	9 (18)	
45–54	10 (20)	
55–64	19 (38)	
65–74	10 (20)	< 0.001
Chemotherapy	Yes 38 (76)	
	No 12 (24)	
Cancer stage	II 7 (14)	
	III 31 (62)	
	IV 12 (24)	
Smoker	Yes 37 (74)	< 0.001
	No 13 (26)

Figure 1. Distribution of the subsite of the tumor in oral mucositis in patients undergoing radiotherapy for head and neck cancer in Iraq (n=50).

with RT only, and 79% of those treated with concurrent protocols (Table 2). Grade III OM occurred in 18% of patients treated with RT and CT, while it occurred in 8% with RT only. OM appeared in 42% of patients with stage II cancer, and 77% and 75% of those with stages III and IV. OM occurred among 73% smokers and 69% nonsmokers. But severe OM ($\geq$ grade III) occurred in 26% of smokers and 11% of non-smokers (Table 2). In this study, the majority of OM cases (47%) came from nasopharynx tumors (Table 2).

In total, 20% of patients had single breaks in their treatment schedule; the total break days was 20 days, giving an average of 2 days per break (Figure 3). Unplanned breaks were observed more in men, those who smoke, those with both RT and CT treatment, those with stage IV cancer, and those with grade III OM (Table 3).

Figure 2. Distribution of oral mucositis (OM) cases according to OM grade in patients undergoing radiotherapy for head and neck cancer in Iraq (n=50).**Table 2.** Oral mucositis (OM) characteristics in patients undergoing radiotherapy for head and neck cancer in Iraq (n=50). RT, radiotherapy; CT, chemotherapy.

Gender	N	OM, N (%)		P value
Female	14	13 (93)		0.041
Male	36	23 (64)		
Type of therapy				
RT and CT	38	30 (79)		0.052
RT only	12	6 (50)		
Smoker			Grade III OM	
Yes	37	27 (73)	7 (26)	0.355
No	13	9 (69)	1 (11)	
Type of tumor			% OM total incidence	
Nasopharynx	18	17	47	< 0.001
Larynx	11	1	3	
Parotid	7	4	11	
Tongue	6	6	17	
Oral cavity	4	4	11	
Max. Sinus	3	3	8	
Post cricoid	1	1	3	
	50	36

Figure 3. Number and distribution of unplanned breaks in treatment in weeks in patients undergoing radiotherapy for head and neck cancer in Iraq (n=50).

Table 3. Distribution of unplanned breaks in treatment due to oral mucositis (OM) according to different variables in patients undergoing radiotherapy for head and neck cancer in Iraq (n=50). RT, radiotherapy; CT, chemotherapy.

Variable	Sub group	OM cases	N breaks	%	P value
Gender	Males	23	8	35%	0.212
	Females	13	2	15%	
Smoker	Yes	27	8	30%	0.669
	No	9	2	22%	
Therapy	RT and CT	30	9	30%	0.506
	RT only	6	1	17%	
Stages	II	3	1	33%	0.822
	III	24	5	21%	
	IV	9	4	44%	
Grade of OM	Grade 2	20	6	30%	0.078
	Grade 3	8	4	50%	

Discussion

In most countries around the world, HNC is most common in men, and the male/female ratio ranges from 2:1 to 4:1^{7,17}; in the UK, the ratio of male/female was 2.7:1, and in Australia it was 2.6:1^{18,19}. In our study the ratio was 2.6:1, which is consistent with studies elsewhere. In a similar study, Vera *et al.* found the mean age of 450 HNC patients was 61.3 ± 12.3 years¹⁴, and it was 53.3 ± 11 years in our study. According to Cancer Research UK, 50% of HNC cases each year are diagnosed in people aged 65 and over¹⁸. Some of our patients were aged 65 years but only constituted to 20% of the study population. This difference in age incidence can be attributed to many causes, such as the rising age incidence of HNC in the West¹⁷, higher life expectancy in those countries²⁰, differences in environment, and differences in life style²¹.

In the current study OM occurred in 72% of patients, while in other studies OM occurred among virtually all patients who are undergoing RT^{11,21}. Eilers and Million consider being female, young age and elderly as risk factors for developing OM²². This agrees with our study; 93% of females had OM, and there were high rates observed in the age groups of <35 years and >65 years.

In our study, grade III OM occurred in 18% treated with both therapies, while its appearance in 8% only among those who received RT only. Lalla *et al.* found a high incidence of OM with primary tumors in the oral cavity, oropharynx or in the nasopharynx¹⁶. This is well observed in the current study in which all patients had primary tumors. All patients with oral cavity, tongue, maxillary sinus and post-cricoid tumor developed OM. 94% of patients with nasopharynx tumor had OM and 47% were seen in nasopharynx patients. The tongue, oral cavity, and maxillary tumors constituted 36% of OM, while parotid tumor contribution was 11%.

The main principles of treatment by radiation is to deliver the total fractionated dose without interruptions. However, in daily

clinical practice unplanned treatment interruptions are inevitable. Bese *et al.* concluded that patients, because of moderate or severe ulcerative OM had 15.8% and 46.8% incidences of RT break, respectively²³. In our study, among 36 patients with OM, 10 of them (27.8%) needed breaks. The percent of breaks was high in males (35%), smokers (30%), those who were treated with CT plus RT (30%), those with stage IV (44%), and those with grade III OM (50%). In this study, two patients had breaks before the end of the 3rd week, and four had unplanned breaks at the 6th and 7th weeks, so a total of six patients (12%) had breaks at a critical treatment time. However, the break durations were only 1–3 days, but it is important to mention that in most of the times, the break is decided by patients themselves (subjective). It is convenient to mention here the conclusion of Bonomi *et al.*, that OM is not only painful but also decreases the patient's willingness to continue treatment²⁴.

Conclusions

OM is an ongoing toxicity of RT, yet it still represents an important clinical challenge and causes burden to patients and caregivers. Most patients with HNC treated by radiation develop OM. The sub-site of the tumor is a main risk for development of OM. It was observed that young and old ages, combined RT plus CT, and advanced stage of tumor are associated with high incidence and severe OM. Patients with OM are at high risk of unplanned breaks in radiation. HNC in Iraq attack young and middle age people, which may lead to increases on its social and economic burden.

Recommendations

1. Using a multidisciplinary approach for oral management of HNC, before, during and after treatment.
2. Provision of psychological care and support services for these types of patients.
3. Education of patients and families regarding oral care.
4. Encouragement and support of multi-center studies and researches.
5. Raising competency of dentists, primary health care physicians and dermatologists to ensure early detection of HNC.

Data availability

Underlying data

Zenodo: Excel sheet file of 50 head and neck cancers whom suffer from oral mucositis due to radiotherapy, <http://doi.org/10.5281/zenodo.2543204>²⁵.

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](#) (CC-BY 4.0).

Grant information

The author(s) declared that no grants were involved in supporting this work.

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<http://www.doi.org/10.5281/zenodo.2543204>

Open Peer Review

Current Peer Review Status: ? × ? ?

Version 1

Reviewer Report 29 July 2020

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² Radiology department, Faraskour Central Hospital, Damietta Health Administration, Ministry of Health and Population, Damietta, Egypt

The authors of the article titled; "Oral mucositis patients undergoing radiotherapy for head and neck cancer: An observational cross-sectional study", investigated the oral mucositis (OM) rate, grades and effect on treatment continuation in a sample of 50 head and neck cancer (HNC) patients undergoing treatment at Baghdad Radiation Oncology and Nuclear Medicine Center, Iraq, from 30th April to 10th September 2017. The article may present an important statistical tool for Iraqi HNC patients, however, many issues should be addressed in order to improve the scientific impact of the article.

- The population sample size looks relatively small compared to similar studies. I think, if the sample size increased, that would show significant differences for the authors' selected variables, especially when applying more complicated significance tests other than simple T-test.
- At the abstract conclusion section:
 - The authors mentioned OM occurred more in female patients who received chemotherapy (CT) plus radiotherapy (RT). But, they did not illustrate the chemotherapy details (type, dose, duration, and whether it was definitive or adjuvant). Please, track this throughout the article sections and include it at the study statistics.
 - The authors stated "OM-related unplanned breaks may interrupt treatment schedule". The authors did not show data with significant difference for that conclusion. Again, the sample size needs to be increased.

- At the introduction section:
 - The authors mentioned different primary causes for HNC, yet, they investigated smoking only. Are other variables investigated for the study population?
 - The last paragraph of the introduction section should be reformatted and attached to references.
- The methods section:
 - The authors did not mention surgery as a treatment modality for HNC patients. This should be addressed and included at the study statistics.
- The authors selected variables:
 - Please, state “tumor stage” instead of “stage”
 - Please, state “OM grade” instead of “grade”.
 - Did you show any data for OM onset?
 - Did you investigate viral infections as well?
- Treatment unplanned breaks issue needs to be discussed in detail and data sorted as well. Who decided the break? Which treatment was interrupted in “CT plus RT” group? And, for how long was it? Were the breaks caused by OM only?
- Please, discuss why there was no significant difference in all groups (Table 3).
- I would recommend reformatting the recommendation section to reflect the study results and conclusion.
- Table 1: please, adjust clearly the P-value (done for which groups) and mention in the text.
- Figure 2: please, add the axis title for the graph, and make the graph simple.
- Table 2: better to change the % of total OM for the “Type of tumor” to be the % of OM within the same tumor type. Example: Nasopharynx has 17 OM patients out of 18 patients, so the % of OM in Nasopharynx patients will be $17/18 \times 100 = 94.4\%$. Apply for all then readjust the statistics for that. Also, please, mention the P-value in text.
- Figure 3: please, write the axis titles for the figure. Make it simple.
- Table 3: The P-value for the tumor stages is not clear. Please, specify.

- In total, the article English language should be improved. I suggest to it be reviewed by a native English speaker.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 07 July 2020

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The authors of "Oral mucositis patients undergoing radiotherapy for head and neck cancer: An observational cross-sectional study" reported the occurrence of oral mucositis in 50 patients undergoing radiotherapy for head and neck cancer in Iraq. They estimated the incidence of oral mucositis and the related grade (assessed by WHO scale) by age, gender, type of tumor, type of therapy and smoking habit. The study is interesting but I have some suggestions to improve the

clarity of the paper and the impact of the results and their interpretation:

- Risk factors: why do the authors provide specific analysis for smoker patients and not for drinkers or for those with viral infections?
- Exclusion criteria: how many patients were excluded from 30th April to 10th September 2017?
- Data collection: it is not clear how they collect data (they asked patients to fill in a questionnaire, they extract data from medical records, ...).
- Table 1: there are not only patients' demographic data (change title); add p value description in the text; 86% of men were smokers and 43% of women (change phrase in the text and modify in the Discussion).
- Occurrence of OM by age: the suggestion is described 15-44, 45-65 and ≥ 65 years old.
- Table 2: it is not clear if p value 0.355 refers to OM or in Grade III OM for smoker/non smoker; it could be more informative to show % of OM in every type of tumor (17/18=94,4% of OM in nasopharynx patients, 1/11=9,1% in larynx patients...).
- Figure 3: clarify the meaning of x-axis; the meaning is, for example: 3 patients broke treatment after 6 weeks from the first RT?
- Table 3: are the authors sure that the only reason to break treatment is OM? In the Discussion they reported: "that in most of the times the break is decided by patients themselves". This aspect needs to be more detailed: how many times does it happen? In which way did they break the treatment?
- Was OM the only reason for breaking the treatment? All differences by sub groups are not significant (add a comment in the text).
- Recommendations: are not related with results reported in the article (especially for n. 2 and 3).
- In general, the English needs to be revised.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Epidemiology, Statistics, Cancer Registries Data

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 29 October 2019

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Tatsuhiko Miyazaki

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In this manuscript entitled “Oral mucositis in patients undergoing radiotherapy for head and neck cancer: An observational cross-sectional study”, the authors reported the cross-sectional analyses of oral mucositis of 50 head and neck cancer cases which had undergone radiation therapy. They presented 36 out of 50 cases (72%) manifested oral mucositis. Location of the tumor and gender were revealed to correlate the incidence of OM significantly, but no parameter was detected with significant difference regarding unplanned break of the therapy. The data and curation result have several matters to address.

Major points:

1. This manuscript shows limited impact of scientific novelty, nevertheless has a potent importance for indexing when considering the mean of regional statistical studies in Iraq.
2. The number of studied cases looks inadequate for the strength of statistical analyses. Even after the first publication in F1000 Research, the authors should make an effort to increase the number of analysed cases and revise the data. It might be expected that type of therapy should reveal a statistically significant difference in the incidence of OM.
3. Regarding the scoring system of OM, the authors employed WHO scale of OM only. This scale system should be simple and easy to value but there are more precise novel scoring systems such as Oral Mucositis Assessment Scale (Toro *et al.*, 2007¹). The authors should at least refer to the OM assessment system in the discussion part.

4. In the method part, it looks inappropriate to test the significance using simple t-test in each parameter. At least, the authors should employ the multivariate analysis which might be available on SPSS software.
5. There was no presented data regarding the chemotherapy (type, timing, regimen as well as actual dose value). The authors should manifest the data and show the statistical analyses regarding this point.
6. Settings of the radiation therapy were not described in detail and also there was no data about surgery. If the patients got RT and chemotherapy only, the authors should describe it.

Minor points:

1. In the introduction part, the authors described Human Hepatitis Virus as a risk factor, but in the cited references, it looks like Human Papilloma Virus should be the risk factor.
2. Figure 1: The presentation of the pie chart looks unsuitable. Improvement of the colour usage (it's not necessarily in colour figure) is recommended.
3. In the results (Table 2 and 3), it looks like smoking should be a big risk factor of incidence of HNC. The authors might be better to mention it more strongly.
4. Conclusion: It might be better to conclude in medical scientific terms.

References

1. Toro J, Arango J, Westbrook S, Jewell P, et al.: Oral Mucositis Measured by the Oral Mucositis Assessment Scale (OMAS), but Not by the World Health Organization (WHO) Scoring System, Correlates with Nutritional Changes after Autologous Peripheral Blood Stem Cell Transplantation. *Blood*. 2007; **110** (11). [Publisher Full Text](#)

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

No

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Pathology, Oncology and Genomic Medicine

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 04 September 2019

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Pierfrancesco Franco

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The authors report on the bone marrow changes during RT-CT in anal cancer patients as assessed by FDG-PET performed at week 2 of treatment. The study is of interest. Bone marrow sparing approaches tend to rely on the fact that bone marrow is a static organ at risk to be avoided during planning and delivery, but this is not the case, since both CT and RT may change the relative proportion of active/whole bone marrow and the spatial distribution.

I have some comments:

Introduction:

1. I would cite HPV infection as a risk factor.

Methods:

1. I would not call eligibility criteria out; it is a retrospective study and hence I would rather define patients' characteristics.
2. No data on chemotherapy are present (type, timing, regimen); please provide details.
3. With respect to RT, please provide details on the setting (definitive RT, adjuvant RT); if part of the cohort includes post-operative patients, please describe.
4. Which OM scoring scale did you use? Please specify.

Results:

1. Please provide data on the timing of worst OM; at which week of treatment.

Discussion:

1. Please cite and discuss Franco *et al.* (2017¹).

General comment:

1. I would suggest the authors to have their manuscript revised by a native speaker. Language needs to be improved.

References

1. Franco P, Martini S, Di Muzio J, Cavallin C, et al.: Prospective assessment of oral mucositis and its impact on quality of life and patient-reported outcomes during radiotherapy for head and neck cancer. *Med Oncol.* 2017; **34** (5): 81 [PubMed Abstract](#) | [Publisher Full Text](#)

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Radiation oncology; head and neck cancer; clinical oncology

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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