ORIGINAL RESEARCH

Knowledge and Practice of Radiation Stents for Oral Cancer Patients among the Sudanese's Maxillofacial Surgeons, Prosthodontists, Oncologists, and Radiotherapists

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Abstract

Aim: To assess the knowledge and practice of radiation stents for oral cancer patients among the Sudanese's maxillofacial surgeons, prosthodontists, oncologists, and radiotherapists in Khartoum state.

Materials and methods: A self-administered questionnaire composed of three sections, including the participant's sociodemographic, knowledge, and practice data, was conducted and distributed among the specialists and Registrars of maxillofacial surgery, prosthodontics, oncology, and radiotherapy who were working at the Khartoum Teaching Dental Hospital, the Faculty of Dentistry (University of Khartoum), and the Khartoum Oncology Hospital, respectively, during the study's duration. A cluster sampling technique was used, and within the cluster group, simple randomization was used. The sample size was 137 participants. The participant's knowledge and practice scores were calculated as percentages achieved by dividing the numbers of the accurate answers of the participants by the total number of questions and categorized as good (66.6%–100%), average (33.3%–66.6%), and poor (less than 33.3%).

Result: The response rate was 80%. Forty five (40.9%) of the respondents were males, and 65 (59.1%) were females. The high-frequency age-group was 30–40 years (59 subjects, 53.6%). Thirty-eight participants (75.5%) were unfamiliar with the radiation stent. The overall knowledge score was poor, with a significant difference between the different groups ($p = 0.0001$*). Only the prosthodontists reported a good level of knowledge about the radiation stent (73%), while the oncologists and the radiologists showed a zero level of knowledge. Despite this, the practice score of the radiation stent was poor among all groups. The level of knowledge regarding the complications of radiation and the different protective measures among the maxillofacial surgeons, oncologists, and radiotherapists was 55%, 60%, and 50%, respectively, while the prosthodontists reported 70%. Only 27 (24.5%) participants reported a multidisciplinary treatment approach. At the same time, the majority, 59.1%, declared that they do not follow a formal clinical guideline and/or protocol for dental treatment in oral cancer patients. The lack of knowledge and communication between the different health providers were the main barriers preventing the use of radiation stents.

Conclusion: The knowledge and practice of the radiation stent were poor. A highlighted need was strengthened to improve the training and communication among the multidisciplinary oral cancer team members, and standard clinical guidelines and protocols need to be conducted and followed to improve patient treatment outcomes.

Clinical significance: Radiation stents have a significant role in reducing the complications of radiation therapy. Improving the knowledge and practice of radiation stents will have a substantial influence on the quality of health services provided for the oral cancer patients and their quality of life.

Keywords: Knowledge, Oral cancer, Practice, Radiation stent, Treatment.

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Introduction

Oral cancer is a health problem that affects people all over the world, and most new cases are found in developing countries.[1] In Sudan, oral cancer is the fourth most common cancer in males and the fifth in females.[2] The treatment goal in oral cancer is to eradicate the disease and retain the patient's oral health, function, esthetics, psychology, and quality of life.[3–8] Different treatment modalities may be used to achieve this goal, such as surgery, radiotherapy, chemotherapy, or a combination of these modalities.[3–7] Most advanced oral cancer cases necessitate the introduction of radiotherapy as an adjunctive treatment before and/or after the surgery or as a palliative treatment.[3–7]

Radiation therapy is "the therapeutic use of ionizing radiation".[4] It affects the tumor cell DNA and disturbs the molecular properties of tumor cell mutation. Despite the advancement in radiation therapy, this treatment may be associated with a wide range of oral complications,[9–22] which can be minimized or even eliminated if the multidisciplinary oral cancer team follows specialized oral care

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protocols before, during, and after radiation therapy, including the use of protective radiation measures.[23–27]

Several protective measures have been prescribed to reduce the amount of radiation received by the healthy tissues, including proper positioning of the patient and the radiation source, protective shielding, and radiation stents.[27–39] A radiation stent is an individualized mouth-opening device that inhibits or eliminates unnecessary radiation into normal adjacent tissue, reducing post-therapy morbidity.[27–39] Goel et al.[40] reported that the use of an intraoral stent during radiotherapy for tongue cancer significantly reduced the incidence of mucositis, xerostomia, and salivary changes compared with the group without a radiation stent.

Moreover, Verrone et al.[28] concluded that using a stent reduces the radiation dose in the glandular tissue and positively impacts salivary changes. Johnson et al.[34] focused on the importance of radiation stent devices and recommended their use in all cases to spare the contralateral healthy tissues from radiation.

Several stent designs have been described, including radiation carriers stents, positioning stents, protecting stents, tissue recontouring stents, and bolus compensators stents.[27–40] Radiation stents are commonly constructed from heat-cured acrylic resin with or without shielding alloy, followed by silicone.[38] With advanced dental technology, computer-aided designing and manufacturing (CAD/CAM) can efficiently be used to construct radiation stents.[32]

Literature documented suggests surveys were conducted in different parts of the world[41–46] to evaluate the knowledge, attitude, and practices among undergraduate medical students,[41] nurses,[42] specialists,[43] even the patients[44] and healthcare workers,[45] and dentists[46] about oral cancer in order to increase awareness, improve early detection, prevent the disease, reduce the side effects of radiotherapy and chemotherapy, promote a standard-of-care management, and improve the patient's quality of life.

Despite the reported advantages of radiation stents,[27–40] there is no evidence concerning the awareness of the oral cancer team members about radiation stents, and no literature labels their practice among the Sudanese oral cancer patients.

The aim of the study is to assess the knowledge and practice of radiation stents for oral cancer patients among the Sudanese's maxillofacial surgeons, prosthodontists, oncologists, and radiotherapists in Khartoum state.

Materials and Methods

The study was approved by the ethical committees of the Sudanese Ministry of Health, the State of Khartoum, and the University of Khartoum's Faculty of Dentistry. Before enrolment, the participants signed an informed consent. The study was conducted between June 2019 and January 2020.

The Study Population

The study population included: (i) prosthodontists and restorative dentists (registrars, specialists) who registered at the Sudanese Medical Council and worked at the prosthodontic and restorative clinic in the Faculty of Dentistry, University of Khartoum. (ii) The registrars and specialists of the Department of Maxillofacial Surgery worked at the Khartoum Teaching Dental Hospital. (iii) The Registrars and specialists of the Oncologist and Radiotherapy worked at Khartoum Oncology Hospital during the study's duration.

The total population was found to be 280, distributed as follows: 30 specialists and 60 registrars of maxillofacial surgery, 30 specialists and 20 Registrars of prosthodontics, 40 specialists and 60 Registrars of oncology, and 40 radiotherapy (Table 1).

Data availability: The data used to support the findings of this study are available from the corresponding author upon request.

Ethical approval: The study was approved by the Ethical Committees of the Sudanese Ministry of Health, the State of Khartoum, and the University of Khartoum's Faculty of Dentistry.

Table 1: Distribution of the study's population and the sample size

Sample (participants) distribution	*Population size*	*Sample size*
Maxillofacial surgeons		
Specialists	30	16
Registrars	60	27
Total	90	43
Prosthodontists		
Specialists	30	10
Registrars	20	20
Total	50	30
Oncologists		
Specialists	40	20
Registrars	60	20
Total	100	40
Radiotherapists	40	24
Total	280	137

Sample Selection and Sample Size Calculation

Cluster-randomized sampling technique was used. The adequate sample size was determined using the following formula:

$$n = \frac{N_Z{}^2 pq}{d^2(N-1) + Z^2 pq} deff$$

where n = the sample size, z = the critical value for achieving (1–α)% confidence level, here, we use $z = 1.96$, p = the anticipated population proportion, $q = 1–p$, and d = the desired margin of error taken as 0.06. Finally, the determined sample size was 137 participants.

The number of respondents needed from each hospital and speciality was figured out using a probability that was proportional to the size of each hospital's population. The sample within the cluster was chosen using a simple randomization method.

Questionnaire Design

The questionnaire was self-administered, written in English, and had 23 closed-ended questions and only one open-ended question. The participants were interviewed in-person and gave their signed consent. The questionnaire was left with the participants with the expectation that they would complete it voluntarily within 1 week.

The exclusion criteria of the study included: (i) incomplete or improperly filled questionnaires and (ii) participants who did not provide signed consent for the study.

The questionnaire had three sections: the first and second sections were based on previous research,[41,43] while the third section included questions written by the authors. The sections covered the following aspects: seven demographic data questions

(section A),[41,43] five questions assessing the participant's knowledge and practice about radiation therapy, and the most common complications reported[43] (section B), and the last 12 questions targeted the knowledge and practice of the participants about the different protective measurements, including the radiation stent, the different types of radiation stent, the material used, the advantages, the practice of the radiation stent, and barriers preventing the use of the radiation stent, as well as the participant's recommendations (section C).

Reliability and Validity of the Questionnaire

A pilot study was performed to inspect the questionnaire's internal consistency, the acceptability of the time needed to complete the questionnaire, the data collection approach's practicality, and the questions' clarity. Using convenience sampling technique, the questionnaire was administered to 30 participants twice, with two-week elapsed intervals. The Cronbach α was used to measure the consistency between the different questions and the validity, resulting in 0.701 and 0.83, respectively. The final results did not include the pilot research sample.

The Participant's Knowledge and Practice Scores

The participant's knowledge and practice scores were calculated as percentages achieved by dividing the number of accurate answers by the total number of questions. Accordingly, the knowledge of the participants was categorized into good (66.6%–100%), average (33.3%–66.6%), and poor (less than 33.3%).

Data Analysis

Data were collected, coded, tabulated, and statistically analyzed using the IBM Statistical Package for Social Sciences software (SPSS version 22). Descriptive statistics were presented in frequency tables, graphs, means, and standard deviations. The Chi-square test was used to analyze the data. A *p*-value of 0.05 was considered significant, with a 95% confidence interval.

Results

Out of the 137 questionnaires that were distributed, 110 were statistically analyzed, with a response rate of 80.3%. Among the 27 (19.7%) excluded questionnaires, 6 (4.4%) did not provide informed consent, 14 (10.2%) were incompletely filled, and 7 (5.1%) were improperly filled, selecting two options when only one option was requested. Forty five (40.9%) of the respondents were males, and 65 (59.1%) were females. The high-frequency age-group in the study was 30–40 years (59 subjects, 53.6%). The oncologist showed the highest response rate (100%) (the respondents were 40 subjects, and the required sample size was 40) (Table 2).

The majority of respondents, 65 (59.1%), declared that they were not aware of or did not follow a formal clinical guideline and/or protocol for dental assessment of preradiation treatment of head and neck cancer patients before radiotherapy. Only 27 (24.5%) mentioned that they used an NCCN guideline as a specific guideline (Table 3).

The majority of respondents mentioned that the more common complications seen during and/or after radiotherapy were mucositis (94.5%), xerostomia (95.5%), trismus (90%), dental caries (81.8%), candidiasis (80%), osteoradionecrosis (79.1%), taste impairment (73.6%), and periodontitis (72.7%) (Fig. 1).

Although 90% of respondents knew about the protective measures that should be used during radiation therapy. The majority (88.9 %) considered that apron shielding was the primary protective measurement. Only 27 (24.5%) of the participants recognized the radiation stent, while eighty-three subjects (75.5%) declared that they were unfamiliar with it (Table 2).

Table 2: Participants' characteristics, including the participant's gender, age, and their specialties

Variable	*Frequency*	*Percent (%)*
Gender		
Male	45	40.9
Female	65	59.1
Total	110	100
Age		
21–30 years	33	30
31–40 years	59	53.6
41–50 years	18	16.4
The specialty of the participants		
Maxillofacial surgery		
Consultants	16	14.5
Registrars	16	14.5
Prosthodontics		
Consultants	13	11.8
Registrars	8	7.3
Oncology		
Consultants	15	13.6
Registrars	25	22.7
Radiotherapists	17	15.6

Table 3: Participants' knowledge about the multidisciplinary clinic or meeting

Variable	*Frequency*	*Percent (%)*
Multidisciplinary clinic/meeting in your hospital		
Yes	27	24.5
No	81	73.6
I am not sure	2	1.8
Specific preradiation dental protocol		
Yes	27	24.5
No, I am aware of protocol, but I do not follow	18	16.4
No, I am not aware of any protocol	65	59.1
Knowledge about protective measurement of radiation		
Yes	99	90
No	11	10
Protective measurement you are familiar with		
Apron shielding	88	80
Face mask	61	55.5
Radiation stent	27	24.5

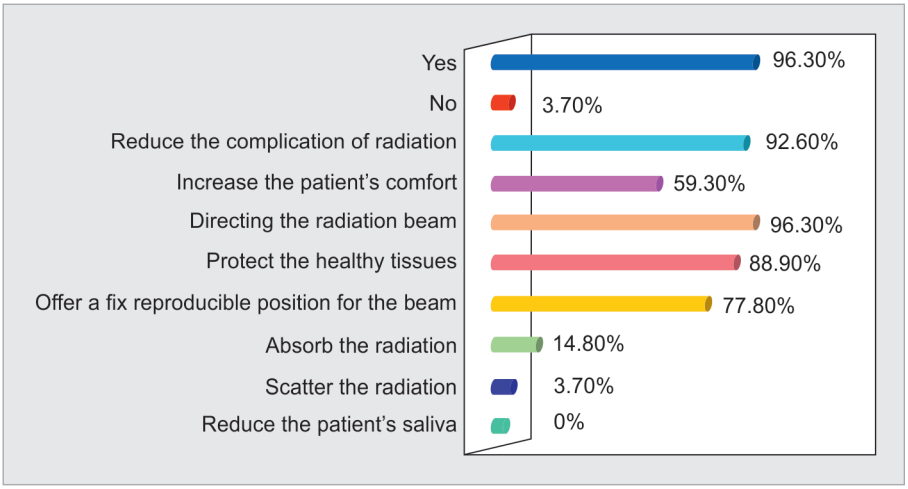

Fig. 1: The participants' knowledge about the advantages of radiation stents

For all the subsequent statistical results and further evaluation, the sample size tends to be 27 respondents who recognized the radiation stent as one of the protective measures to address the study's objective.

Out of the 27 respondents, 24 of them (88.9%) mentioned they knew the different types of radiation stents. The majority (21, 87.5% and 20, 83.3%) recognized the positioning radiation and the tongue-depressing stent, respectively. A minimum number of the responders (7, 29.2%, and 11, 45.8%) falsely considered the nasal and palatal stents as types of radiation stents (Table 4).

Almost all the respondents (26, 96.3%) proclaimed they knew about the advantages of radiation stents. Hence, the majority reported that it was used to direct the radiation beam, reduce the complications of radiation (25, 92.6%), and it protects the healthy tissues (24, 88.9%), while only 3.7% had the incorrect knowledge that the radiation stent scattered the radiation. On the other hand, no one reported that a radiation stent might reduce the saliva of the patient (Table 3). Moreover, the majority (25, 92.6%) described acrylic resin as the material of choice for the construction of the radiation stent, while no one mentioned the gypsum material (Table 4).

Table 5 shows the knowledge of the participants. The majority of the prosthodontists (76.2%) scored good while the majority of the maxillofacial surgeons, the oncologists, and the radiotherapists scored poor with a significant correlation between the participants' specialties and their self-evaluated knowledge (p-value = 0.001*) (Table 5).

All of the respondents showed poor practice scores regarding the construction of the radiation stent (Table 5).

Table 6 reported the barriers that prevent the construction of the radiation stent; most of the respondents stated that the lack of knowledge and communication with other specialties were the main barriers preventing the usage of radiation stents usage (Table 6). Almost all of the respondents, 107 (97%), recommended improving awareness and practice of radiation stents (Table 6).

The challenge encountered during the study was distributing and collecting the questionnaires in a way that followed the randomized sampling method. Hence, the study population worked

Table 4: Participants' knowledge about radiation stents (types, advantages, materials commonly used for construction, barriers that prevent construction, and recommendations)

Variable	*Frequency*	*Percent*
Knowledge about radiation stent		
Yes	27	24.5
No	83	75.5
Different types of radiation stents		
Positioning stent	21	87.5
Tissue bolus stent	4	16.7
Tongue-depressing stent	20	83.3
Nasal stent	7	29.2
Palatal stent	11	45.8
Tissue recontouring stent	12	50
Advantages of the radiation stent (N = 27 respondents)		
Familiar with radiation stent advantage	26	96.3
Not familiar with advantage	1	3.7
Reduce the complication of radiation	25	92.6
Increase the patient's comfort during the radiation session	16	59.3
Directing the radiation beam	26	96.3
Protect the healthy tissues	24	88.9
Offer a fix reproducible position for the beam	21	77.8
Absorb the radiation	4	14.8
Scatter the radiation	1	3.7
Reduce the patient's saliva	0	0
Material commonly used for construction of radiation stent		
Chrome cobalt	3	11.1
Wax	1	3.7
Acrylic resin	25	92.6
Gypsum	0	0

Table 5: The assessment of the level of knowledge of the participants about radiation stent, the association between the participant's specialty and their self-evaluated knowledge about the radiation stent, and the assessment of the participants' practice of the radiation stent

The assessment of the level of knowledge of the participants about radiation stent				
Specialists/Knowledge	*Poor N/%*	*Average N/%*	*Good N/%*	*Total*
Maxillofacial surgeons	22/68.8%	7/21.9%	3/9.4%	32/100%
Prosthodontists	4/19%	1/4.8%	16/76.2%	21/100%
Oncologists	40/100%	0/0%	0/0%	40/100%
Radiotherapists	17/100%	0/0%	0/0%	17/100%
The association between the participant's specialty and their self-evaluated knowledge about the radiation stent				
Specialists/Knowledge	*Yes N/%*	*No N/%*	*Total N/%*	*p-value*
Maxillofacial surgeons	10/31%	22/69%	32/100%	0.001*
Prosthodontists	17/81%	4/19%	21/100%	
Oncologists	0/0%	40/100%	40/100%	
Radiotherapists	0/0%	17/100%	17/100%	
The assessment of the participants' practice of the radiation stent				
Specialists/Practice	*Poor N/%*	*Average N/%*	*Good N/%*	*Total*
Maxillofacial surgeons	32/100%	0/0%	0/0%	32/100%
Prosthodontists	21/100%	0/0%	0/0%	21/100%
Oncologists	40/100%	0/0%	0/0%	40/100%
Radiotherapists	17/100%	0/0%	0/0%	17/100%

Table 6: The barriers that prevent the construction of radiation stent and the participants' recommendations

Variable	*Frequency*	*Percent (%)*
Barriers prevent construction of radiation stent ($N = 110$ respondents)		
Lack of knowledge and practice	102	92.7
Lack of communication with team	86	78.2
Lack of funding	20	18.2
Lack of time	10	9.1
Recommendations ($N = 110$ respondents)		
Improve the awareness and training	107	97.3
Time being released from other duties	18	16.4
Need of a specialized center	47	42.7
Financial support	31	28.2

at three different study areas with different schedules, and each professional had his or her own specific working hours.

Discussion

Radiotherapy is a treatment modality commonly used for treating head and neck malignancies.[7–11] Unfortunately, several oral complications may be encountered during and/or after the treatment course.[7–23] These complications result in increased patient discomfort, significant morbidity, increased cost, and a negative impact on the patient's quality of life.[7–23]

To our knowledge, this study is the first to assess the knowledge and practices of the radiation stents among oral cancer team members in Khartoum state, Sudan.

The majority of the participants in this study were female, reflecting an increase in female dental professionalism and practice compared with males. A similar trend was noticed by Ahmed and Naidoo[46] in Sudan and Chaudhary et al.[47] and Fotedar et al.[41] in India.

The majority of the participants reported the absence of the multidisciplinary team and specified a protocol used for oral cancer treatment at their hospitals, except the oncologists, who reported their team and ENT specialists. The result reflects the lack of knowledge about the importance and the efficiency of the multidisciplinary team in treating oral cancer patients and an increasing need to improve the knowledge of all the healthcare providers who are dealing with oral cancer patients about the advantages of the multidisciplinary team. This finding is in line with Brody et al.,[48] who stated that with the advancements in radiotherapy treatment, the dental team in Ireland is still admitted with many challenges, including the communication between the different members of the multidisciplinary team and the lack of standardized guidelines and funding. On the same line, Pai and Ongole[42] reported poor knowledge about oral cancer management protocol by half of the participants in a survey conducted among 158 nurse staff in India. Almahmoud Idris et al.[45] documented a poor level of knowledge about the best-treatment modality for oral cancer among the healthcare workers in Sudan including doctors, nurses, pharmacists, laboratory technologists, laboratory assistants, and counter. In contrast, Suhaimi[43] conveyed that more than half of the undergraduate dental and medical students in Malaysia and New Zealand described the presence of a multidisciplinary meeting at the main oral cancer centers located in the major cities. In accordance with that, Shellenberger and Weber[49] stated that multidisciplinary team care is recommended to provide efficient, timely, and evidence-based management for head and neck cancer patients.

The vast majority of the participants in this study recognized mucositis and xerostomia as the most common radiotherapy-related oral complications encountered during or after therapy. A result matched Sroussi et al.,[50] who stated that mucositis, infections, salivary

changes, fibrosis, sensory dysfunctions, dental caries, periodontal disease, and osteoradionecrosis are the common complications of head and neck cancer radiotherapy. Even though most respondents stated that they knew about the protective measures used during radiation, the majority reflected a lack of knowledge about the radiation stent despite its evidence-based benefits.[24,32,40] Further analysis in this study revealed that the prosthodontist had good knowledge. As a result, in accordance with Mantri et al.,[27] they stated that close collaboration between the radiotherapist and the prosthodontist is essential for treating oral cancer patients, and this collaboration involves the construction of the radiation stent. Aggarwal and Kumar[30] mentioned that the prosthodontist should actively participate in treating and rehabilitating head and neck cancer by constructing a protective radiation stent. In contrast, Zaid et al.[32] stated that an oral–maxillofacial surgeon makes conventional customized radiation stents.

In this present study, the majority of the maxillofacial surgeons, oncologists, and radiotherapist reported poor level of knowledge about radiation stents, this can be due to the lack of information about radiation stents during the undergraduate and postgraduate studies, the lack of communication between oral cancer treatment team members, or even the lack of multidisciplinary team care. This outcome was a major alarm that needed to be addressed right away and required immediate attention to raise the awareness of the advantages of using the radiation stent. In accordance with this result, Ahmed and Naidoo[46] reported that the vast majority of the dentists who participated in a survey conducted to assess the knowledge, attitude, and practice of dentists in Khartoum State about oral cancer prevention and early detection, highlighted the need for additional oral cancer education and training sessions.

Although good knowledge about oral cancer risk factors, signs, symptoms, diagnostic techniques, and prevention methods was reported by Almahmoud Idris et al.[45] among the primary healthcare workers in Khartoum State, including doctors, nurses, pharmacists, laboratory technologists, laboratory assistants, and counters, the result of the same study revealed a poor knowledge about the best treatment methods for oral cancer.

Patel et al.[51] declared that 55% of the dental respondents in their study felt incompetent to treat patients with head and neck radiation therapy owing to a lack of knowledge and inadequate training and showed interest in continuing educational and training programs. On the same line, Fotedar et al.[41] reported that 99% of undergraduate dental students in India Gandhi Medical College, Shimla, agreed on the need for additional training and information regarding oral cancer, including diagnosis, risk factors, and management protocol. This finding highlights the importance of increasing the awareness of health providers other than the prosthodontist about the advantages of the radiation stent to improve the therapeutic service, optimize the patient's treatment approach, and ensure a standard of care in patient management.

Almost all the respondents who recognized the radiation stent identified their advantages. The reported advantages were in line with Brody et al.,[48] who mentioned that the radiation stent could protect the remaining healthy oral tissues, increases the distance between the mandible and the maxilla, protect the healthy jaw, direct and concentrate the radiation dose more precisely on the target area, ensure the stable position of the beam during radiation, and immobilize the mandible.[27,31,38,39] In the opposite direction, most of the participants who knew about the radiation stent had never fabricated it. This result is in line with the other literature reporting that only 5% of Malaysian dentists and 8.6% of New Zealand dentists "often/always" provide their patients with mucosal guards or radiation stents.[43] Patel et al.[51] declared that only 11% of dentists provided mucosal guard stents to reduce the adverse effects of radiation therapy.

Most of the participants emphasized that the lack of knowledge about radiation stents and the lack of communication with other specialties were the main barriers preventing the use of radiation stents. Moreover, they recommended improving the knowledge of oral cancer team members about the importance of using radiation stents and the need for a specialized center for oral cancer treatment. These were in agreement with many investigators.[25,26,43,46,48] The limitation of this study was the relatively limited specialty investigated. Further study is needed, including all the specialties within the maxillofacial team.

Conclusion

Within the limitations of this study, a poor level of knowledge was reported on the aspects of radiation stents. Although the prosthodontists had a relatively good level of knowledge compared with the other members, they did not construct it as well as the other specialties. The majority of the maxillofacial surgeons, radiotherapists, and the oncologists reported a poor level of knowledge.

The lack of knowledge and practice, followed by the lack of communication with the other team members, are the main barriers that prevent the use of radiation stents. A recommendation to improve healthcare awareness and training about radiation stents and to provide a specialized center for oral cancer patients treatment has been raised.

Auhtors' Contributions

HR was responsible for the conception and design of the study, acquisition of data, drafting of the paper, and its critical revision; AF was involved in the critical revision of the questionnaire, analysis and interpretation of data, and drafting and revising the paper critically for important intellectual content.

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