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CASE REPORT :

Prosthetic rehabilitation of partially edentulous patients with limited mouth opening: Case report

Auteurs : Ines Saadellaoui[1], Sana Bekri[2], Amel Labidi[3], Yosra Mabrouk[4], Sameh Rzigui[5], Hiba Triki[6], Lamia Mansour[7]

[1] DDS, resident dentist, removable prosthetics department, Biological Approach and Dento-Facial Clinic laboratory (LR12ES10), Faculty of Dental Medicine, University of Monastir, Tunisia

[2,3]DDS, associate professor, removable prosthetics department, Biological Approach and Dento-Facial Clinic laboratory (LR12ES10), Faculty of Dental Medicine, University of Monastir, Tunisia

[4,5] DDS, assistant professor, removable prosthetics department, Biological Approach and Dento-Facial Clinic laboratory (LR12ES10), Faculty of Dental Medicine, University of Monastir, Tunisia

[6,7] DDS, professor, removable prosthetics department, Biological Approach and Dento-Facial Clinic laboratory (LR12ES10), Faculty of Dental Medicine, University of Monastir, Tunisia

Corresponding Author: Sana Bekri

E-mail: sanabekri2015@gmail.com

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Abstract

Mouth opening limitation is one of the symptoms in the oral cavity after head and neck radiotherapy. It is considered as a challenge for the dentist to perform any intraoral procedures. For these patients, the prosthetic steps are complicated by the limitation of the mouth opening. This complexity manifests itself from the impression phase. In this clinical report, flexible impressions and digital impressions were made to overcome the reduced access to the oral cavity. We emphasize the interest of mouth exercise physiotherapy before prosthetic procedures in order to increase mouth opening and facilitate prosthetic treatment.

Keywords: Radiotherapy, case report, CAD-CAM, Digital impression, Physiotherapy.

Introduction

Patients with head and neck radiotherapy suffered from mouth opening limitation. All prosthetic procedures require a wide mouth opening starting from impression making to prosthesis insertion. This condition is not met for patients with a history of head and neck radiotherapy. In the literature, various methods of managing mouth opening are described such as flexible impression and sectional impression trays, which can provide an alternative to take the impression for these patients [1-4]. At the same time, the practitioner must adapt the prosthetic means to manage the limitation of the mouth opening.

Since the development of digital dentistry, intra-oral digital impression is highly recommended to manage difficult cases with restricted mouth opening. The removable partial dentures (RPDs) can be elaborated using 3D printing technology, which provide a reliable method for fabricating dental prosthesis.

The objective of this work was to present through a clinical case the prosthetic management of a partially edentulous patient with limited mouth opening.

Patient and observation

Patient Information: A thirty-five year- old female patient comes in consultation, in the prosthodontic department of the dental clinic of Monastir, Tunisia, for an oral rehabilitation with functional requests.

The patient revealed a history of head and neck radiotherapy following a cavum cancer since 2007.

Clinical Findings: The oral examination revealed a limited mouth opening between incisal edges of maxillary and mandibular anteriors with a value equal to 16mm.

The missing teeth were 16, 18, 26, 28, 45, 47, 48, 36, 37 and 38. The decayed teeth were 17, 27, 44, 42, 43, 41, 31, 32 and 33. A mobility of the 27 and a root decay of the 17 were noted.

The examination of the oral osteomucosal tissues revealed a firm and adherent fibro mucosa with no undercuts in the maxillary arch. In the right mandibular edentulous sector, the fibro mucosa was hypertrophic (Figure 1: A, B, C, D, E).

Figure 1: A,B,C,D,E Intra oral views of the maxillary and mandibular arches

F: Panoramic X-Ray

Diagnostic assessment: The panoramic X-ray showed a radiological crown radiological root ratio less than 1 for all teeth except the 27, which had a radiological crown radiological root ratio more than 1. The 44 presented a vertical fracture (Figure 1F).

Study casts were analyzed on the articulator to evaluate the occlusal plane and the available occlusal height. Study casts were obtained after preliminary impressions. In this case, it was difficult to make these impressions using conventional methods, due to a restricted mouth opening. The solution was to make flexible impressions (Figure 2) using a high viscosity silicon: at first, the material was manipulated, rolled, and adapted on to the hard and soft tissues. Once the material had been set, the impressions were removed from the patient's mouth, in which a low viscosity silicon was putted and the impressions were re-inserted in the mouth one by one. The obtained casts were mounted on the articulator.

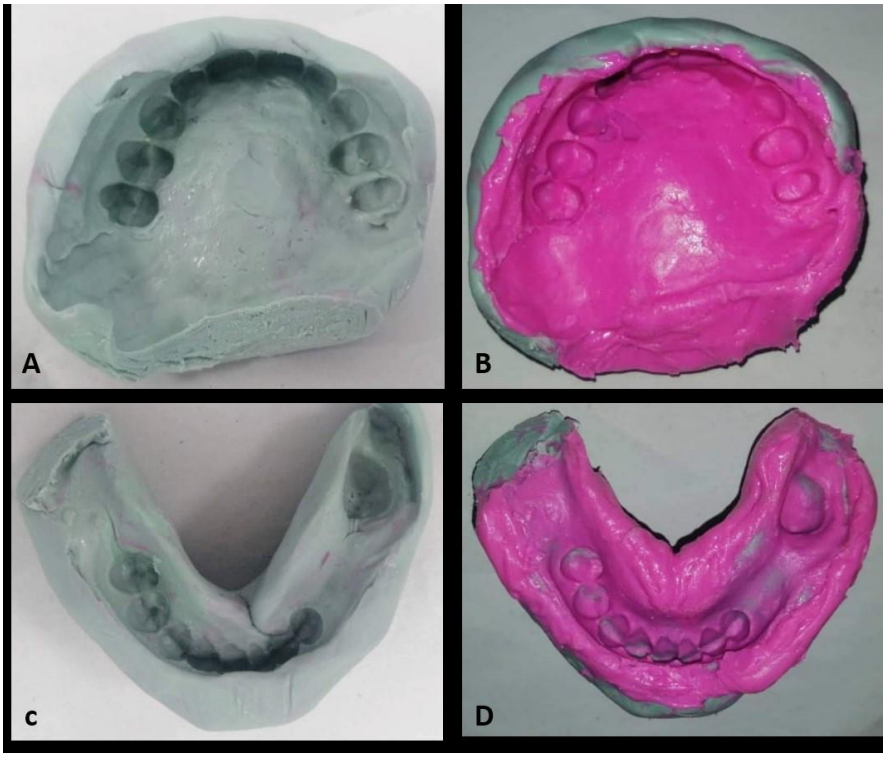

Figure 2: Flexible impressions

The study casts' analysis revealed an extrusion of the 15, with its periodontal support, with a value equal to 2mm. The prosthetic usable occlusal height was insufficient.

After confrontation of clinical and radiological Data, the prosthetic decision was to make a combined prosthesis in the maxillary arch including a metallic framework RPD and a metallic crown with an esthetic resin facet on the 15. In the mandibular arch, a metallic framework RPD was indicated.

The therapeutic plan was simulated on wax (Figure 3). This simulation allowed prevision of esthetic and functional aspects of prosthetic outcome and facilitated its explanation to the patient.

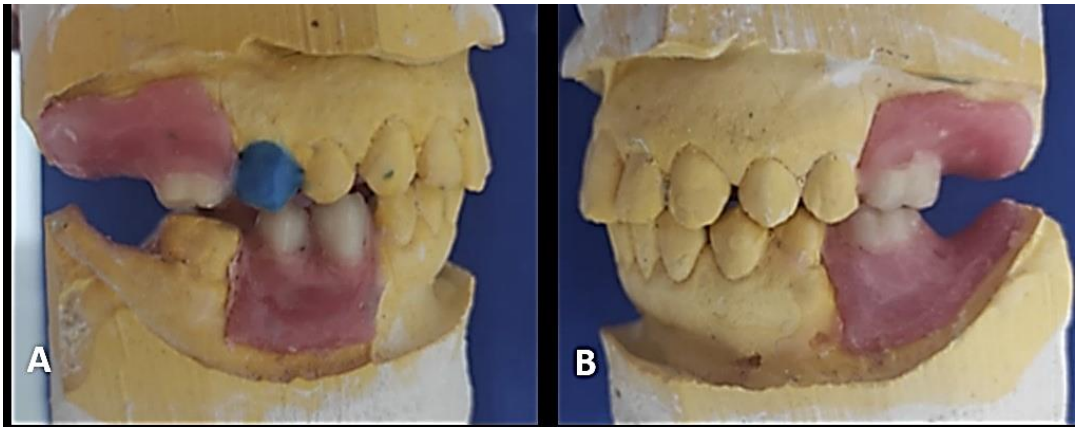

Figure 3 : Prosthetic project simulation on wax: **A**: Right lateral view; **B**: Left lateral view

Therapeutic interventions: A sanitation phase of the oral cavity was done beforehand including scaling, extraction of 44, 17 and 27 and treatment of the decayed teeth.

Before starting prosthetic procedures, it was important to increase the mouth opening. Thus, mouth exercise physiotherapy was indicated. It consisted of putting tongue depressors in the mouth for ten minutes, ten times per day, during ten days. The number of spatulas were determined according to comfortable maximal mouth opening. Then we proceed to the evaluation of the mouth opening. After one month, an amelioration of 8mm was noted (Figure 4).

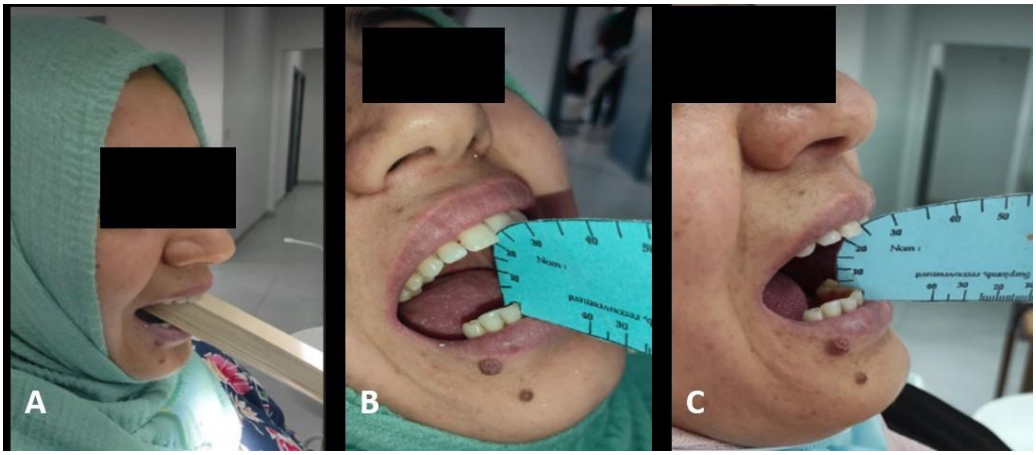

Figure 4: Mouth exercising physiotherapy: A: The use of tongue depressors; B: Mouth opening equal to 20mm after 15 days; C: Mouth opening equal to 24mm after one month.

In order to manage the reduction of the available occlusal height, a mucosal thickening surgery was realized in the right mandibular edentulous sector. To correct the occlusal plane disturbed by the extrusion of the 15 with its periodontal support, a fixed prosthesis was planned. A peripheral preparation of the second upper premolar was done followed by gingivectomy.

A digital impression of the preparation, the mandibular arch and the occlusion of the patient was then carried out using an intra oral 3D scanner (Launca). The digital scan file was then processed into a stereolithographic (STL) file (Figure 5).

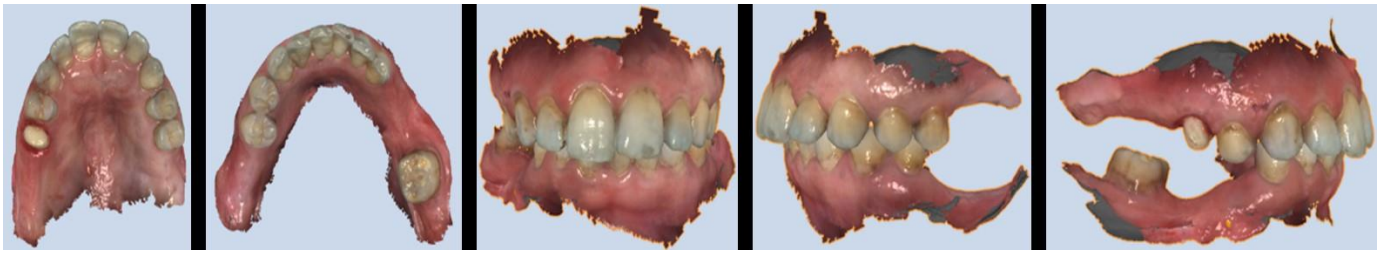

Figure 5 : Digital impressions

After that, the design of the crown was realized and fabricated in the dental prosthesis laboratory. After crown fitting, the sealing was carried out.

Maxillary and mandibular anatomo-functional impressions (Figure 6), related to the future RPDs were made using a low viscosity silicone. Individual trays were used as support for the impression material. They were elaborated on the resin casts obtained after digital impressions. These casts were made using 3D printing technology.

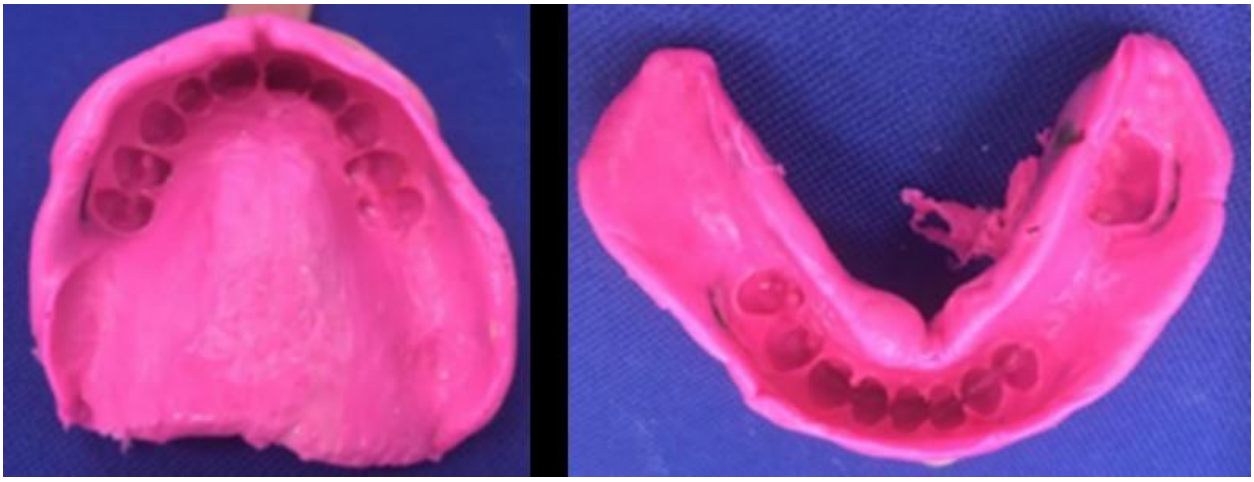

Figure 6 : Maxillary and mandibular anatomo-functional impressions

After casting, the obtained physical casts were scanned and the RPD framework designs were done. The Computer Aided Design (CAD) software package can fill in the unwanted undercuts automatically, select suitable components from the library, and drag and drop them on the dental cast. After the design approval, the metal framework removable partial dentures were directly fabricated using 3D printer. The metal framework RPDs were conventionally adjusted, finished, and polished. Then, they were validated in mouth and the jaw relationship at centric relation and correct occlusal vertical dimension (OVD) was recorded.

In this case, the vertical prosthetic space still less than 7mm, and so resin sculpted teeth were indicated. The technician of the laboratory proceeds to the sculpture of teeth on wax (Figure 7). The validation of the teeth mounting was carried out and the resin of the prosthesis was cured.

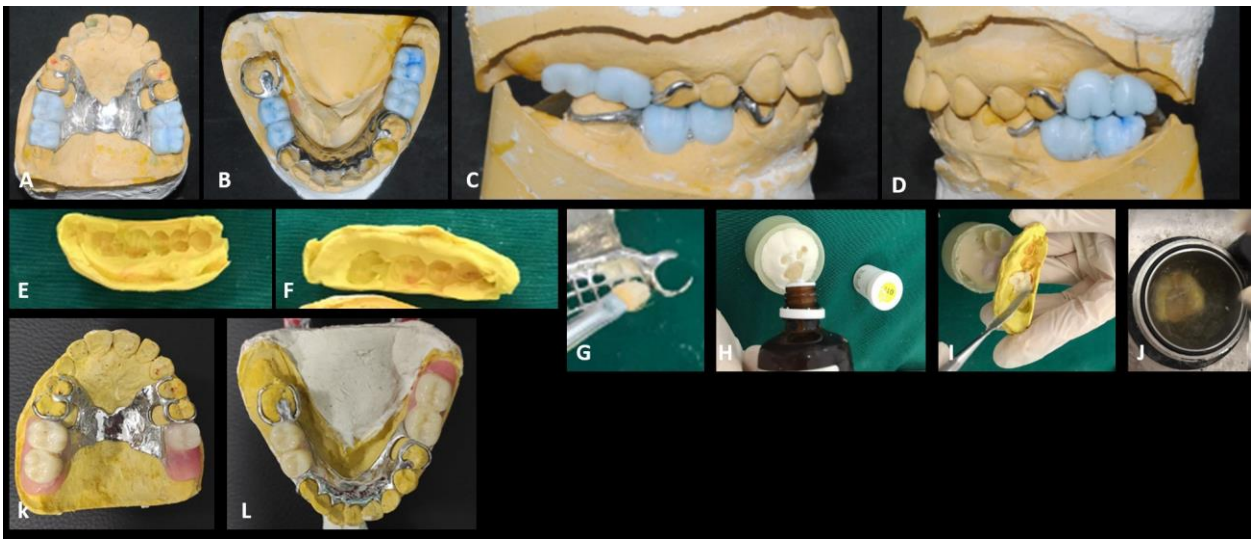

Figure 7: Framework removable partial dentures with sculpted teeth:

A to D: wax teeth carving; **E and F:** silicone keys making; **G to J:** resin preparation and polymerization; **k and L:** Framework RPDs

The framework RPDs were fitted in the mouth and the equilibration was carried out. It is necessary to eliminate any source of irritation in the intrados, extrados and edges of the removable prosthesis. It is determined by palpation of the entire prosthesis before try-in in the mouth. The intrados and the edges must be perfectly polished and smooth.

It is also necessary to check that the clasps do not traumatize the gingival tissue.

Follow-up and outcome of interventions: The framework RPDs were well integrated in the mouth and the patient was very satisfied with the result (Figure 8). Routine instructions on the

placement, removal, and maintenance of the new partial dentures were given to the patient. The patient is currently under surveillance with a follow-up of 7 months.

Figure 8: Esthetic and functional integration of the removable partial dentures

Discussion

Prosthetic rehabilitation of irradiated patients presents some particularities even if the treatment itself is not very different from that carried out in the usual conditions. These particularities of treatment are due to the risks associated with the sensitivity and the fragility of the bone caused by the rays, to xerostomia but above all to the limitation of mouth opening. This complication is relatively frequent after radiotherapy of nasopharyngeal tumors, due to the fact that during such treatment, temporomandibular joints and pterygoid muscles are located inside the irradiation field in almost all cases. This can lead to the appearance of scars and fibrosis of the masticatory musculature. It seems that the pterygoid muscles are the main factor. Indeed, in many cases, it is possible to avoid irradiation of the temporomandibular joints but not of the pterygoids muscles. According to Dijkstra and Coll [5], in an irradiated patient, a trismus is noted from a mouth opening value less than or equal to 35mm. When high doses of irradiation are used, these consequences are permanent.

Mouth opening limitation constitutes a handicap for the prosthetic treatment. That's why, before prosthetic procedures, mouth exercise physiotherapy should be indicated to improve mouth opening and facilitate prosthetic treatment. The use of tongue depressors showed a clinical efficacy in this case with limited mouth opening. Patill, in 2012, showed that mouth-exercising devices contribute to satisfactory results after 6 months follow-up [1]. Cox and Coll used tongue spatulas also for jaw exercises [2]. This physical therapy modifies tissue remodeling through promotion of physical movements. The world workshop on Oral Medicine V summarized that mouth exercise physical therapy independently or in combination with other modalities may be useful to improve mouth opening in oral submucous fibrosis patients [2]. In addition, past literature demonstrated significant positive association between jaw exercises and improved mouth opening range in head and neck cancer patients [2].

For these patients, prosthetic rehabilitation entails an accurate impression of the patient's mouth. When using the conventional method, wide mouth opening is necessary. However, for the patient with limited mouth opening, a modification of the standard impression procedure is often necessary to accomplish this fundamental step in the fabrication of a successful prosthesis.

In our case, flexible impressions were realized, which help us to overcome the reduced access to the oral cavity. They can simplify the manipulation and decrease the patient's trauma. Krishna and Coll in 2013 used flexible impression tray techniques, then they fabricated two-piece custom sectional trays using locking button to make final impressions [1].

In the literature, various designs of sectional trays were described [3,4]. These techniques result in an accurate impression for such patients. All impression materials can be used without any

problem. It is necessary that impression techniques should not be compressive to avoid any irritation of the mucosa which can be a source of osteradionecrosis.

With the development of the intraoral scanning system, clinicians can reconstruct highly accurate 3D surfaces of teeth or mucosa and record them in a short time [6]. This process not only saves much labor-intensive work but also eliminates inter-operator variability. In this clinical report, the use of intra-oral scanning has overcome the difficulty in taking the impression for the fixed prosthesis.

Digital impressions were made using intra oral scanner. This technology offers various advantages. It allowed clinicians to make oral impressions in a highly accurate way [7], in a short time with more comfort of both patients with limited mouth opening and dentists [8]. The intraoral scanner must be of small dimensions to be able to get introduced into the mouth in such mouth opening. In fact, there are several types of intraoral scanners with different dimensions so the practitioner must choose his equipment carefully.

In this case, we described an integrated treatment procedure, combining intraoral scanning and 3D printing technologies. Actually, 3D printing technology has become more important in medicine and especially in dentistry. Equipped with the advantages of precise reproduction from virtual to physical objects, this method can be used in order to fabricate the RPD metal framework as a useful alternative to conventional impression and casting techniques [9]. According to Maryod and Taha [10], digitally fabricated RPDs had greater retention and fit than those obtained using conventional methods in 20 mandibular Kennedy class I RPD patients. Other studies showed that digitally fabricated RPDs had a significantly better retention and fit compared to the conventional RPDs with tests at different intervals over a 3-month follow-up period [8].

In our case, anatomo-functional impressions were made using individual trays in order to capture soft tissue morphology, document the extension of movable tissues and to record the difference in depressibility between dental and osteo-mucous supporting tissues. In a large edentulous ridge, conventional impression techniques with border molding are relatively better at recording tissue duality than intra oral scanning technology, which positively affect the denture fit and outcome.

For an irradiated patient, a well-made removable prosthesis should have some criteria such as a non-forced peripheral joints to avoid osteoradionecrosis and a restored OVD. The occlusal concept is dictated by the edentulism topography and its extension. Resin prosthetic teeth should be used and they must be correctly positioned with a sufficient overbite to avoid bites and injuries of the irradiated tissues.

For fixed prosthesis, the situation of the cervical limit depends on the design of the prosthetic work and especially on patient hygiene. If the prophylaxis is very good, the limit can be sub, juxta or supra-gingival. According to Simart S, cervical preparations should respect gingival tissues, they should be atraumatic and without deep gingival eviction. In the irradiated sectors, gingival retractors containing vasoconstrictors and the electrocautery must be avoided because they can trigger osteoradionecrosis [5].

The irradiated tissues are brittle. They are characterized by hypo-vascularization, hypo-cellularity and hypoxia. Consequently, the irradiated patient is more susceptible to the development of viral and bacterial infections and dental decays that are often asymptomatic and rapidly progressing. Regular monitoring of the irradiated patient is therefore necessary.

Oral hygiene and daily cleaning of prostheses is an important prophylactic gesture to teach to irradiated patients. These prostheses are brushed after each meal with a soft toothbrush and they are immersed in a solution of digluconate of chlorhexidine during 15 minutes daily. They must be rinsed thoroughly after using these products. Any mucosal irritation should be treated well and its healing must be carefully monitored.

Conclusion

All prosthetic procedures require wide mouth opening to carry out various steps, starting from tray placement during impression to the final prosthesis insertion, especially removable prosthesis. In patients with restricted mouth opening, mouth exercising physiotherapy showed a great interest in increasing mouth opening and facilitating impression making and prosthetic treatment. The integration of intra oral scanning technology and digital dentistry is interesting in managing these difficult cases. Regular monitoring is highly recommended for irradiated patients given the risk of osteoradionecrosis. Patients' cooperation is the primary requirement in order to reach successful outcomes.

Competing interests

The authors declare no competing interest.

Informed Consent: informed consent was obtained from the patient.

Authors' contributions

All the authors contributed to the realization of this work. They also declare that they have read and approved the final version of the manuscript.

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