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2 **Prosthetic rehabilitation in carcinoma of the**  
3 **tongue and oral pelvis: presentation of a**  
4 **clinical case**  
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10 **ABSTRACT**

11 *Abstract (not more than 250 words) of the Case reports should have the following sections: Aims,*  
12 *Presentation of Case, Discussion and Conclusion. Only Case Reports have word limits: Papers should*  
13 *not exceed 2000 words, 20 references or 5 figures. Other Type of papers have no word limits.*  
14

**Aims:** the authors want to describe a case of prosthetic rehabilitation in a 50 years old woman who has undergone a removal surgery of a neoplastic lesion that involved the oral pelvis and the lingual border. The inherent literature regarding the prosthetic rehabilitation of post-irradiated bones is also evaluated.

**Presentation of Case:** A 50-year-old Caucasian woman with a history of smoking and alcohol consumption has come to our attention with an ulcerative lesion of the left lingual pelvis.

**Discussion:** The patient's clinical, radiological, and anamnestic data enabled the preoperative staging of the oral cavity's neoplasm, which has been treated with a transmandibular conservative surgical resection of the lesion associated with a mRND and bilateral neck dissection (LV. I to III); this was then followed by an immediate surgical reconstruction with a radial antebachial bundle-cutaneous free flap.

**Conclusion:** One year after surgery, excluding the presence of recurrences through MR with contrast, the dental residues have been removed, and rehabilitation with an implanted prosthesis has been completed. Aesthetic outcome was remarkable. Both the preoperative multi-specialist evaluation and the definition of a common rehabilitation program represent essential prerequisites in order to avoid some possible and serious complications of the treatment. Postoperative radiotherapy for oral cancer is now universally associated with implant-prosthetic rehabilitation therapy.

15  
16 *Keywords: [Oral cancer], [Forearm free flap], [Reconstruction], [Radiotherapy], [Oral*  
17 *implantology], [Antebrachial bundle-cutaneous free flap]*

18  
19 *(Note: 1. Case Reports should follow the structure of Abstract, Introduction, Presentation of Case,*  
20 *Discussion, Conclusion, Acknowledgements, Competing Interests, Authors' Contributions, Consent*  
21 *(where applicable), Ethical approval (where applicable), and References plus figures and/or tables.*  
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23  
24

25 **1. INTRODUCTION**  
26

27 Oral cavity reconstruction secondary to removal surgery of neoplastic lesions has undergone  
28 significant changes over the last twenty years in order to reach an acceptable quality of life  
29 mainly thanks especially to two factors: revascularized free flaps and the use of  
30 osseointegrated dental implants.

31 The radial antebachial bundle-cutaneous free flap represents one of the most commonly  
32 used revascularized free flaps for oral cavity reconstruction. This flap was first described by  
33 Yang et al. in 1981 [1], but only in 1983 did Soutar et al.[2] define it as a versatile solution for  
34 reconstruction of soft tissues and mucosal defects of the oral cavity.

35 Prosthetic rehabilitation following oral cancer surgery is often difficult without using  
36 endosseous implants, which are able to ensure stabilization and retention of the prostheses.  
37 The use of dental implantology during the reconstructive phase of oral cancer surgery can  
38 be divided into two categories: retention of a removable prosthesis or steady prosthetic  
39 rehabilitation with or without maxillary bone reconstruction. The reliability of dental  
40 implantology in irradiated bone has been a major point of debate in the recent literature.

41 The authors propose a paradigmatic clinical case of oral cancer carcinoma treated with  
42 surgical ablation combined with adjuvant radiotherapy, reconstruction with radial  
43 antebachial free flap, and consistent prosthetic rehabilitation on implants based on an  
44 accurate review of recent inherent literature.

45

## 46 **2. CLINICAL CASE**

47

48 A 50-year-old caucasian woman with a history of smoking (20 cigarettes per day) and  
49 alcohol consumption (less than 1 liter per day) has come to our attention at the ENT  
50 Department and Maxillo-Facial Surgery Unit of San Giovanni Bosco Hospital of Turin with an  
51 ulcerative lesion of the left lingual pelvis. This lesion involved also the left lingual border,  
52 evoking pain and a blockage of the lingual body, which was also infiltrated deeply up to  
53 involve the cortical bone of the mandibula.

54 Through MR (Fig. 1), it is clearly visible the involvement of the hyoglossus muscle, the whole  
55 left part of the tongue, and the presence of an homolateral lymph node lesion with a  
56 diameter smaller than 3 cm. Thanks to radiological imaging and the clinical history, it was  
57 possible to define a preoperative staging of T4N1M0.

58 The patient's neoplasm has been treated with a conservative transmandibular removal  
59 surgery through a translabyrinthine approach with an en bloc hemiglossectomy associated  
60 with a bone mandibular dowel and bilateral mRND (LV I to III).

61 Reconstruction has been performed by using an antebachial bundle skin flap vascularized  
62 from the radial artery and its venae comitantes and cefalic. Arterial and venous anastomoses  
63 were performed between the facial and radial arteries and between the brachial venous axis  
64 and the internal jugular vein on the left, respectively. Before doing osteotomies, preplating  
65 was performed, i.e., the positioning of the synthesis plates before performing the  
66 osteotomies in order to facilitate the reconstruction. The osteotomy was performed in steps  
67 to increase the bone-facing surface and improve the stability of the subsequent fixation.  
68 Furthermore, the dentition not related to the lesion was partially preserved in order to have  
69 an extra occlusal reference. The resection monoblock includes the hemitongue, the  
70 ipsilateral oral floor, the mandibular plug, and the laterocervical dissections (Fig. 2).

71 The examination of the surgical specimen confirmed the clinical staging and indicated the  
72 postoperative RT (67 Gy, about one month after the operation). Fig. 3 shows the result of the  
73 surgery in the immediate post-operative period with x-ray control, which highlights the bone  
74 plug and the reconstruction. The postoperative period was regular.

75 12 months after surgery, an MR with contrast study has been done, which confirmed the  
76 absence of recurrences. The removal of the residual dental elements was performed,

77 followed by the removal of most of the coronal synthesis plate in order to obtain a gain in  
78 available bone height. Six submerged implants for prosthetic purposes were then positioned.

79 An x-ray control was performed at 5 months and eventually the second surgical time for  
80 uncovering the implants. The prosthetic load was performed after about 1 month in order to  
81 permit adequate recovery of the soft tissues around the healing abutments.

82 In Fig. 4 it is possible to observe the presence of a provisional prosthesis in the patient's  
83 mouth, with large cleaning spaces.

84 In this case, we opted for a fixed prosthesis without mucosal support screwed onto the  
85 posterior implants and cemented on a metal structure screwed to the three anterior implants,  
86 which are therefore joined together. In this way, it was decided to obtain a better distribution  
87 of the prosthetic load across the osteotomy, a particularly critical point following the  
88 administration of postoperative radiotherapy treatment.

89 In Fig. 5 we can appreciate the good esthetical outcome with the preservation of the vertical  
90 dimension and good projection of the lips in spite of the translabiotomy access .

91

### 92 **3. RESULTS AND DISCUSSION**

93

94 In literature, success rates in the surgical treatment of oral carcinomas with dental  
95 rehabilitation associated with the use of free tissue grafts and radiotherapy treatment present  
96 variable percentages. Among the main factors that oppose an effective prosthetic  
97 rehabilitation are a clear reduction of the neutral zone, a reduced lingual functionality that is  
98 difficult to compensate for by remaining soft tissues and mandibular bone, and a reduced  
99 salivary production. Using these endosseous implants can partially reduce the impact of  
100 these factors.

101 Results are better in the mandible than in the maxilla, probably due to differences in bone  
102 structure. Recent reports find higher success rates with native bone (90%) than grafted bone  
103 (70–80%) [3]. According to some authors [4], the high percentage of implant survival failures  
104 would be related to the high percentage of patient mortality rather than the loss of  
105 osseointegration. Implant failure in radiation-treated patients is related to radiation-induced  
106 changes in both soft and hard tissues. At the bone level, vessels of the Haversian canals  
107 may become obliterated, and the periosteum could lose cellularity, vascularization, and  
108 osteoid formation. The hematopoietic proliferation becomes scattered in the bone marrow,  
109 and the sinusoids assume an irregular configuration and distribution [5]. The late effects of  
110 radiotherapy may cause a prevalence of the catabolic processes over the anabolic ones in  
111 bone formation, with a clear reduction of the mineral content in the radio-treated bone. On  
112 the other hand, at the soft tissue level, the main problem seems to be related to the  
113 reduction of salivation and, therefore, to a reduced ability to cleanse the oral cavity.

114 There is debate in the literature about the optimal timing of implant placement in patients  
115 requiring radiotherapy. A systematic review [6] over a period of 16 years demonstrated a  
116 comparable failure rate between implants placed before or after radiotherapy treatment  
117 (3.2% versus 5.4%, respectively). Most of the failures were recorded between 1 and 12  
118 months after surgery. Substantial failure rates are related to radiation therapy doses  
119 exceeding 45 Gy.

120 Some authors believe that the implants should be placed immediately after the ablative  
121 procedure, in the same surgical session, in order to obtain better osseointegration before  
122 irradiation, thus eliminating the need for further surgery or additional therapy with hyperbaric

123 oxygen and enabling adequate rehabilitation of speech and swallowing [7]. A combined  
124 surgical approach in a single stage seems, according to these authors, to be easy and  
125 effective, allowing total mandibular rehabilitation. Another advantage of this approach is the  
126 wide access to bone segments with considerable surgical exposure, which allows for  
127 accurate alignment of implants with the corresponding maxillary dentition [8]. This approach  
128 cannot be done without a meticulous presurgical examination and a careful multidisciplinary  
129 evaluation with well-defined treatment planning. The major disadvantage of the immediate  
130 insertion of the implants is the risk of improper positioning in cases of gross anatomical  
131 alterations, which has a negative influence on rehabilitation. It is also necessary to consider  
132 the risk of interference with or delay of cancer therapy, including radiotherapy, in the event of  
133 the development of postoperative complications related to the implants, as well as the risk  
134 that an early tumor recurrence could render implants useless.

135 Other authors are against the placement of implants in the first phase of surgery. Oral  
136 reconstruction and rehabilitation could be divided into primary and secondary reconstruction.  
137 Patients who have undergone partial mandibulectomy without bone reconstruction may  
138 require secondary reconstruction before implant placement in the site of the bone defect.  
139 Due to the frequency of recurrences and metastases in the first two years following the  
140 primary treatment, it has been suggested to carry out costly treatments only after this period  
141 of high risk, since it is not appropriate to implant patients with an uncertain prognosis in the  
142 first instance. Proponents of this approach believe that blood supply to the bone flap may be  
143 compromised during the first stage of surgery due to osteotomies, so implant placement is  
144 less accurate at this time as bone and soft tissue healing is not yet complete. Others have  
145 proposed to delay implant placement from 6 to 12 months after radiotherapy and then  
146 observe an integration period of 5 to 6 months before the second surgical stage and  
147 prosthetic loading [9]. This period seems necessary to achieve appropriate osseointegration  
148 after the administration of radiotherapy. There are authors who, on the other hand, favor  
149 short healing times for implants in order to substantially prevent bone resorption [10].

150 It has also been proposed to use hyperbaric oxygen therapy in order to promote bone and  
151 tissue healing, but the results in the literature are not clear. Hyperbaric oxygen therapy  
152 inhibits leukocyte adhesion to endothelium, reducing tissue damage, improving leukocyte  
153 motility, and increasing microcirculation [11]. In the early stages, there is vasoconstriction,  
154 reduction of edema, activation of phagocytes, and an anti-inflammatory effect [12], while in  
155 the long term, neovascularization, osteogenesis, and stimulation of collagen production by  
156 fibroblasts are obtained, which favor wound healing. Marx in 1983 [13] had proposed a  
157 protocol consisting of 20 sessions before and 10 after therapy with osteointegrated implants,  
158 supported by Larsen in 1997 [14]. Some authors have shown themselves in favor of  
159 hyperbaric therapy as an aid to the osseointegration of the implants [15], while others [16]  
160 [17] have opposed this practice for economic reasons or potential complications. A single  
161 randomized trial [18], reported in a Cochrane review [19], does not show substantial  
162 interferences of hyperbaric therapy on the implant's success rate.

163 In the case under examination, the choice made was a result of a mindful multidisciplinary  
164 preoperative evaluation, according with literature [20], associated with the patient's requests.  
165 It would have been possible to carry out a rehabilitation with a removable prosthesis on  
166 implants, but this prosthesis would have given considerable mucosal support with  
167 mechanical interference from the antibrachial flap, which, although pliable and thin, does  
168 not have the typical characteristics of oral cavity mucosa. Furthermore, this problematic  
169 mucosal support could probably have led to decubitus either on the residual mucosa or on  
170 the flap itself, both due to the mechanical interference with the flap and irregularities of the  
171 residual bone surface after the surgery, which are difficult to compensate for prosthetically;  
172 these two factors are also associated with an increased occurrence of oral cancer.

173 Radiotherapy basically causes a salivary reduction with gingival tissue damage that is poorly  
174 suited to mobile prostheses. In our case, a large cleansing space was left between the posts  
175 in order to facilitate cleaning and make the implants last longer, avoiding dangerous peri-  
176 implantitis. Furthermore, the patient wanted a fixed prosthesis at all costs in order to  
177 consolidate a new aesthetic appearance associated with modified voluptuous habits  
178 (smoking and alcohol cessation) in the context of a total improvement in the overall quality of  
179 life.

180

#### 181 **4. CONCLUSION**

182

183 In cases of surgical success in maintaining or reconstructing a sufficient amount of bone in  
184 order to obtain a favorable anatomical set, rehabilitation on implants is, in our opinion, the  
185 best solution for patients with oral cavity neoplasms, even following combined radio-surgical  
186 treatment. Today is relatively reliable to insert endosseous implants on radiotreated bone  
187 after a suitable waiting period or even at the same time as ablative surgery.

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190

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197 so state.

198

#### 199 **COMPETING INTERESTS**

200

201 Authors declare that they have no conflict of interest.

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#### 203 **AUTHORS' CONTRIBUTIONS**

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205 Authors declare that they have not received institutional funding for this study.

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#### 208 **REFERENCES**

209

210 1. Yang DY. Management of vascular problems in microsurgery. *Zhonghua Wai Ke Za*  
211 *Zhi*. 1981;19(3):131-135.

212 2. Soutar DS, Scheker LR, Tanner NS, McGregor IA. The radial forearm flap: a  
213 versatile method for intra-oral reconstruction. *Br J Plast Surg*. 1983;36(1):1-8.

214 3. Dholam KP, Gurav SV. Dental implants in irradiated jaws: a literature review. *J*  
215 *Cancer Res Ther*. 2012;8 Suppl 1:S85-93.

216 4. Nelson K, Heberer S, Glatzer C. Survival analysis and clinical evaluation of implant-  
217 retained prostheses in oral cancer resection patients over a mean follow-up period  
218 of 10 years. *J Prosthet Dent*. 2007;98(5):405-410.

- 219 5. Knospe WH, Blom J, Crosby WH. Regeneration of locally irradiated bone marrow. I.  
220 Dose dependent, long-term changes in the rat, with particular emphasis upon  
221 vascular and stromal reaction. *Blood*. 1966;28(3):398-415.
- 222 6. Colella G, Cannavale R, Pentenero M, Gandolfo S. Oral implants in radiated  
223 patients: a systematic review. *Int J Oral Maxillofac Implants*. 2007;22(4):616-622.
- 224 7. Korfage A, Schoen PJ, Raghoobar GM, Bouma J, Burlage FR, Roodenburg JL,  
225 Vissink A, Reintsema H. Five-year follow-up of oral functioning and quality of life in  
226 patients with oral cancer with implant-retained mandibular overdentures. *Head Neck*.  
227 2011;33(6):831-839.
- 228 8. Chim H, Salgado CJ, Mardini S, Chen HC. Reconstruction of mandibular defects.  
229 *Semin Plast Surg*. 2010;24(2):188-197.
- 230 9. Claudy MP, Miguens SA Jr, Celeste RK, Camara Parente R, Hernandez PA, da  
231 Silva AN Jr. Time interval after radiotherapy and dental implant failure: systematic  
232 review of observational studies and meta-analysis. *Clin Implant Dent Relat Res*.  
233 2015 Apr;17(2):402-11. doi: 10.1111/cid.12096. Epub 2013 Jun 7. PMID: 23742098.
- 234 10. Shiota T, Ohno K, Michi K, Tachikawa T. An experimental study of healing around  
235 hydroxylapatite implants installed with autogenous iliac bone grafts for jaw  
236 reconstruction. *J Oral Maxillofac Surg*. 1991;49(12):1310-1315.
- 237 11. Mortensen SP, Damsgaard R, Dawson EA, Secher NH, González-Alonso J.  
238 Restrictions in systemic and locomotor skeletal muscle perfusion, oxygen supply  
239 and VO<sub>2</sub> during high-intensity whole-body exercise in humans. *J Physiol*.  
240 2008;586(10):2621-2635.
- 241 12. Spiegelberg L, Djasim UM, van Neck HW, Wolvius EB, van der Wal KG. Hyperbaric  
242 oxygen therapy in the management of radiation-induced injury in the head and neck  
243 region: a review of the literature. *J Oral Maxillofac Surg*. 2010;68(8):1732-1739.
- 244 13. Marx RE, Kline SN. Principles and methods of osseous reconstruction. *Int Adv Surg*  
245 *Oncol*. 1983;6:167-228.
- 246 14. Larsen PE. Placement of dental implants in the irradiated mandible: a protocol  
247 involving adjunctive hyperbaric oxygen. *J Oral Maxillofac Surg*. 1997;55(9):967-971.
- 248 15. Granström G. Placement of dental implants in irradiated bone: the case for using  
249 hyperbaric oxygen. *J Oral Maxillofac Surg*. 2006;64(5):812-818.
- 250 16. Benites Condezo AF, Araujo RZ, Koga DH, Curi MM, Cardoso CL. Hyperbaric  
251 oxygen therapy for the placement of dental implants in irradiated patients:  
252 systematic review and meta-analysis. *Br J Oral Maxillofac Surg*. 2021 Jul;59(6):625-  
253 632. doi: 10.1016/j.bjoms.2020.08.050. Epub 2020 Aug 19. PMID: 33952404.
- 254 17. Shaw RJ, Butterworth CJ, Silcocks P, Tesfaye BT, Bickerstaff M, Jackson R,  
255 Kanatas A, Nixon P, McCaul J, Praveen P, Lowe T, Blanco-Guzman M, Forner L,  
256 Brennan P, Fardy M, Parkin R, Smerdon G, Stephenson R, Cope T, Glover M.  
257 HOPON (Hyperbaric Oxygen for the Prevention of Osteoradionecrosis): A  
258 Randomized Controlled Trial of Hyperbaric Oxygen to Prevent Osteoradionecrosis  
259 of the Irradiated Mandible After Dentoalveolar Surgery. *Int J Radiat Oncol Biol Phys*.

260  
261

2019 Jul 1;104(3):530-539. doi: 10.1016/j.ijrobp.2019.02.044. Epub 2019 Mar 7.  
PMID: 30851351.

262  
263  
264  
265

18. Schoen PJ, Raghoobar GM, Bouma J, Reintsema H, Vissink A, Sterk W, Roodenburg JL. Rehabilitation of oral function in head and neck cancer patients after radiotherapy with implant-retained dentures: effects of hyperbaric oxygen therapy. *Oral Oncol.* 2007;43(4):379-388.

266  
267  
268

19. Coulthard P, Patel S, Grusovin GM, Worthington HV, Esposito M. Hyperbaric oxygen therapy for irradiated patients who require dental implants: a Cochrane review of randomised clinical trials. *Eur J Oral Implantol.* 2008;1(2):105-110.

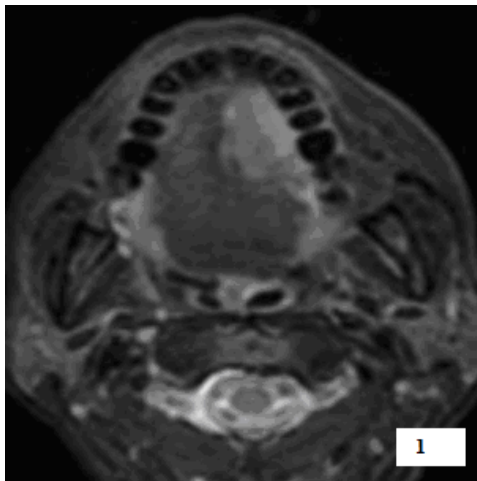
269  
270  
271

20. Barret JP, Roodenburg JL. Functional rehabilitation in advanced intraoral cancer. *Int J Surg Oncol (N Y).* 2017 Feb;2(2):e10. doi: 10.1097/IJ9.000000000000010. Epub 2017 Jan 10. PMID: 29177211; PMCID: PMC5673113.

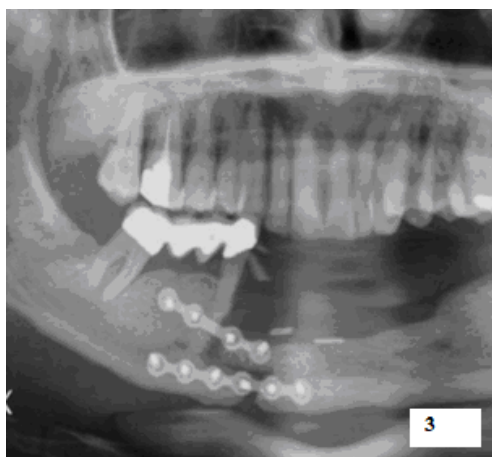
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## FIGURES

274



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278 Figure Legends:

279 Fig 1: MR of the carcinoma showing the involvement of the whole left part of the tongue;

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281 Fig. 2: resection monoblock including the hemitongue, the ipsilateral oral floor, the  
282 mandibular plug, and the laterocervical dissections;

283

284 Fig. 3: immediate post-operative period x-ray control;

285

286 Fig. 4: provisional prosthesis in the patient's mouth, with large cleaning spaces;

287

288 Fig. 5: final esthetical outcome.