ELSEVIER

Brachytherapy ■ (2017) ■

BRACHYTHERAPY

# High-dose-rate interstitial brachytherapy boost in inoperable locally advanced tongue carcinoma

Miguel Angel Santos[1], Jose Luis Guinot[1,*], Maria Isabel Tortajada[1], Paula Santamaría[1], Valentin Campo[2], Laura Oliver[2], Marina Peña[1], Leoncio Arribas[1]

[1]*Department of Radiation Oncology, Fundación Instituto Valenciano de Oncología (IVO), Valencia, Spain*
[2]*Departament of Medical Physics, Fundación Instituto Valenciano de Oncología (IVO), Valencia, Spain*

**ABSTRACT**

**PURPOSE:** Locally advanced tongue carcinomas (LATCs) in inoperable lesions are managed with external beam radiation therapy (EBRT) and chemotherapy. In our institution, the boost to the gross tumor volume is delivered with high-dose-rate brachytherapy (HDR-BT) after EBRT. We review the outcome of these patients when HDR-BT is added as a boost.

**METHODS AND MATERIALS:** From May 2000 to December 2014, a total of 24 patients with LATC, nonsurgical oral tongue, and base of tongue carcinomas were treated with EBRT and with interstitial plastic tubes for brachytherapy; median dose was 18−24 Gy in 6−8 fractions after 50−60 Gy of EBRT. Mean age was 60 years, 20 men and 4 women. The distribution by stages was 11 patients in Stage III and 13 patients in Stage IV. All cases but one received chemotherapy.

**RESULTS:** With a median followup of 44 months, local control (LC) rate at 4 years was 80% for the entire group, 78% in Stage III, and 90% in Stage IV. The cause-specific survival was 68% at 4 years; the regional control was 76%. Four patients developed distant metastasis with disease free from distant metastasis of 77% at 4 years. The overall survival was 68% at 4 years.

**CONCLUSIONS:** HDR-BT yields similar results to low dose rate in treatment of patients with LATC, with better results than those reported with exclusive EBRT. HDR-BT allows to increase the local dose, with good LC rates. In patients with large tumors requiring very mutilating surgery and patients who refuse surgery, EBRT with HDR-BT boost is a good option to increase the LC and cause-specific survival while keeping a better functional outcome. 

*Keywords:* Locally advanced; Tongue carcinoma; High dose rate; Brachytherapy

## Introduction

Treatment of early-stage tongue carcinoma by surgery or external beam radiation therapy (EBRT) is equally successful, and both modalities yield equivalent local control (LC) rates. In locally advanced tongue carcinomas (LATCs), when the tumor size of oral tongue or base of tongue (BOT) cancer is large, tumors >3−4 cm, or N positive lesions, several options can be chosen. EBRT, chemotherapy, and surgery, either hemiglossectomy or total glossectomy, have been used alone or in combination, with results and survival rates in Stages III and IV of 30−50%, decreasing the survival rate at 15−30% with lymph node metastasis (1, 2).

Brachytherapy (BT) is an important alternative to conventional radiation therapy; it provides a high localized dose of radiation, with rapid falloff and short overall treatment time (3, 4). It can be applied as a sole treatment, as a treatment complementary to surgery, and as a local boost in combination with EBRT (5). And it is the best way to deliver radiation to the tumor bed decreasing the late effects of EBRT. The experience with low dose rate (LDR) has shown benefits as a postoperative procedure (6, 7) or even

Received 20 March 2017; received in revised form 19 June 2017; accepted 10 July 2017.

Conflict of interest: The authors report no proprietary or commercial interest in any product mentioned or concept discussed in this article.

* Corresponding author. Department of Radiation Oncology, Fundación Instituto Valenciano de Oncología (IVO), C/ Profesor Beltrán Baguena 8, 46009 Valencia, Spain. Tel.: +34961114131; fax: +34961114747.

*E-mail address:* jguinot@fivo.org (J.L. Guinot).

1538-4721/$ - see front matter 
http://dx.doi.org/10.1016/j.brachy.2017.07.006

as primary treatment of small tumors without surgery achieving a LC in T1-2 oral carcinomas between 64% and 92% (8). Low-dose-rate brachytherapy (LDR-BT) in combination with EBRT has been reported to achieve better results concerning LC. Although nowaday, high dose rate is becoming the standard in BT, and there is a fear to increase the late complications rate (3). This can be the reason of the scarce number of papers related to this topic.

In advanced tumors, local surgery is usually discarded and radio chemotherapy is the standard. Although toxicity has decreased with intensity modulated radiation therapy (IMRT), EBRT is associated with numerous side effects, including mucositis, dysphagia, fibrosis, and mandibular radionecrosis. Therefore, interstitial BT has been used as a boost after EBRT in order to give a higher dose to the tumor with less toxicity. Combined EBRT and BT are indicated for tumors larger than 3−4 cm not suitable for surgery (9).

In this study, we evaluate retrospectively the treatment outcomes of EBRT plus an HDR-BT boost for LATC of oral cavity or BOT, and we calculate the LC rate, regional control (RC) rate, disease free from distant metastasis, overall survival (OS), cause-specific survival (CSS) rates, and disease-free survival (DFS) to know if HDR-BT boost can be safely used in LACT.

## Methods and materials

All patients with LATC treated with a boost of HDR-BT at our institution between May 2000 and December 2014 were recorded. The implantation procedure and the general definition process for this site have been previously described (10). Briefly, 3D-EBRT was delivered with 6-MV photon beams to the oral cavity and cervical nodes through conformed opposed lateral fields with or without wedges and a direct anteroposterior field to treat the supraclavicular area under the thyroid notch. A reduction in lateral fields was done after 40 Gy to shield the spine, and supplementary fields with electrons were used to treat spinal areas. The median dose with EBRT to the primary was 50 Gy (50−60 Gy), and the mean dose was 56.5 Gy. The dose for the metastatic lymph node region was 70 Gy. All cases but one received systemic treatment.

BT was performed 2−3 weeks after the EBRT under general anesthesia, with parallel needles in a triangular shape, with 10−12 mm between them, covering the residual palpable tumor and the initial involved areas according to the MRI or exploration. Needles were substituted by plastic tubes with a button on the top (Fig. 1). A CT planning scan was done on the same or the next day, with 3-mm slices. The clinical target volume was defined around the plastic tubes. A modified Paris system was used to calculate the isodoses with the Nucletron-Elekta TPS. Basal dose was the mean of Point A, placed between the triangles, and the treatment isodose was the 90% of the basal dose, with

Fig. 1. Implant of eight plastic parallel tubes.

a manual adjustment of the isodose curves to decrease the dose to 0.1 cc of the mandible under the prescription dose. We tried to keep a dose-nonuniformity ratio ($V_{150}/V_{100}$) under 0.35 (Fig. 2)

The dose per fraction was 3 Gy twice a day 6-h apart, 78 fractions after 50 Gy and 67 fractions after 60 Gy EBRT to give a total dose of 18−24 Gy.

### *Statistical analysis*

For the statistical analysis about LC, RC, OS, CSS, and DFS rates, corrected actuarial survivals were calculated using the Kaplan−Meier method. For comparison, log-rank test has been used; $p < 0.05$ was considered as statistically significant value. Local recurrences were considered as tumor growth in the same area or close to the primary tumor and were confirmed by biopsy. Regional recurrences were considered as any regional lymph nodes growth in the cervical area.

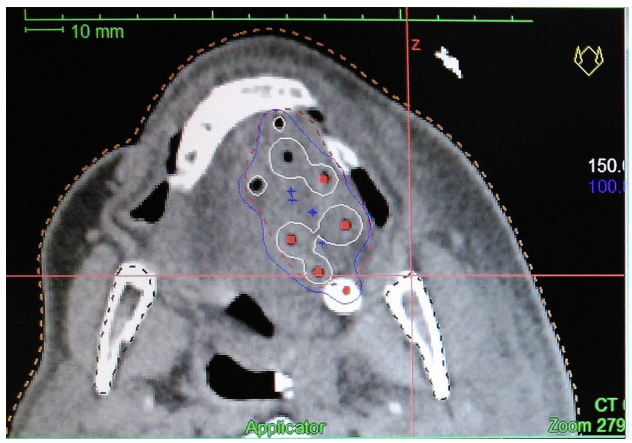


Fig. 2. Isodose curves in a T3 tongue carcinoma.