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Original article

## High dose rate brachytherapy with customized applicators for malignant facial skin lesions



### Utilisation d'applicateurs personnalisés en curiethérapie de haut débit de dose des néoplasies cutanées de la face et du cuir chevelu

R. Jumeau<sup>a,\*</sup>, S. Renard-Oldrini<sup>a</sup>, F. Courrech<sup>b</sup>, I. Buchheit<sup>b</sup>, G. Oldrini<sup>c</sup>, G. Vogin<sup>a</sup>, D. Peiffert<sup>a</sup>

<sup>a</sup> Department of radiotherapy, institut de cancérologie de Lorraine, 6, avenue de Bourgogne, 54500 Vandœuvre-lès-Nancy, France

<sup>b</sup> Department of radiation physics, institut de cancérologie de Lorraine, 6, avenue de Bourgogne, 54500 Vandœuvre-lès-Nancy, France

<sup>c</sup> Department of radiology, institut de cancérologie de Lorraine, 6, avenue de Bourgogne, 54500 Vandœuvre-lès-Nancy, France

#### ARTICLE INFO

##### Article history:

Received 8 March 2016

Received in revised form 20 March 2016

Accepted 23 March 2016

##### Keywords:

HDR brachytherapy

Local control

Customized applicators

Non-melanoma skin cancer

Surface molds

Dose optimization

#### ABSTRACT

**Purpose.** – Brachytherapy is a well-known treatment in the management of skin tumors. For facial or scalp lesions, applicators have been developed to deliver non-invasive treatment. We present cases treated with customized applicators with high dose rate system.

**Material and methods.** – Patients with poor performance status treated for malignant skin lesions of the scalp or the facial skin between 2011 and 2014 were studied. Afterloading devices were chosen between Freiburg® Flap, silicone-mold or wax applicators. The clinical target volume (CTV) was created by adding margins to lesions (10 mm to 20 mm). The dose schedules were 25 Gy in five fractions for postoperative lesions, 30 Gy in six fractions for exclusive treatments and a single session of 8 Gy could be considered for palliative treatments.

**Results.** – In 30 months, 11 patients received a treatment for a total of 12 lesions. The median age was 80 years. The median follow-up was 17 months and the 2-year local control rate was 91%. The mean CTV surface was 41.1 cm<sup>2</sup> with a mean thickness of 6.1 mm. We conceived three wax applicators, used our silicone-mold eight times and the Freiburg® Flap one time. We observed only low-grade radiodermatitis (grade I: 50%, grade II: 33%), and no high-grade skin toxicity.

**Conclusion.** – High dose rate brachytherapy with customized applicators for facial skin and scalp lesions is efficient and safe. It is a good modality to treat complex lesions in patients unfit for invasive treatment.

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#### RÉSUMÉ

**Objectif de l'étude.** – La curiethérapie est un traitement historique des néoplasies cutanées. Pour les lésions de la face ou du scalp, des applicateurs ont été développés pour réaliser des traitements non invasifs. Nous présentons une série de cas qui ont reçu une curiethérapie de haut débit de dose avec des applicateurs personnalisés.

**Matériel et méthodes.** – Nous avons inclus les patients de faible indice de performance pris en charge pour des néoplasies de la face et du scalp entre 2011 et 2014. Les applicateurs ont été choisis parmi celui de Freiburg®, un en silicone et un en cire. Le volume cible anatomo-clinique incluait une marge de 10 à 20 mm autour de la lésion. Il a été prescrit 25 Gy en cinq fractions pour les traitements postopératoires, 30 Gy en six fractions pour les traitements exclusifs et une dose unique de 8 Gy en palliation.

##### Mots clés :

Curiothérapie de haut débit de dose

Contrôle local

Applicateurs personnalisés

Néoplasies cutanées non-mélanomateuses

Applicateurs superficiels

Optimisation de la dose

\* Corresponding author.

E-mail address: [raphael.jumeau@gmail.com](mailto:raphael.jumeau@gmail.com) (R. Jumeau).

**Résultats.** – Sur 30 mois, 11 patients ont été inclus pour un total de 12 lésions. L'âge médian des patients était de 80 ans. La durée médiane de suivi était de 17 mois et le taux de contrôle local à 2 ans de 91 %. Le volume cible anatomoclinique moyen était de 41,1 cm<sup>2</sup>, avec une épaisseur moyenne de 6,1 mm. Trois applicateurs en cire ont été conçus, huit lésions ont été traitées avec un applicateur en silicone et une avec celui de Freiburg®. Il a été observé après le traitement des radiodermites de faibles grade (I : 50 % ; II : 33 %) et aucune radiodermite de haut grade.

**Conclusion.** – La curiethérapie de haut débit de dose avec applicateurs personnalisés pour les lésions de la face et du scalp est sûre et efficace. C'est une bonne modalité de traitement des lésions complexes pour les patients avec un faible indice de performance.

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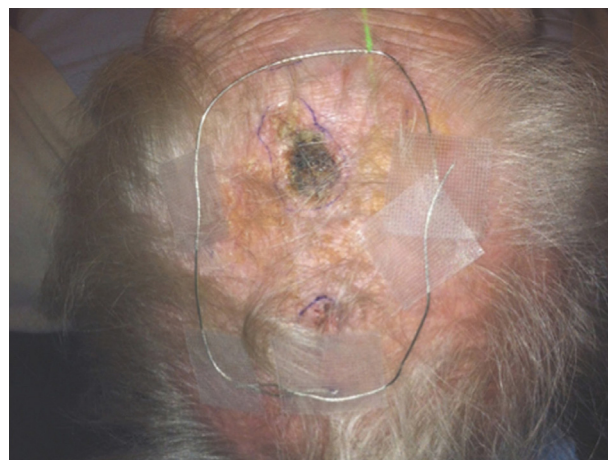
## 1. Introduction

Non-melanoma skin tumours are one of the most common cancers worldwide [1]. Skin can also be a metastatic site for various types of cancer [2]. In the management of skin lesions, surgery is usually the most simple treatment [3]. Definitive radiation therapy can be an alternative for patients unfit for surgery, complex locations or by patient preference [4]. Adjuvant radiation therapy is also considered in cases with close or positive margins. Irradiation can be delivered by external beam with photons or brachytherapy. One of the main advantages of brachytherapy over external beam radiation therapy is the possibility to deliver an accurate treatment focused around the radiation source, thus administering a higher and more precise dose. Skin brachytherapy can be performed using interstitial techniques or with superficial techniques using applicators. With interstitial brachytherapy, hypodermic catheters have to be surgically placed into the patient, inside or near the target volume. Irradiation is then delivered into the catheters by 192-iridium wire or with pulsed techniques by stopping the radioactive source at predefined locations. With the recent disappearance of 192-iridium wire, interstitial brachytherapy is possible only with pulsed techniques [5]. For some locations such as the face or the scalp, skin thickness is not sufficient to implant catheters. In order to treat superficial lesions, companies developed applicators to perform superficial irradiation; applicators can also be homemade, with moulds or wax [6–8]. Superficial techniques are performed with brachytherapy systems that use high dose rate sources (over 12 Gy/h) to deliver a fast treatment. Thus, high dose rate brachytherapy with applicators could be an alternative to interstitial brachytherapy with the possibility of an outpatient procedure, which is important for unfit patients [9]. Furthermore, afterloading treatments are performed with dedicated treatment planning system that can optimize the dose to obtain personalized treatments. We present our experience with high dose rate brachytherapy using customized applicators for complex neoplastic lesions of the facial skin and the scalp.

## 2. Patients and method

### 2.1. Patients and lesions

We retrospectively included analysed patients treated for malignant diseases of the scalp or facial skin between 2011 and 2014 in our department. We considered primary cutaneous tumours and metastatic skin tumours with a radical or a palliative intention. Patients had poor performance status or poor prognosis and all demanded a short treatment. In some cases, brachytherapy was as an adjuvant treatment in cases of surgical resection with positive margins. This study was approved by our institutional review board and ethics committee and conducted in accordance with the Declaration of Helsinki, good clinical practice and French regulatory requirements.



**Fig. 1.** High dose rate brachytherapy for malignant facial skin lesions: gross target volume and clinical target volume delimitation.

*Curiothérapie de haut débit de dose de néoplasies cutanées de la face et du cuir chevelu : délimitations du volume tumoral macroscopique et volume cible anatomoclinique.*

### 2.2. Targets

The lesion borders were underlined with a marker that corresponded to the gross tumour volume (GTV). An extra margin of 10 mm was added to the GTV to create the clinical target volume (CTV) [10]. We used the margin of 20 mm for patients with neuroendocrine tumors and sarcomas. For postoperative cases, margins were added to the surgical bed to perform the CTV. For each patient the CTV was represented on the skin by a metal wire (Fig. 1). The planning target volume (PTV) was equal to the CTV [11].

### 2.3. Applicators and contentions

For each case, we chose between a Freiburg® Flap (Elekta AB, Stockholm, Sweden), a silicone-mold or a wax applicator (Fig. 2). The type of applicator was determined according to the availability of the product. The Freiburg® Flap was cut to overlap lesion contours and catheters were introduced into the applicator to guide the radioactive source. The silicone-mold applicator was a predesigned applicator that consisted of a 1 cm thick mould with 12 catheters inside. Wax applicators were created with preheated wax leaves applied onto the patient's face. Catheters were then introduced between the wax leaves. In all applicators, catheters were positioned parallel from each other and spaced at a fixed distance in respect to the Paris brachytherapy system [12]. To assure the reproducibility of applicator positioning, we used thermoplastic masks (CIVCO medical solutions, Kalona, IA, US) that kept the imprint of the applicator and the patients in the same position (Fig. 3). Patients were in a supine position on a foam mattress, except for one patient who was installed prone to treat posterior scalp lesions.

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