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From applicator-based (Paris system) implantations to rhinoseptoplasty: the concept of anatomic implantation for interventional radiotherapy in squamous cell carcinoma of the nasal vestibule. Short term results in a monoinstitutional series

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How to cite this article: Tropiano P, Tagliaferri L, Tondo A, Varrucchi S, Gallus R, Mattiucci GC, De Ridder M, Rijken JA, Scheurleer WFJ, D'Aviero A, Fionda B, Riu FG, Bussu F. From applicator-based (Paris system) implantations to rhinoseptoplasty: the concept of anatomic implantation for interventional radiotherapy in squamous cell carcinoma of the nasal vestibule. Short term results in a monoinstitutional series. *Mini-invasive Surg* 2024;8:17. <https://dx.doi.org/10.20517/2574-1225.2024.41>

Received: 7 May 2024 **First Decision:** 21 Aug 2024 **Revised:** 28 Aug 2024 **Accepted:** 6 Sep 2024 **Published:** 9 Sep 2024

Academic Editors: Ehab Hanna, Giulio Belli **Copy Editor:** Pei-Yun Wang **Production Editor:** Pei-Yun Wang

Abstract

Aim: Interventional radiotherapy (IRT) is being increasingly advocated as the standard treatment for the primary lesion in nasal vestibule squamous cell carcinoma (NV-SCC). The respect of the anatomical planes of the nose tip during implantation has been hypothesized to reduce the classical IRT toxicities on the cartilages, such as septal and even alar perforations. The present work describes a monoinstitutional series of NV-SCC treated with an IRT technique that follows the above principle (anatomical implantation), with a focus on IRT toxicities.

Methods: All consecutive patients with nasal vestibule (NV) carcinoma treated between March 2022 and October



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2023 with IRT on the primary lesion at Azienda Ospedaliera Universitaria di Sassari and Mater Olbia Hospital were included.

Results: A total of 15 patients were treated with IRT following the principles of anatomical implantation. The only treatment-related toxicity observed has been the mechanical damage to the skin from the buttons used to stabilize the plastic tubes.

Conclusion: IRT with anatomical implantation allows a high nose preservation rate and very good cosmetic results, which appear to be decisive advantages in comparison with traditional surgery, while confirming comparable effectiveness from an oncological point of view. However, in the present series, we describe typical skin toxicity that may have a negative impact on cosmetic results. We propose a new strategy involving the use of a soft medium such as a sponge to protect the skin from damage.

Keywords: Nose vestibule cancer, brachytherapy, interstitial implantation, endocavitary, cosmetic preservation, skin toxicity

INTRODUCTION

Nasal vestibule squamous cell carcinoma (NV-SCC) is classically considered a rare type of cancer. It has been reported to account for less than 1% of all head and neck malignancies, with an incidence of 0.3-0.4/100,000 person per year^[1]. However, data on the incidence is unreliable because the nasal vestibule (NV) is not a clearly defined anatomic area and a specific WHO International Classification of Diseases (ICD) code has not been assigned. The current Union for International Cancer Control (UICC)/American Joint Committee on Cancer (AJCC) staging system classifies primary lesions of the NV with the same criteria as ethmoid and nasal cavity proper.

The recent interest on these issues and the systematic description of the peculiar clinical features of NV-SCC^[2-4] has brought to propose new standards for classification and staging of these malignancies^[3-6]. These include the definition of clear anatomical boundaries for the NV itself, a specific WHO code for the site and the adoption of a specific separate T classification, making NV the third subsite within nasal cavity and paranasal sinuses^[7].

Surgery (mostly consisting of partial or total rhinectomy) has been the traditional, predominant treatment for NV-SCC^[8-16]. Interventional radiotherapy (IRT) has demonstrated non-inferiority to upfront surgery in terms of local-recurrence free survival (LRFS) and disease-specific survival (DSS)^[6,8,9,17-27], while providing superior local control compared to external beam radiation therapy (EBRT)^[6,20,28-32]. However, when surgery is selected, in view of the specific spread pattern of NV-SCC among cartilages, with early skin invasion, a through resection of the ala/nasal wall is most often indicated, requiring complex and unpredictable multiple reconstructive surgeries or the creation and fitting of a bone-anchored prosthesis (epithesis) for cosmetic restoration^[33-39]. On the contrary, IRT allows the preservation of the cartilaginous framework, leading to much more favorable functional^[3,40] and cosmetic outcomes^[6,21]. Based on these findings, the Italian Society of Otolaryngology defined IRT as the therapeutic standard for the primary lesions in NV-SCC^[41] without bone involvement.

To achieve optimal cosmetic and functional results through IRT, the necessity to preserve the perichondral layer feeding the cartilage has been outlined, and novel criteria for the implantation of the applicators have been described, thus defining the concept of “anatomic implantation”^[17].

In the present work, we evaluate a monoinstitutional series of NV-SCC treated with IRT through anatomic implantation (“anatomic IRT”) and focus on specific toxicities and strategies to avoid them.

METHODS

Patients

Patients with NV-SCC, treated between March 2022 and October 2023 with IRT within the North Sardinia Tumor Board, involving the Otolaryngology Division of the University Hospital of Sassari and the Radiation Oncology Division of Mater Olbia Hospital, have been included. This study adhered to the ethical principles outlined in the Declaration of Helsinki. Ethical approval was not mandated by Italian law (GU No. 76, 31 March 2008) due to its observational retrospective design. Informed consent for the procedure and photographic documentation were obtained.

The minimal required work-up included physical examination, rhinoscopy, rigid nasal endoscopy, neck ultrasound performed by the head and neck surgeon (FB) and contrast-enhanced computed tomography (CT) of the face, neck and chest. Whenever the actual spread in soft tissues of the nose/cheek/superior lip was not clearly defined, magnetic resonance imaging (MRI) completed the diagnostic work-up of the primary tumor. In case of doubts concerning lymph nodes at imaging, an ultrasound-guided fine needle aspiration biopsy (FNAB) of the suspicious node(s) was performed.

For staging purposes, we used both the Rome Classification and the UICC/AJCC system for T, and the UICC/AJCC system for N classification^[42].

Treatment modalities

A variable number of 6-Fr flexible implant tubes were inserted using metal guide channels [Figure 1] and fixed by buttons that can be anchored to the skin by stitches and are anyway going to be adherent to increase the reliability of the treatment plan [Figure 2]. The implants are best applied under general anesthesia; orotracheal intubation is preferred and a laryngeal mask should be avoided to minimize the hindrance by the anesthesiology tube which should be stabilized as far away as possible from the operating field. The implantation was performed by a head and neck surgeon in the presence of experienced IRT radiation oncologists.

Infiltration of the subperichondral planes with local anesthetics, with or without adrenaline, as in functional nose surgery, is fundamental to obtain analgesia in case of local anesthesia and is helpful in facilitating the optimal catheter path along the planes avoiding piercing of the mucoperichondrium. The exact configuration and number of catheters is tailored to the extent, depth, and shape of the lesion according to pre-implant MRI or CT scan, clinical experience, work-up data, and intraoperative findings. The dose is prescribed after implant encompassing the full clinical target volume (CTV) and sparing as much as possible the surrounding healthy structures. For this reason, interaction between the surgeon and the IRT radiation oncologist is always recommended at the implantation phase in the surgical theater.

Anatomic implantation

With this technique, a “fully interstitial” implant is preferable. However, when this approach is insufficient for adequate CTV coverage by overreaching all the limits of the lesion, alternative methods can be used to obtain complete coverage and stabilize the tubes. A scenario may be the presence of a bulky skin spread, which can be approached with a “contact” strategy, by placing the tubes on the skin in the area of such exophytic spread [Figure 3]. A different, very common situation is the extension of the lesion posterior to the limit of the NV, which is the plane tangential to the piriform opening^[4,42]. If this extension is limited and



Figure 1. Metal guides are placed altogether before the introduction of implants (plastic tube). Introducing a metal guide with a plastic tube already in place would put the latter at risk of being severed and therefore being unusable for the following IRT. IRT: Interventional radiotherapy.



Figure 2. Stabilization of implants is achieved by anchoring them with buttons in an interstitial implant.

close to the nasal spine, the problem can be overcome with plastic tube placement in the superior lip under the spine, which is useful as well to cover possible spread to the superior lip itself [Figures 4 and 5]. More



Figure 3. An example of a patient with squamous cell carcinoma of the inferior wall of NV featuring an exophytic growth towards the superior lip and the inferior nasal spine, which can be approached with a “contact” strategy, by placing the tubes on the skin in the area of such superficial spread and stabilizing them through an interstitial path away from the CTV. NV: Nasal vestibule; CTV: clinical target volume.

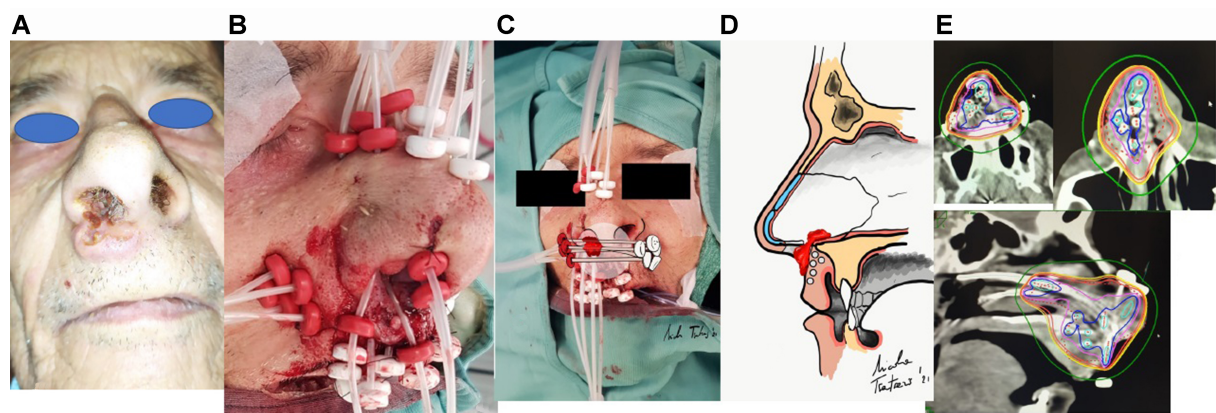


Figure 4. (A) A bulky lesion of the inferior wall of the vestibule extensively invaded the superior lip; (B and C) Catheters were placed both along the “classical” subperichondral paths and perpendicular to them along the coronal main axis of the superior lip; (D and E) This allowed the target volume to be completely covered with a fully interstitial implant. Modified from *Malignancies of the Nasal Vestibule*. Editor Francesco Bussu. Springer.

often, a fully interstitial implant placement may not adequately cover the CTV in case of spread beyond the piriform aperture, because of the bony structures; thus, endocavitary implantation may be needed. The latter has been performed in the present series by fixation to sponge packing of blind end tubes [Figure 6]; this is a simple and non-traumatic procedure, and the presence of the packing in the nasal cavity has the additional advantage of improving dose delivery by eliminating the interface with air, and capturing 200% isodoses directly around the catheters, thereby preventing mucosal toxicity.

The recording of a 20% grade 2 persistent skin toxicity (see results) in the first ten patients prompted us to add a trick to our implantation to reduce such specific toxicity. We started to interpose a soft medium between the buttons and the skin, a simple trick to perform, made with easily available materials, which is safe and does not significantly lengthen the surgical procedure.

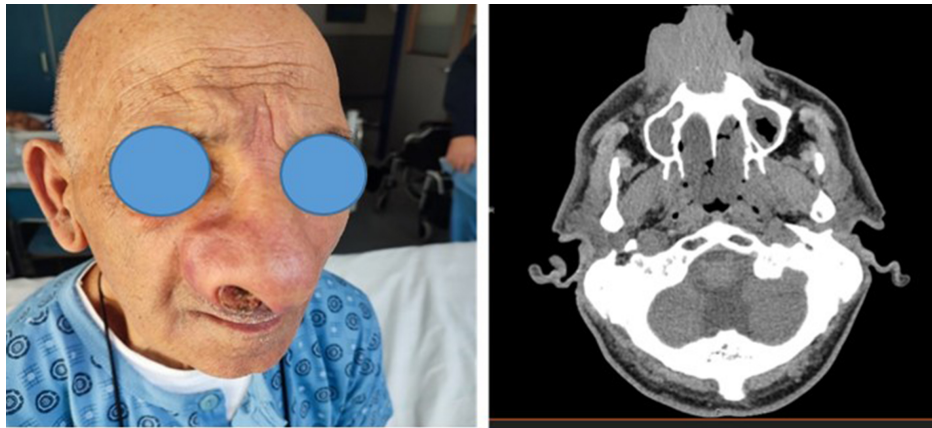


Figure 5. The images illustrate an example of a patient diagnosed with T4a stage SCC of the NV (Rome classification): the tumor invades the inferior nasal spine and the hard palate. SCC: Squamous cell carcinoma; NV: nasal vestibule.

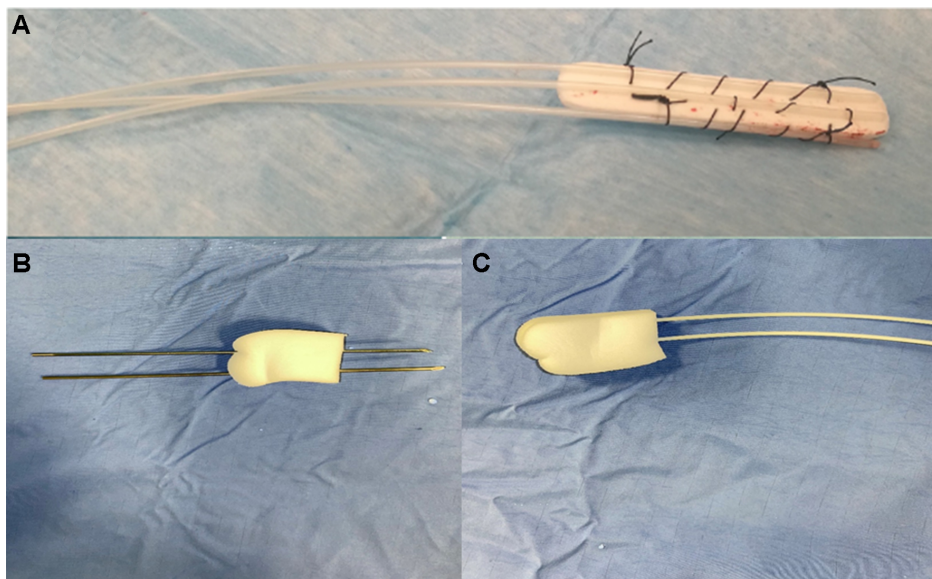


Figure 6. Endocavitary implants for NV-SCC, characterized by plastic tubes fixed preliminarily on Merocel® nasal packing. In the past, we sutured the plastic tubes onto the nasal packing (A) (modified from *Malignancies of the Nasal Vestibule*. Editor Francesco Bussu. Springer) but tightening them too much could have blocked and made them unusable, so that, on the contrary, we experienced issues concerning stability and therefore reliability of the treatment plan. In the present series, we have always preliminarily placed the plastic tubes inside the nasal packing. When using this trick, made possible by passing the metal guides inside the Merocel® (B), blind tubes are stabilized on the packing by their larger ends on the distal extremity and by buttons on the proximal one (C). NV-SCC: Nasal vestibule squamous cell carcinoma.

Such medium can also be obtained from a Freiburg flap surface mold (if available), by detaching single silicon spheres (Figure 7, case from Policlinico Agostino Gemelli Hospital, Rome). In the present series, the bearings have been manufactured prior to the implant, using small squares of Merocel® and perforating them with the help of a needle guide for plastic tubes to make insertion and sliding easier [Figure 8]. The pads are positioned during the implantation between the anchoring button and the skin (both at the entry and exit points) [Figure 9].

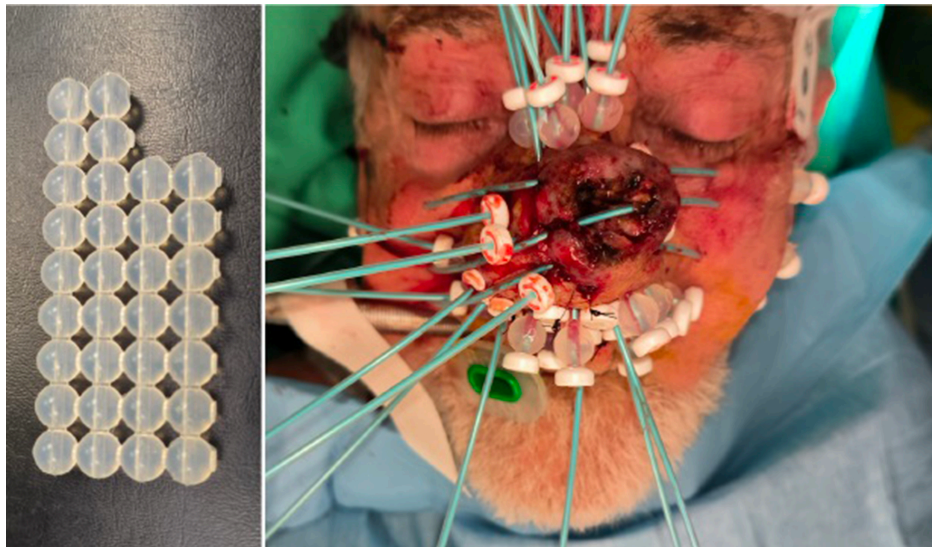


Figure 7. Freiburg flap silicon spheres can be used to protect the skin from mechanical damage (courtesy of Luca Tagliaferri, Policlinico Agostino Gemelli Hospital, Rome).

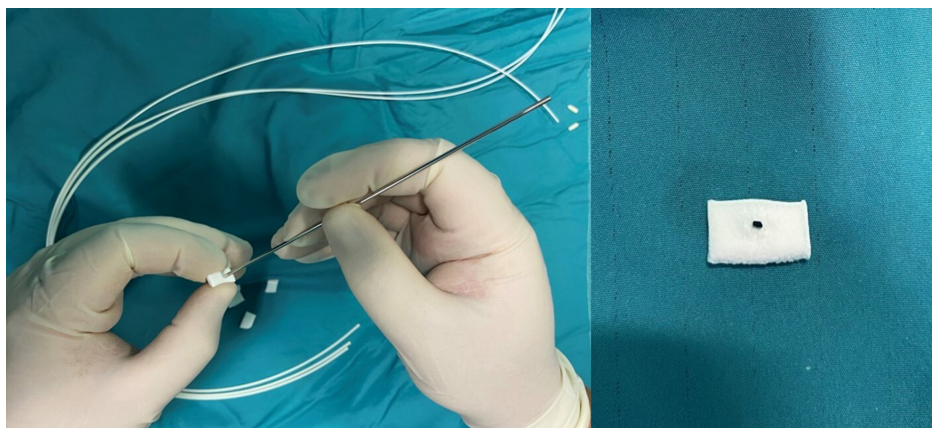


Figure 8. Meroce® fragments are perforated using a metal guide needle for plastic tubes.

Pre-plan evaluation of MRI and/or CT imaging is performed to define the extent of target volume. After the surgical procedure, a planning CT is acquired to perform implant reconstruction and target delineation. A new CT scan is acquired to check implant stability and to proceed to replanning if necessary.

Delivery

High dose rate (HDR) IRT was applied using an I-192 source, delivered by a Bravos (Varian Medical Systems) afterloader with a standardized fractionation: 44-Gy total dose, 3 Gy per fraction, except for first and last fractions of 4 Gy, two fractions per day, 6-hour interval between the fractions, and maximum overall treatment time of ten days.

Removal of the implant was done immediately after the treatment was finished. The removal was done in the outpatient ENT office of Mater Olbia Hospital.



Figure 9. Two perforated sponge fragments are inserted into the plastic tubes beneath the anchoring button, and both fragments remain in contact with the skin protecting from mechanical damage.

Toxicities have been systematically recorded according to the Common Terminology Criteria for Adverse Events (CTCAE) v5.0.

RESULTS

A total of 15 patients were included in the study. Out of these, seven patients were able to achieve coverage with a fully interstitial delivery, while the remaining eight cases required concomitant intracavitary implants (mixed delivery) [Figure 10, Table 1].

The median volume of the CTV in the selected series was 21.50 cc (range 8.30-83.89).

The CTV coverage was optimized by capturing 200% isodoses directly around the catheters and 300% inside the catheters. A dosimetric accuracy analysis was performed before each treatment and the Dose non-uniformity ratio (DNR) was calculated, resulting in a median value of 0.54 (range 0.7-0.44).

Out of the three patients with cervical lymph node involvement (cN+), one had evident positive neck nodes in preoperative imaging, while the other two were diagnosed with neck metastasis through FNAB in the context of a lump clinic, as previously described^[43,44]. The three cN+ patients additionally underwent functional neck dissection (ND), while elective ND was not performed in the remaining cN0 cases. At follow-up, two patients were found to have residual/recurrent disease. One patient had a locoregional relapse of the disease, while the other had an isolated regional recurrence. Both cases occurred within the first four months after treatment and underwent salvage surgery. None of the patients died as a result of the disease. The average follow-up was seven months.

No instances of septal or alar perforations were recorded after treatment. Treatment-related toxicity was observed in two patients who experienced skin scarring in the area corresponding to the buttons (two of the first ten patients, 30%). It was discovered that these scars were associated with the close adherence of the



Figure 10. A series of tumors, before and after implantation and the final results. Patient 1: NV-SCC arising in the medial wall (columella) and treated with fully interstitial implant (A) with complete response, mild acute mucosal and skin toxicity (B) and excellent midterm (3 months) cosmetic results (C); Patient 2: Recurrent NV-SCC with an extensive skin invasion after multiple surgeries (D), treated with a mixed implant (1 endocavitary catheter) (E). IRT confirms an impressive ability to preserve the nasal framework while obtaining complete response (F); Patient 3: NV-SCC arising in the lateral wall (G) is treated with mixed implant (H) with complete response and satisfying cosmetic results at two months (I and J). NV-SCC: Nasal vestibule squamous cell carcinoma; IRT: interventional radiotherapy.

implant to the skin, which was done to maximize stability of the implant and reliability of the treatment plan. The scarring appeared to be primarily due to mechanical damage rather than irradiation, as the scars were located away from the areas irradiated with high doses [Figure 11].

For the last five patients, a skin sparing technique, as described in the methods section, was employed during the implantation process. No significant skin scarring was observed in these patients [Figure 12].

DISCUSSION

The present results confirm that the NV's anatomy makes it well-suited for IRT, given the absence of adjacent vital structures [organs at risks (OARs)] and the resistance of the cartilaginous rigid framework to radiation-induced toxicity^[3,5,18]. This explains why, with equal oncological outcomes, IRT ensures the

Table 1. Patients and tumors characteristics

esFeatures		
Age, years	Median	59.13
	Range	27-79
Sex, No. (%)	Male	10 (66.6)
	Female	5 (33.4)
Primary vs. recurrent (%)	Primary	12 (80)
	Recurrent	3 (20)
Subsite of primary, No. (%)	Ala/limen nasi	8 (53.4)
	Inferior border/superior lip	4 (26.6)
	Septum/columella	3 (20)
UICC/AJCC cT classification, No. (%)	T1	2 (13.4)
	T4a	13 (86.6)
Rome cT classification, No. (%)	1	1 (6.7)
	2a	8 (53.2)
	2b	3 (20)
	3	2 (13.4)
	4a	1 (6.7)
cN stage, No. (%)	0	12 (80)
	1	2 (13.3)
	3b	1 (6.7)
Delivery (%)	Pure interstitial	6 (40)
	Mixed (interstitial + endocavitary)	9 (60)
Interstitial plastic tubes, No.	Median	9.13
	Range	5-15
Endocavitary plastic tubes (in the nine mixed implantations), No.	Median	2.88
	Range	1-9
Oncological outcomes (%)	Alive and in FU	14 (93.3)
	Died for other causes	1 (6.7)
Follow-up time, months	Median	7.22
	Range	1-21
Post-IRT local recurrence (%)	Recurrence	1 (6.7)
	No evidence of recurrence	14 (93.3)
Regional recurrence (%)	Recurrence	2 (13.4)
	No evidence of recurrence	13 (86.6)
Cosmetic defect, No. (%)	None	13 (86.6)
	Perinasal skin scars	2 (13.4)

Notably, the T classification distribution is extremely uneven using the UICC/AJCC classification. UICC: Union for International Cancer Control; AJCC: American Joint Committee on Cancer; FU: follow-up; IRT: interventional radiotherapy.

preservation of the nasal pyramid and therefore cosmetic results much superior compared to surgery^[16-21], which, also in recent series, almost always requires rhinectomy^[45].

However, also with brachytherapy and IRT, toxicities such as septal and alar perforations have been reported^[3,41], particularly when interstitial dose delivery is used^[23]. Such complications are likely due to mechanical damage and disruption of the perichondrium, which supplies blood to the cartilage, rather than irradiation to the cartilage itself^[3,17,18].



Figure 11. A bulky lesion of the lateral wall of the NV (A and B) treated by IRT (C and D) with complete response and skin scars at the level of the buttons (E and F); (G and H) As evident from the treatment plan, this toxicity was not associated with hotspots but with mechanical damage. NV: Nasal vestibule; IRT: interventional radiotherapy.



Figure 12. One of the five patients with NV-SCC (A) underwent IRT with mixed implantation (B); (C) There is no evident cutaneous toxicity three months after irradiation. NV-SCC: Nasal vestibule squamous cell carcinoma; IRT: interventional radiotherapy.

To address this issue, new principles of anatomic implantation have been developed that avoid piercing of the perichondrium, therefore indicating the subperichondral planes of (rhino)-septoplasty as the optimal path for plastic tubes^[3,17,18] (“anatomic IRT”).

This study is the first objective assessment of the results of anatomic IRT. As expected, no septal or alar perforations have been observed. However, skin scarring as a specific toxicity resulting from excessive adherence of the buttons to the skin for stabilization has been reported. To address this issue, we describe a strategy to minimize this minor yet concerning toxicity, with promising initial results.

One potential future strategy to improve fixation and minimize complications, while keeping the principles of anatomic implantation, may be the use of individual 3D printed molds^[46,47].

In terms of oncological effectiveness, our results suggest a high rate of local control with IRT. However, it is important to note that IRT is only a local treatment and nodal involvement at diagnosis is a crucial factor for survival in NV-SCC^[47-55], as well as in most head and neck mucosal malignancies. In our study, 20% of cases had positive nodes at diagnosis and were managed with surgery (bilateral comprehensive neck dissection), and a 20% nodal relapse rate was observed. In this regard, the role of sentinel lymph node biopsy surely warrants further investigation. All neck metastases at diagnosis and recurrences in previously observed cN0 were at level I; the recurrence in the already operated cN+ case occurred at level IX. Notably, the ultrasound-guided FNAB, obtained by a head and neck surgeon, allowed the detection of two-thirds of cN+ cases, which had been classified as cN0 at morphological imaging. This highlights the importance of comprehensive neck evaluation in the management of NV-SCC. In fact, small nodes in level I are most often present and are usually interpreted as reactive/aspecific; the ultrasound screening of a well-trained head and neck surgeon and the FNAB performed in the lump clinic with rapid on-site evaluation^[43,44] seem to be powerful tools for the early detection and treatment of neck metastasis in this disease, with a probable impact on prognosis. On the other hand, the inclusion of neck evaluation in a lump clinic in the work-up of NV-SCC clearly increases the reliability of the cN0 staging and therefore the safety of neck observation.

Our experience^[16,20], supported also by the findings of this study, suggests that local recurrence typically occurs within the first months after IRT. Therefore, a series with an average follow-up period of seven months provides useful information regarding local control.

Furthermore, even if evidence on the subject is still lacking, the salvageability of local recurrences is, in theory, very good, as it would involve anyway a rhinectomy and diagnosis of recurrence can be relatively easy and early.

Regarding dosimetric parameters, it is important to note that IRT is characterized by a highly favorable dose distribution. It delivers high doses to the target area with a very rapid fall-off in surrounding tissues^[56]. Specifically, assessing doses to critical OARs, such as the eyes and lens, is crucial but largely depends on the distance of the CTV from the ocular region^[57]. For this reason, we consistently monitor the dose to the eyes and lens, which typically remains below established constraints; however, in certain situations, additional measures may be implemented to further reduce the dose^[58].

However, the following limitations should be kept in mind when reading these results.

Limitations of the study

- Most of the data about the comparison of different treatment modalities are not direct, but extrapolated from different series. However, if the current results are confirmed, it could not be ethically acceptable to keep proposing total rhinectomy when a nose preservation option with the same oncological results is available^[41].
- This is a relatively small series with a short follow-up, making it difficult to detect small differences or to generalize the findings broadly; yet, the described disease is considered rare, and our focus is mainly on acute and subacute toxicity, therefore providing valuable information.
- While immediate and short-term benefits are clear, a deeper exploration of long-term outcomes, particularly concerning regional recurrence rates and long-term cosmetic results (which, for example, may be impacted by the development of radiation-induced telangiectasia), is needed.

In conclusion, our findings, even if to be considered preliminary because of the small numbers and the short follow-up, confirm the excellent local control achieved with IRT and the low occurrence of classical toxicities (septal and alar perforations) with the anatomic implantation thus supporting the adoption of anatomic IRT as treatment of choice for a primary lesion in NV-SCC without bone invasion^[41], as recently suggested by the Italian Society of Otolaryngology. The present result also points to the possibility of reducing skin toxicity, therefore further improving cosmetic outcomes in these patients.

DECLARATIONS

Authors' contributions

Study conception and design: Tropiano P, Bussu F, Riu FG, Rijken JA

Data acquisition: Tondo A, Varruciu S, Tropiano P

Quality control of data and algorithms: Tagliaferri L, Varruciu S, Gallus R, Mattiucci GC, De Ridder M, Rijken JA, Scheurleer WFJ, D'Aviero A, Fionda B, Riu FG, Bussu F

Data analysis and interpretation: Tropiano P, Bussu F, Tondo A, Varruciu S

Manuscript preparation: Tropiano P, Bussu F, Tondo A

Manuscript editing: Tropiano P, Bussu F, Tondo A, Riu FG

Manuscript review: Tagliaferri L, Varruciu S, Gallus R, Mattiucci GC, De Ridder M, Rijken JA, Scheurleer WFJ, D'Aviero A, Fionda B, Riu FG, Bussu F

Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Financial support and sponsorship

None.

Conflicts of interest

All authors declared that there are no conflicts of interest.

Ethical approval and consent to participate

The current study was done in accordance with the ethical standards of each institutional committee on human experimentation, the Declaration of Helsinki. Data were analyzed with an observational retrospective design, and in this case, mandatory ethical approval is not required under Italian law (GU No. 76 31 March 2008). Informed consent was obtained from the patients for the procedure.

Consent for publication

Patients' written informed consent for publication was obtained.

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REFERENCES

1. Agger A, von Buchwald C, Madsen AR, et al. Squamous cell carcinoma of the nasal vestibule 1993-2002: a nationwide retrospective study from DAHANCA. *Head Neck* 2009;31:1593-9. DOI PubMed
2. Bussu F, Rizzo D, Tramaloni P, et al. Peculiar patterns of spread of nose vestibule malignancies. In: Bussu F, editor. Malignancies of the nasal vestibule. Cham: Springer International Publishing; 2023. pp. 25-38. DOI
3. Bussu F, Tagliaferri L, Piras A, et al. Multidisciplinary approach to nose vestibule malignancies: setting new standards. *Acta Otorhinolaryngol Ital* 2021;41:S158-65. DOI PubMed PMC
4. Bussu F, Tagliaferri L, Crescio C, et al. New standards for the management of nose vestibule malignancies. *Acta Otolaryngol*

- 2023;143:215-22. [DOI](#) [PubMed](#)
5. Parrilla C, Bussu F, Turra N, et al. Anatomy of the nose vestibule. In: Bussu F, editor. *Malignancies of the nasal vestibule*. Cham: Springer International Publishing; 2023. p. 1-9. [DOI](#)
6. Czerwinski MD, Jansen PP, Zwijnenburg EM, et al. Radiotherapy as nose preservation treatment strategy for cancer of the nasal vestibule: the Dutch experience. *Radiother Oncol* 2021;164:20-6. [DOI](#) [PubMed](#)
7. Scheurleer WFJ, de Ridder M, Tagliaferri L, et al. Validation of the “Rome” classification for squamous cell carcinoma of the nasal vestibule. *Cancers* 2023;16:37. [DOI](#) [PubMed](#) [PMC](#)
8. Zaoui K, Plinkert PK, Federspil PA. Primary surgical treatment of nasal vestibule cancer - therapeutic outcome and reconstructive strategies. *Rhinology* 2018;56:393-9. [DOI](#) [PubMed](#)
9. Vital D, Morand G, Huber GF, Studer G, Holzmann D. Outcome in squamous cell carcinoma of the nasal vestibule: a single center experience. *Head Neck* 2015;37:46-51. [DOI](#) [PubMed](#)
10. Lambertoni A, Cherubino M, Battaglia P, et al. Squamous cell carcinoma of nasal vestibule and pyramid: outcomes and reconstructive strategies. *Laryngoscope* 2021;131:E1198-208. [DOI](#) [PubMed](#)
11. Langendijk JA, Poorter R, Leemans CR, de Bree R, Doornaert P, Slotman BJ. Radiotherapy of squamous cell carcinoma of the nasal vestibule. *Int J Radiat Oncol Biol Phys* 2004;59:1319-25. [DOI](#) [PubMed](#)
12. Wong CS, Cummings BJ. The place of radiation therapy in the treatment of squamous cell carcinoma of the nasal vestibule. a review. *Acta Oncol* 1988;27:203-8. [DOI](#) [PubMed](#)
13. Bussu F, Tagliaferri L, Mattiucci G, et al. HDR interventional radiotherapy (brachytherapy) in the treatment of primary and recurrent head and neck malignancies. *Head Neck* 2019;41:1667-75. [DOI](#) [PubMed](#)
14. Tagliaferri L, Fionda B, Bussu F, et al. Interventional radiotherapy (brachytherapy) for squamous cell carcinoma of the nasal vestibule: a multidisciplinary systematic review. *Eur J Dermatol* 2019;29:417-21. [PubMed](#)
15. Luca T, Valentina L, Fionda B, et al. Interventional radiotherapy (brachytherapy) for the treatment of primary lesions in nasal vestibule malignancies. In: Bussu F, editor. *Malignancies of the nasal vestibule*. Cham: Springer International Publishing; 2023. pp. 135-44. [DOI](#)
16. Bussu F, Tagliaferri L, Mattiucci G, et al. Comparison of interstitial brachytherapy and surgery as primary treatments for nasal vestibule carcinomas. *Laryngoscope* 2016;126:367-71. [DOI](#) [PubMed](#)
17. Bussu F, Tagliaferri L, De Luca LM, et al. A novel approach to interventional radiotherapy (brachytherapy) in nose vestibule. From Paris system rules to anatomic implantation. In: Bussu F, editor. *Malignancies of the nasal vestibule*. Cham: Springer International Publishing; 2023. pp. 161-76. [DOI](#)
18. Bussu F, Tagliaferri L, Czerwinski M, et al. Setting new standards for nasal vestibule malignancies. In: Bussu F, editor. *Malignancies of the nasal vestibule*. Cham: Springer International Publishing; 2023. pp. 195-208. [DOI](#)
19. Czerwinski MD, van Leeuwen RGH, Kaanders JHAM, et al. Image guided brachytherapy for cancer of the nasal vestibule: local control and cosmesis. *Int J Radiat Oncol Biol Phys* 2019;103:913-21. [DOI](#) [PubMed](#)
20. Tagliaferri L, Carra N, Lancellotta V, et al. Interventional radiotherapy as exclusive treatment for primary nasal vestibule cancer: single-institution experience. *J Contemp Brachytherapy* 2020;12:413-9. [DOI](#) [PubMed](#) [PMC](#)
21. Levendag PC, Nijdam WM, van Moolenburgh SE, et al. Interstitial radiation therapy for early-stage nasal vestibule cancer: a continuing quest for optimal tumor control and cosmesis. *Int J Radiat Oncol Biol Phys* 2006;66:160-9. [DOI](#) [PubMed](#)
22. Galli J, Bussu F, Passali GC, et al. Brachytherapy for nose vestibule malignancies: functional results. In: Bussu F, editor. *Malignancies of the nasal vestibule*. Cham: Springer International Publishing; 2023. pp. 145-60. [DOI](#)
23. Lipman D, Verhoef LC, Takes RP, Kaanders JH, Janssens GO. Outcome and toxicity profile after brachytherapy for squamous cell carcinoma of the nasal vestibule. *Head Neck* 2015;37:1297-303. [DOI](#) [PubMed](#)
24. Murakami N, Omura G, Yatsuoka W, et al. Hybrid intracavitary-interstitial brachytherapy in a case of nasal vestibule cancer penetrating the hard palate. *BJR Case Rep* 2021;7:20200178. [DOI](#) [PubMed](#) [PMC](#)
25. Bilski M, Cisek P, Baranowska I, et al. Brachytherapy in the treatment of non-melanoma skin peri-auricular cancers - a retrospective analysis of a single institution experience. *Cancers* 2022;14:5614. [DOI](#) [PubMed](#) [PMC](#)
26. Tagliaferri L, Giarrizzo I, Fionda B, et al. ORIFICE (interventional radiotherapy for face aesthetic preservation) study: results of interdisciplinary assessment of interstitial interventional radiotherapy (brachytherapy) for periorificial face cancer. *J Pers Med* 2022;12:1038. [DOI](#) [PubMed](#) [PMC](#)
27. Rembielak A, Mansy G, Barnes EA, Licher J, Tselis N. Advances in skin brachytherapy: cosmesis and function preservation. *Clin Oncol* 2023;35:507-15. [DOI](#) [PubMed](#)
28. Scheurleer WFJ, Dehnad H, Braunius WW, et al. Long-term oncological follow-up after mold-based pulsed dose rate brachytherapy for early stage squamous cell carcinoma of the nasal vestibule: a single center experience of 68 patients over a 17-year period. *Brachytherapy* 2023;22:221-30. [DOI](#) [PubMed](#)
29. Wallace A, Morris CG, Kirwan J, Amdur RJ, Werning JW, Mendenhall WM. Radiotherapy for squamous cell carcinoma of the nasal vestibule. *Am J Clin Oncol* 2007;30:612-6. [DOI](#) [PubMed](#)
30. Vanneste BG, Lopez-Yurda M, Tan IB, Balm AJ, Borst GR, Rasch CR. Irradiation of localized squamous cell carcinoma of the nasal vestibule. *Head Neck* 2016;38 Suppl 1:E1870-5. [DOI](#) [PubMed](#)
31. Paolo T, Paolo F, Andrea M, et al. Acknowledged therapeutic options in nose vestibule malignancies. In: Bussu F, editor. *Malignancies of the nasal vestibule*. Cham: Springer International Publishing; 2023. pp. 57-75. [DOI](#)

32. Lukens JN, Gamez M, Hu K, Harrison LB. Modern brachytherapy. *Semin Oncol* 2014;41:831-47. DOI PubMed
33. Wagenblast J, Baghi M, Helbig M, et al. Craniofacial reconstructions with bone-anchored epithesis in head and neck cancer patients - a valid way back to self-perception and social reintegration. *Anticancer Res* 2008;28:2349-52. PubMed
34. Papaspyrou G, Schick B, Schneider M, Al Kadah B. Epithetic nasal reconstruction for nasal carcinoma: retrospective analysis on 22 patients. *Eur Arch Otorhinolaryngol* 2017;274:867-72. DOI PubMed
35. D'heygere V, Mattheis S, Stähr K, et al. Epithetic nasal reconstruction after total rhinectomy: Oncologic outcomes, immediate and long-term adverse effects, and quality of life. *J Plast Reconstr Aesthet Surg* 2021;74:625-31. DOI PubMed
36. Calabrese LS, Rizzo D, Vaira LA, Riu FG, Rubino C, De Riu G. Surgery in nose vestibule malignancies: the reconstructive phase. In: Bussu F, editor. *Malignancies of the nasal vestibule*. Cham: Springer International Publishing; 2023. pp. 83-98. DOI
37. Saponaro G, Gallus R, Budiman S, et al. Prostheses for cosmetic and functional restoration after ablative surgery for nose vestibule malignancies. In: Bussu F, editor. *Malignancies of the nasal vestibule*. Cham: Springer International Publishing; 2023. pp. 99-115. DOI
38. Haynes WD, Tapley N. Proceedings: radiation treatment of carcinoma of the nasal vestibule. *Am J Roentgenol Radium Ther Nucl Med* 1974;120:595-602. DOI PubMed
39. Wang CC. Treatment of carcinoma of the nasal vestibule by irradiation. *Cancer* 1976;38:100-6. DOI PubMed
40. Bacorro W, Escande A, Temam S, et al. Clinical outcomes after interstitial brachytherapy for early-stage nasal squamous cell carcinoma. *Brachytherapy* 2017;16:1021-7. DOI PubMed
41. Bussu F, Tagliaferri L, Corbisiero MF, et al. Management of nasal vestibule carcinomas: recommendations by the Oncological Committee of the Italian Society of Otorhinolaryngology - head and neck surgery. *Acta Otorhinolaryngol Ital* 2024;44:13-20. DOI PubMed PMC
42. Bussu F, Gallus R, Rizzo D, et al. A proposal for a consistent classification of nasal vestibule carcinomas. In: Bussu F, editor. *Malignancies of the nasal vestibule*. Cham: Springer International Publishing; 2023. pp. 47-56. DOI
43. Fois P, Mureddu L, Manca A, et al. Preoperative diagnosis of Warthin tumors combining cytological, clinical and ultrasonographic information within a multidisciplinary approach in a lump clinic. *J Pers Med* 2023;13:1075. DOI PubMed PMC
44. Petrone G, Rossi ED, Gallus R, et al. Utility of ultrasound-guided fine needle aspiration cytology in assessing malignancy in head and neck pathology. *Cytopathology* 2021;32:407-15. DOI PubMed
45. Pirola F, Di Santo D, Turri-Zanoni M, et al. Squamous cell carcinoma of the nasal vestibule: a multi-centric observational cohort study. *Laryngoscope* 2024;134:2634-45. DOI PubMed
46. Talmi YP, Ferlito A, Takes RP, et al. Lymph node metastasis in nasal vestibule cancer: a review. *Head Neck* 2011;33:1783-8. DOI PubMed
47. Membrive Conejo I, Pera Cegarra O, Foro Arnalot P, et al. Custom 3D-printed applicators for high dose-rate brachytherapy in skin cancer. *Brachytherapy* 2021;20:1257-64. DOI PubMed
48. Huang MW, Zhang JG, Zheng L, Liu SM, Yu GY. Accuracy evaluation of a 3D-printed individual template for needle guidance in head and neck brachytherapy. *J Radiat Res* 2016;57:662-7. DOI PubMed PMC
49. Scurry WC Jr, Goldenberg D, Chee MY, Lengerich EJ, Liu Y, Fedok FG. Regional recurrence of squamous cell carcinoma of the nasal cavity: a systematic review and meta-analysis. *Arch Otolaryngol Head Neck Surg* 2007;133:796-800. DOI PubMed
50. Kummer E, Rasch CR, Keus RB, Tan IB, Balm AJ. T stage as prognostic factor in irradiated localized squamous cell carcinoma of the nasal vestibule. *Head Neck* 2002;24:268-73. DOI PubMed
51. Filtenborg MV, Lilja-Fischer JK, Sharma MB, et al. Nasal vestibule squamous cell carcinoma: a population-based cohort study from DAHANCA. *Acta Oncol* 2022;61:127-33. DOI PubMed
52. Eberle F, Engenhart-Cabillic R, Schymalla MM, et al. Carbon ion beam boost irradiation in malignant tumors of the nasal vestibule and the anterior nasal cavity as an organ-preserving therapy. *Front Oncol* 2022;12:814082. DOI PubMed PMC
53. Jeannon JP, Riddle PJ, Irish J, O'Sullivan B, Brown DH, Gullane P. Prognostic indicators in carcinoma of the nasal vestibule. *Clin Otolaryngol* 2007;32:19-23. DOI PubMed
54. Wray J, Morris CG, Kirwan JM, et al. Radiation therapy for nasal vestibule squamous cell carcinoma: a 40-year experience. *Eur Arch Otorhinolaryngol* 2016;273:661-9. DOI PubMed
55. Mukai Y, Janssen S, Glanzmann C, Holzmann D, Studer G. Local control and intermediate-term cosmetic outcome following IMRT for nasal tumors : an update. *Strahlenther Onkol* 2017;193:295-304. DOI PubMed
56. Kovács G. Modern head and neck brachytherapy: from radium towards intensity modulated interventional brachytherapy. *J Contemp Brachytherapy* 2015;6:404-16. DOI PubMed PMC
57. Zwierzchowski G, Bielęda G, Szymbor A, Boehlke M. Personalized superficial HDR brachytherapy-dosimetric verification of dose distribution with lead shielding of critical organs in the head and neck region. *J Pers Med* 2022;12:1432. DOI PubMed PMC
58. Fionda B, Bussu F, Placidi E, et al. Interventional radiotherapy (brachytherapy) for nasal vestibule: novel strategies to prevent side effects. *J Clin Med* 2023;12:6154. DOI PubMed PMC