

Original Article

The management of nasal defects after non-melanoma skin cancer excision

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Abstract: Background: The reconstruction of the nasal defects occurring after a tumor excision is rather difficult. The purpose of this study is to present our choices of reconstruction using flaps or grafts depending on the size, localization, and depth of the nasal defects occurring after a basal cell carcinoma and squamous cell carcinoma and to demonstrate our clinical approach and algorithm. Patients and methods: We retrospectively reviewed 224 patients who underwent nasal reconstruction after excision of nonmelanoma skin cancer between January 2010 and January 2015. Data collected included patients' age and sex, anatomic location, tumor diagnosis, defect size, depth of the defects, reconstruction methods, recurrence, follow-up time, related to smoke and complications required. Results: A total of 224 patients were included in this study. Basal cell carcinoma was diagnosed 145 patients (64.7%), squamous cell carcinoma was diagnosed in 79 patients (35.3%). The most common location for nasal reconstruction was the nasal dorsum and sidewalls (56%). The nasolabial flaps were the most commonly used flap (n=49), followed by bilobed flap (n=34), forehead flap (n=32), V-Y rotation advancement flap (n=27), glabellar flap (n=26), skin graft (n=15), single or bilateral transposition flap (n=20), and other combined flaps (n=21). Conclusions: Obtaining tumor-free borders and satisfying aesthetic results are foremost aim in nasal reconstruction after nasal skin cancer excision. In this study, our clinical approach for nasal defects reconstruction is presented, which is based on frequently performed local flaps and skin grafting.

Keywords: Nose, skin tumor, nasal reconstruction, flap, graft

Introduction

The nose is located in the middle of the face. Therefore, nasal disfigurements or irregularities after skin cancer excision may lead to psychological and social problems. With its multiple aesthetic subunits and interposed curvatures and convexities, the nose can be a very challenging region for reconstruction. The nose consists of three layers: the (1) outer covering, (2) inner lining and the area between the two soft tissue layers, and (3) osteocartilaginous framework. Each layer that has been lost should be reconstructed one by one, and the ideal surgical technique of nasal reconstruction should be selected with respect to the size, shape, thickness, and location of the defect [1]. Burget and Menick suggested the "subunit" principle, which involves the excision of remaining healthy skin and the reconstruction of an entire nasal subunit when the defect involved is

a 50% or greater surface area of the subunit [2, 3]. The nose is aesthetically subdivided into multiple subunits according to natural creases or boundaries. These subunits are the dorsum, paired sidewalls, tip, columella, alae, and soft triangles. They emphasized that this principle is helpful for camouflaging incision lines and creating unremarkable scars, thereby providing aesthetically better outcomes.

Basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) are the most common malignant tumors affecting the nasal skin [4]. After excision of the nasal skin, carcinomas often consist of defects requiring repair. The successful reconstruction of the nose involves the repair of the nearest natural skin and internal lining defects. Many reconstructive algorithms have been published about nasal reconstruction [5-10]. A single reconstructive procedure or a combination of them can be used to achieve

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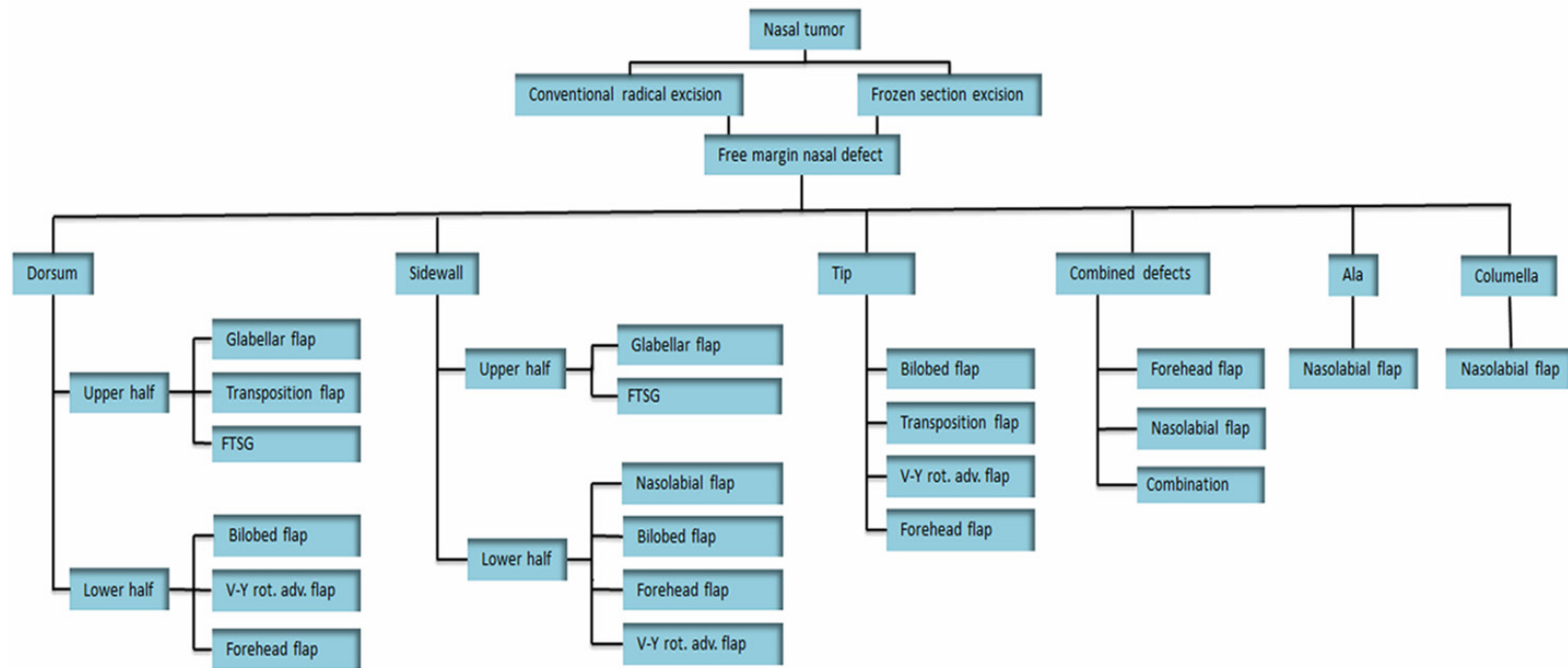


Figure 1. Our algorithm for nasal reconstruction with local and regional flaps.

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Table 1. Distribution of BCC and SCC within age range

Age range	BCC	SCC	Total
≤40	10	1	11
41-50	18	5	23
51-60	27	19	46
61-70	44	26	70
71-80	38	21	59
>80	8	7	15

Table 2. Overall distribution of nasal tumors and defects across anatomic location

Anatomic Location	Tumor type		Male	Female	Total
	BCC	SCC			
Dorsum	36	22	22	36	58 (25.9%)
Sidewalls	48	20	31	37	68 (30.4%)
Ala	27	12	20	19	39 (17.5%)
Tip	20	4	6	18	24 (10.7%)
Columella	2	4	6	-	6 (2.7%)
Combined	12	17	14	15	29 (12.9%)
Total	145 (64.7%)	79 (35.3%)	99 (44.2%)	125 (55.8%)	224

Table 3. Type of tumor related to systemic disease, smoking and sunlight exposure

Variable	BCC	SCC	Total
Systemic Disease			
DM	14	17	31 (13%)
Other	4	8	12 (5.4%)
Not	127	54	181 (80.8%)
Smoker			
Smoker	45	29	74 (33.1%)
Not smoker	101	49	150 (66.9%)
Exposure to sunlight			
>3 h	69	36	105 (46.9%)
<3 h	76	43	119 (53.1%)

complete restoration attending to cosmetic and functional regard.

In this study, we present our experience with nasal reconstruction. We retrospectively assessed patients who underwent reconstructions with local or regional flaps or grafts after the excisions of BCC and SCC. These principles of nasal reconstruction are followed and the outcomes reviewed.

Material and methods

We conducted a retrospective clinical review of all patients who underwent nasal reconstruction

after nasal skin tumor excision from January 2010 to January 2015.

The patients' medical records were evaluated for the following criteria: age, sex, anatomic location, tumor diagnosis, defect size, depth of the defect, reconstruction methods (type of flap, cartilage graft requirement, internal lining reconstruction), recurrence, follow-up time, complications and related to smoke were analyzed.

The study protocol has been approved by the appropriate institutional research ethics committee and has been performed in accordance with the ethical standards as laid out in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. All of the patients signed a consent form prior to the reconstruction. Informed consent was obtained from all patients for the publication of the figures in this article.

Nasal defects were classified by size, anatomic localization, and depth: The

defect reconstructions smaller than 0.5 cm were not included in the study because they had primary closures. The localization was determined according to the anatomic subunits. The depth was classified as superficial for involvements extending to the cartilage-bone roof, as deep if there is a cartilage-bone invasion, and as complex if the inner layer was also involved. When the tissue defect involved the skin and the cartilaginous and/or bony part of the nasal framework, both the soft tissue and structural defects were repaired. Internal nasal-lining defects were required for repair with pedicled skin flaps or skin graft. Postoperatively, neither a partial nor a total flap was

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Table 4. Anatomic locations of the defect on the nose and reconstruction methods

Technique	Dorsum	Sidewalls	Ala	Tip	Columella	Combined defect	Total
Nasolabial flap	1	10	30	-	5	3	49 (21.8%)
Bilobed flap	11	11	2	10	-	-	34 (15.1%)
Forehead flap	9	3	5	3	-	11	32 (14.3%)
VY Rotation Adv. Flap	17	5	-	5	-	-	27 (12%)
Glabellar flap	7	19	-	-	-	-	26 (11.6%)
FTSG	5	6	-	1	-	3	15 (6.7%)
Transposition flap	8	6	1	5	-	-	20 (8.9%)
Combination	-	8	1	-	1	11	21 (9.3%)
Total	58 (25.9%)	68 (30.3%)	39 (17.4%)	24 (10.7%)	6 (2.7%)	29 (12.9%)	224

Table 5. The mean VAS values related to aesthetic satisfaction for reconstruction techniques

Technique	N	Average of VAS scale
Nasolabial flap	44	7.27±1.207
Bilobed flap	31	7.77±0.920
Forehead flap	25	6.64±0.994
VY Rotation Adv. Flap	24	6.83±1.129
Glabellar flap	24	7.58±0.775
FTSG	13	7.07±0.862
Transposition flap	17	7.05±0.899
Combination	19	6.68±1.002

$P < 0.001$.

lost. Patients' subjective aesthetic satisfaction was measured using a visual analogue scale (VAS) from 0 to 10 at sixth months after surgery. VAS scores were obtained through conversation (interview) or telephone. We could not contact with 27 patients. According to our experience obtained from this series, we developed a simple algorithm for nasal defects (**Figure 1**).

The working or living environment was considered to be an open area for the patients who were exposed to sun more than three hours daily and as a closed area for those who were exposed to sun for shorter periods.

The means and standard deviations of the data with numerical values were calculated. Normal distribution was tested with Kolmogorov Smirnov Test. The data were tested with Chi-square and Fisher's exact test. Aesthetic satisfactions were compared with Kruskal-Wallis Test. Results with p values less than 0.05 were considered to be statistically significant.

Results

A retrospective chart analysis of 125 female and 99 male patients was performed. The average age of our patients was 63.9 years, with a range of 25 to 87 years. The mean follow-up was 14 months (range 9-24 month). Of the subjects, 55.8% were female and 44.2% male. The most common histology was BCC, affecting 145 patients (64.7 percent). This was followed by SCC, affecting 79 patients (35.3 percent). BCC was more present in all localizations, and this was statistically significant ($P < 0.05$). The distribution of nasal skin carcinomas and the analysis of the reconstruction methods are presented in **Tables 1-4**.

Seventy-three patients (32.6%) were smokers. No significant correlation was found between tumors and smoking ($P < 0.3$). A total of 31 patients had diabetes, and 12 had other systemic diseases, such as chronic renal failure, systemic lupus erythematosus, and rheumatoid arthritis. A total of 181 patients had no accompanying systemic diseases. No significant correlation was found between systemic diseases and tumors ($P < 0.2$).

The most common location for nasal reconstruction was the nasal sidewalls and dorsum (56%). The nasolabial flaps were the most commonly used flap ($n=49$), followed by the bilobed flap ($n=34$). The time it took for the patients under 65 years of age to present to our clinic after their lesions first emerged was 10 ± 6.9 months, and for those older than 65, it was 11.9 ± 8.2 months; no significant difference was found between them ($P < 0.5$).

No statistically significant differences were found for satisfaction between age groups

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Figure 2. (A) Basal cell carcinoma of the lower half sidewall and surgical plan, (B) Intraoperative result, (C) Early postoperative view after two month.

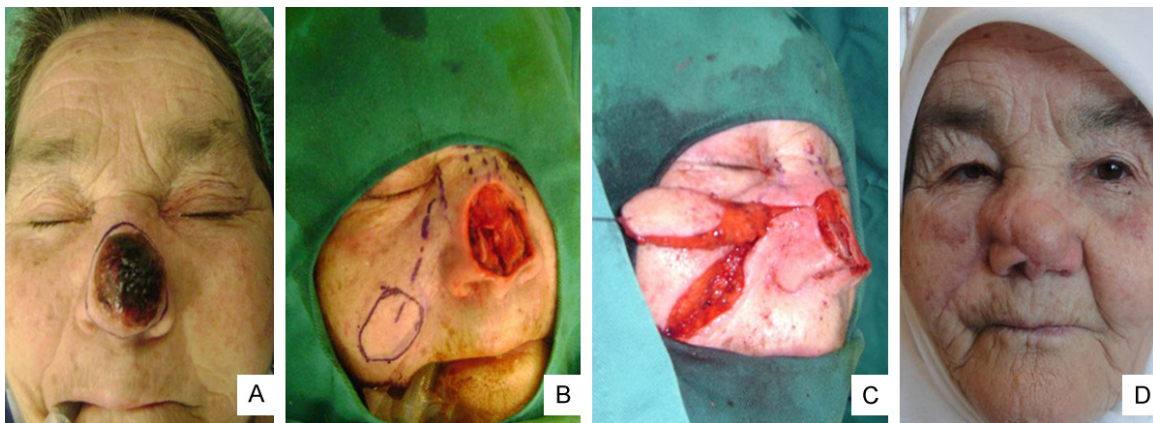


Figure 3. (A) Basal cell carcinoma of the nasal dorsum and tip, (B) Soft tissue and cartilage defect after tumor resection, (C) Harvesting nasolabial island flap and cartilage graft reconstruction, (D) Final result 13 months after operation.

($P < 0.232$). While the highest VAS score for reconstruction techniques was the glabellar flap, the lowest scores were combined techniques and forehead flap ($P < 0.001$). The mean VAS values related to aesthetic satisfaction for reconstruction techniques are summarized in **Table 5**.

Fourteen patients had defects of sufficient depth to require a cartilage graft. Ten septal cartilage grafts and four conchal cartilage grafts were used.

Fourteen patients had defects of the internal lining that were repaired through a variety of

methods: folded cutaneous flap (2), primary closure (1), nasolabial turnover flap (4), skin graft (4), and septal hinged flap (3).

Complications were seen in only 12 subjects in the form of recurrences, which were managed by re-excision and secondary local flaps.

The mean diameter of the defect that occurred following a tumor excision was 1.80 cm. A significant direct correlation was found between the duration of the delay and the defect diameter ($P < 0.01$). A neck dissection was carried out in eight subjects (3.6%). These patients had combined involvements.

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Figure 4. (A) Basal cell carcinoma on the sidewall and surgical design, (B) Anterior view at first month postoperatively.

Discussion

Nasal reconstruction is a challenge from both a functional and an aesthetic aspect. Obtaining the best aesthetic result with minimum morbidity is among the main goals of reconstructive surgery. A successful nasal reconstruction is characterized by an unnoticeable border scar between the nose and surrounding tissues, good color harmony, and a smooth texture with good symmetry of the two sides [10].

As mentioned earlier, Burget and Menick suggested the “subunit” principle, which involves the excision of remaining healthy skin and the reconstruction of an entire nasal subunit when the defect involved is a 50% or greater surface area of the subunit [2, 3]. In contrast, Rohrich et al [7] suggested that this subunit principle has some drawbacks because some healthy tissue is sacrificed by excising the remaining 50% or less of a subunit. In our series, nasal reconstructions were based on the subunit principle. However, if the scar was camouflaged within the subunit, no additional healthy tissue was excised.

The main significant advantage of local nasal flaps is that it helps to provide the ideal skin color, thickness, and texture match for the defect area. An excellent aesthetic outcome can be accomplished if the most suitable flap design is selected [5]. Local nasal flaps depend on the amount of remaining skin tissue, which

is generally insufficient in large nasal defects. Therefore, regional flaps should be considered when considerable skin is required for nasal reconstruction.

Regional flaps are used for the reconstruction of large or full-thickness nasal defects. They are designed to recruit skin from neighboring areas, such as the forehead and cheek. The skin laxity of these donor areas provides much more superfluous skin to build a flap compared with the nasal skin [11].

Bilobed flaps are one of the best choices for defects of the distal half of the dorsum, sidewalls, and tip regions that range up to 1.5 cm in size [12]. Its major advantages include easy designing, excellent color harmony, smooth texture on surrounding tissues, predictable flap survival, and the completion of reconstruction in a single session. Its disadvantages are the inability to follow the nasal subunit reconstruction principles, its limitation in the closure of small nasal defects, and impaired symmetry in the distal nose if not planned carefully [12]. In our series, bilobed flaps were used for the reconstruction of the sidewalls, distal dorsum, and tip defects (34 defects, 15.2%) (Figure 2).

The V-Y rotation advancement flap gives liberty to harvest the flap from any area of the body without being worried about the presence of an artery within the pedicle. Because the pedicle is at the lateral, a total undermining is possible, enabling a tension-free closure [13]. In the series being presented, V-Y rotation advancement flaps were used mostly for dorsum defects in a total of 27 subjects. No postoperative complications occurred. This flap is a reliable one in the reconstruction of nasal defects, as it can be used even without experience, produces an excellent color match, and has aesthetically acceptable scar results. It is very handy in small and middle-size defects.

Nasolabial flaps are a good choice for the defects of the alar, nasal sidewall, and lower one-third of the nose. It can also be used safely

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Figure 5. (A) Basal cell carcinoma of the upper sidewall marked for the excision, (B) Defect repaired with glabellar flap, (C) Postoperative view 12 months after operation.

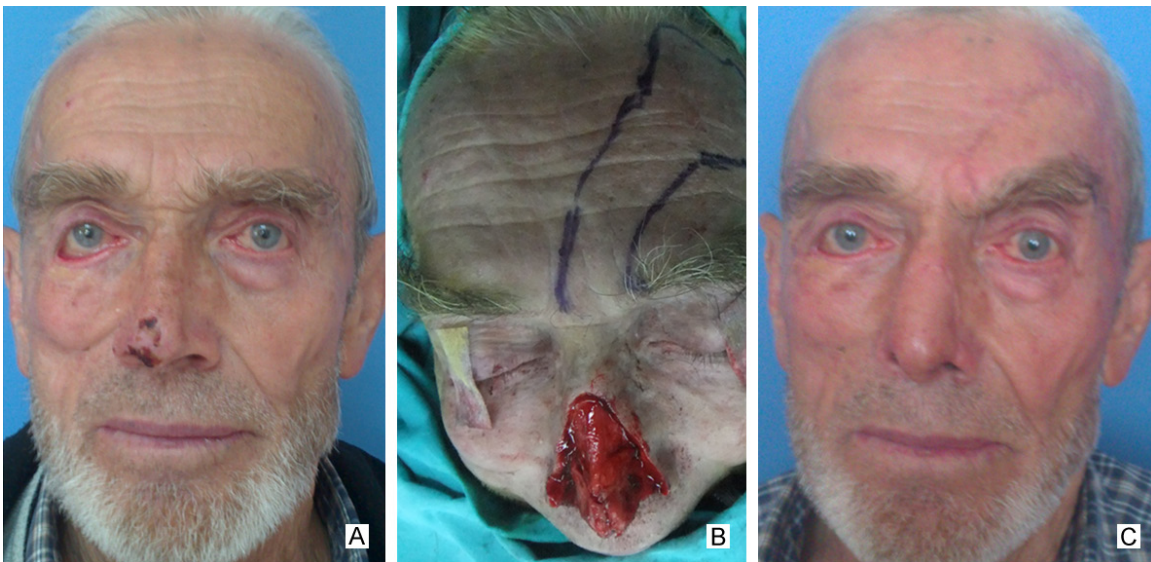


Figure 6. (A) Basal cell carcinoma of the nasal tip, columella and nasal dorsum, (B) Intraoperative view, a frozen section defect and planned reconstruction with forehead flap, (C) Anterior view at third month postoperatively.

in the defects of the internal lining. The donor area scar can be hidden in the nasolabial crease. Due to the strong vascularity of the cheek skin, nasolabial flaps can be designed in different forms. Rich blood support, low donor area morbidity, and its versatility for various nasal defects are the main advantages of a nasolabial flap [14, 15]. The most important possible deficiency of this flap design is that it can distort the alar facial sulcus because the flap must traverse this anatomic junction, which is critical to a normal appearance and is almost

unfeasible to wholly correct once obliterated. In the present series, while 31 nasolabial transposition and V-Y advancement flaps were used for alar and sidewall reconstructions, 18 nasolabial island flaps were used for columella and other combined defect reconstructions (Figures 3, 4).

Glabellar flaps are used for the reconstruction of the upper one-third of the nose. Although they are defined as V-Y advancement flaps, many modifications of them have been report-

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ed. They are easily applied with excellent color and texture match. They can be used in most cases for the primary closure of the donor area and incisions, and final scars can usually be camouflaged [15]. In our series, glabellar flaps were generally used as V-Y rotation advancement flaps in the reconstruction of the defects of the dorsum and upper-half of the sidewalls (26 defects, 11.6%) (**Figure 5**).

The forehead skin is accepted as the best donor area for nasal reconstructions due to its skin quality, color harmony, adequate size, and good vascularity. Reconstruction with forehead skin remains the standard technique for large nasal defects. It can be used for the reconstruction of the whole nose, from ala to ala [16]. Although the forehead flap is conventionally transferred in two sessions, it can also be applied in a single session or in three sessions [17]. Little et al [16] reported major complications, such as flap necrosis, nasal obstruction, and alar notching in 16.1% of the 205 cases. In our series, two-session forehead flaps were used in 32 subjects, and partial distal necrosis developed in one subject (**Figure 6**).

Reconstructions with skin grafts are not usually considered in nasal procedures. The main worries in using grafts are contour defects and a patchwork appearance due to color mismatch. Nevertheless, there are cases where optimum aesthetic results have been achieved in nasal defects larger than 1 cm in appropriate patients [10]. McCluskey et al [18] reported that skin grafts are also a promising reconstructive choice in the defects of the lower one-third of the nose. In the present series, FTSG was used as a reconstructive procedure for 15 subjects' dorsum and sidewall defects.

Structural grafting is necessary to prevent collapse and nasal obstruction as well as to maintain form, especially along the alar rim and tip. The septal cartilage is versatile and valuable for cartilage graft reconstruction. Additionally, conchal and costal cartilage can be used for a cartilage graft. These grafts should be placed in a well-vascularized bed for adequate graft viability. Split calvarial bone grafts can be utilized in the situation of nasal sidewall and nasal pyramid reconstruction [11]. Clinical decision remains the most important determinant in selecting a suitable graft type for reconstruct-

ing nasal defects secondary to skin cancer excision.

The repair of the internal nasal lining is obligatory for the ideal restoration of nasal function and form. A common cause of aesthetic insufficiency in nasal reconstruction is neglect of the lining. In our practice, five different techniques were used to repair the internal lining. These options for relining such a defect included the use of a septal hinged mucoperichondrial flap, skin graft, nasolabial turnover flap, and folded cutaneous flap.

Although many algorithms have been recommended for nasal reconstruction [5-10], comparison is difficult due to the different classifications of nose defects and the variability of the types of reconstruction used. Furthermore, the choice of the best possible reconstructive approach is always affected by experience and the priority of the surgeon, along with ethnic, cultural, and socioeconomic factors and the patients' needs and concerns.

Excision from previously determined surgical margins is one of the most common and effective treatment strategies for BCC and SCC. In well-defined small BCC and SCC, a surgical margin of 4 mm enables a peripheral clearance of approximately 95%. A 3-mm surgical margin is sufficient for a well-demarcated nodular BCC [19]. For this reason, the surgical safety margins around the tumor were set at 4 mm. The primary goal of the Mohs micrographic surgery is to retain a maximum size of the healthy peripheral tissue necessary for reconstruction while achieving a complete excision of the tumor. It has been reported that in this way, a 98-99% cure can be accomplished in both primary and recurrent BCC and SCC [20]. To check surgical margin positivity, frozen section examinations were made during surgery in suspicious, recurrent, or persistent ulcerous cases. The indications of a frozen section examination in skin cancer include the unsatisfactory identification of clinical margins, an infiltrative growth pattern in histopathology, and cases where the skin needs to be protected in long-lasting large or recurrent lesions [21]. The rate of recurrence following this procedure was found to be 5% (n=12). We believe that in clinics where the Mohs surgery cannot be practiced, the intraoperative frozen section procedure is effective in preventing recurrence and retaining the max-

imum amount of healthy tissue in appropriate patients.

Obtaining tumor-free borders and satisfying aesthetic results are key points for nasal reconstruction. Local or staged regional flaps, the use of cartilage support grafts, and internal lining reconstruction are key elements for achieving optimal aesthetic and functional outcomes. Our experience with nasal reconstruction was presented over a five-year patient series, focusing generally on reconstruction types and the characteristics of the studied population.

Disclosure of conflict of interest

None.

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