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Analysis of reconstructive methods in surgical treatment of nasal skin defects

Analiza rekonstruktivnih metoda za hirurško lečenje defekata kože nosa

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Abstract

Background/Aim. Surgeons often face with the problem when selecting a reconstructive method for nasal skin defects. The aim of this study was to determine functional and aesthetic characteristics of different reconstructive methods used for skin defects in different regions of the nose. **Methods.** The study involved 44 patients with basocellular carcinoma in nasal area. The nasal skin was divided into four subunits: the tip, the alar lobules, the sidewalls and the dorsum. The average skin defect size was 10 mm in diameter. Local flaps and full thickness skin grafts were used in the study. We analyzed the functional and esthetic results of different reconstructive methods used for nasal defects in different regions of the nose 12 months after the surgery. **Results**. The study shows that different reconstructive methods produce different functional and esthetic results in the same nasal subunits and that the same reconstructive method produces different results in different nasal subunits. **Conclusions.** Estimation the postoperative functional and esthetic characteristics of different reconstructive methods is one of the basic preconditions of successful reconstruction.

Key words:
nose; carcinoma, basal cell; reconstructive surgical procedures; surgical flaps; transplants; treatment outcome; esthetics.

Apstrakt

Uvod/Cilj. Hirurzi su često u nedoumici prilikom izbora metode za rekonstrukciju defekata kože nosa. Cilj rada bio je da se utvrde funkcionalne i estetske karakteristike različitih metoda za rekonstrukciju defekata kože nosa. **Metode.** Studijom su bila obuhvaćena 44 bolesnika sa bazocelularnim karcinomom kože nosa. Koža nosa je bila podeljena na četiri regije: vrh nosa, alarni predeli, lateralne strane nosa i dorzum. Prosečna veličina defekta kože nosa, nastalog nakon ekscizije bazocelularnog karcinoma, iznosila je 10 mm u prečniku. Za rekonstrukciju defekta kože nosa korišćeni su lokalni kožni režnjevi i transplantati kože pune debljine. Analizirane su funkcionalne i estetske karakteristike korišćenih rekonstruktivnih metoda, dvanaest meseci nakon operacije. **Rezultati.** Ova studija je pokazala da različite rekonstruktivne metode imaju različite funkcionalne i estetske rezultate u istim regijama nosa, kao i da ista rekonstruktivna metoda ima drugačije rezultate u različitim regijama nosa. **Zaključak.** Procena postoperativnih funkcionalnih i estetskih karakteristika različitih rekonstruktivnih metoda jedan je od osnovnih preduslova uspešne rekonstrukcije.

Ključne reči:
nos; karcinom, bazocelularni; hirurgija, rekonstruktivna, procedure; režnjevi, hirurški; graftovi; lečenje, ishod; estetika.

Introduction

Reconstruction of nasal defects often represents a significant challenge owing to several unique qualities of the nose, such as complex topography, mobile free margins, and multiple nasal subunits. Various methods have been described for the reconstruction of tumor-related defects of the nasal soft tissues such as local flaps, island flaps, and free skin grafts [1–4]. Local flaps are preferred for the reconstruction of the nasal skin as they offer a skin texture and color similar to the resected skin portion, thus providing good esthetic results [5, 6]. Grafting remains an excellent choice when other reconstruction options are not desirable [4]. However, the goal of nasal reconstruction is to create an esthetically inconspicuous nose while preserving the functional aspect, especially over the long term [7, 8].

Surgeons often face with the problem when selecting a reconstructive method for nasal skin defects. Generally, this dilemma is present because of the functional and esthetic po-

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stoperative differences, which occur in different reconstructive methods.

The aim of this study was to compare functional and esthetic results of different reconstructive methods used for nasal skin defects in different regions of the nose, in order to help surgeons in selecting an appropriate reconstructive method for nasal skin defects.

Methods

The study involved 44 patients, 29 men and 15 women, with basocellular carcinoma in the nasal area. The study was conducted from 2003 to 2013. The average age of the patients was 66 (range 46–84) years. The inclusion criteria were: basocellular carcinoma affecting only nasal skin, without infiltration of deeper structures; defect which appeared after tumor removal, localized in only one subunit; except for the defect, there are no other changes on the skin of the nose, e.g. tumors, scars and other; normal anatomy of the nose, without obvious deformities; patients had no complications such as dehiscence, flap and full thickness skin graft necrosis, partial or total, and recidivism until the examination.

The nasal skin was divided into four subunits: the tip, the alar lobules, the dorsum and the sidewalls [9]. Skin defect size ranged from 5 mm × 5 mm (alar lobule) to 18 mm × 18 mm (sidewall). The average defect size was 10 mm in diameter. The following reconstructive methods were used in the study: transposition flaps (n = 17), rotation flaps (n = 3), advancement flaps (n = 5), bilobed flaps (n = 4), glabellar flaps (n = 4), Rintala flaps (n = 3), and full thickness skin grafts (FTSG) (n = 8) from donor site, brachial area. Functional and aesthetic postoperative results of the used reconstructive methods were analyzed 12 months after the surgery. All the patients were tested by the same examiner. The recovery of sensation to pinprick, light touch and temperature of each flap and full thickness skin graft was tested. Two-point discrimination and functioning of sweat glands was also examined. Pain sensitivity was evaluated using pinprick, light touch was measured using von Frey hairs and hot and cold sensitivity was tested by thermal esthesiometer with water +10°C or water +40 °C [10, 11]. The lowest value at which the patient correctly identified 2 points at least 3 out of 5 times was recorded as the value for 2-point discrimination. The functioning of sweat glands was tested using ninhydrin test [11]. Sensory function and functioning of sweat glands was assessed on the central portion and 4 peripheral sectors of each flap and full thickness skin graft. The number of positive responses was registered. Comparison has begun with the surrounding recipient sites.

Esthetic parameters such as color, texture and contour, used in the nasal defect reconstruction, were visually assessed with regard to color, texture and contour of the surrounding recipient site. The color was visually assessed as lighter, darker or approximately the same, the texture was assessed as approximately the same or different, while the contour deformity was visually assessed as above, below and approximately at the level of the surrounding skin of the recipient site. Those esthetic parameters that were approximately the same with the surrounding recipient site were considered positive, while those which differed from the surrounding recipient site were considered negative. The patient's subjective assessment of the esthetic appearance of the reconstructed nose and of one independent examiner was graded as excellent, good, and fair.

Results

Recovery of sensation in all modalities in at least one-half of the local flap area was recorded in 32 of the patients with local flaps. Partial recovery was present in additional 4 of the patients. None of the local flaps remained insensitive. The recovery of pain and cold temperature was better than that of hot temperature or light touch. The mean 2-point static discrimination for local flaps was 10.4 mm. The functioning of sweat glands was detected in 35 patients with the local flaps. Reinnervation tended to be more pronounced at the periphery of the flap. The patients with full thickness skin grafts demonstrated sensory recovery that was of a partial nature. The mean 2-point static discrimination for full thickness skin grafts was 12 mm. The functioning of sweat glands was not detected in the patients with full thickness skin grafts. Reinnervation tended to be more pronounced at the periphery of full-thickness skin grafts. The average results of sensory and sweat gland function testing for local flaps and full thickness skin grafts were summarized in Table 1.

Table 1

Functional results of different reconstructive methods

Site	Number and type	Pin-prick (%)	Light touch (%)	Hot (%)	Cold (%)	Two-point discrimination (mm)	Ninhydrin test	
							yes (%)	no (%)
Tip	3 RF	86.7	53.3	53.3	86.7	10	100	/
Tip	5 TF	100	76	56	88	8.2	100	/
Tip	3 RiF	66.7	53.3	46.7	66.7	10.6	100	/
Tip	2 FTSG	60	40	20	40	/	/	100
Alar lobule	3 AF	93.3	86.7	60	86.7	9.3	100	/
Alar lobule	3 TF	73.3	53.3	53.3	66.7	11.3	100	/
Alar lobule	2 FTSG	40	40	20	40	/	/	100
Dorsum	4 TF	90	90	55	85	10.5	75	25
Dorsum	4 BF	88	76	60	76	9.25	100	/
Dorsum	2 FTSG	20	20	20	20	12	/	100
Sidewall	2 AF	100	86.7	60	86.7	13	100	/
Sidewall	5 TF	68	68	56	68	11.6	100	/
Sidewall	4 GF	60	55	45	55	11.25	100	/
Sidewall	2 FTSG	60	40	20	40	12	/	100

RF − rotation flap; TF − transposition flap; RiF − Rintala flap; FTSG − full thickness skin graft; AF − advancement flap; BF − bilobed flap; GF − glabellar flap.

All the three positive esthetic parameters were present in 11 of the patients with the local flaps. One or two positive esthetic parameters were present in additional 25 patients. Twenty-five patients have graded the aesthetic appearance of their nose as excellent, 11 patients as good, while none of the patients graded the aesthetic appearance of their nose as fair. Independent examiner graded 24 patients as excellent, 12 patients as good. Five of the patients with full thickness skin grafts had all of the negative esthetic parameters. Five of the patients graded the esthetic appearance of their noses as excellent, and 3 as good. An independent examiner graded 5 patients as excellent, 2 patients as good and 1 patient as fair. The results of color, texture, contour and patients' subjective assessment and the assessment of an independent examiner for the local flaps and full thickness skin grafts were summarized in Table 2.

For the reconstruction of nasal tip skin defects, the best functional postoperative results had rotation flaps (Figure 1), followed by transposition flaps, Rintala flaps and full thickness skin grafts. For reconstruction of alar lobule skin defects, the best functional postoperative results had advancement flaps, followed by transposition flaps, and full thickness skin grafts. Transposition flaps had the best functional result for the dorsum of the nose, followed by bilobed flaps and full thickness skin grafts. For reconstruction of sidewall skin defects, the best functional postoperative results had advancement flaps, followed by transposition flaps, glabellar flaps and full thickness skin grafts.

According to our study reconstruction of nasal tip skin defects, the best esthetic postoperative results, had transposition flaps, followed by rotation flaps, Rintala flaps and full-thickness skin grafts. For the alar lobule, the best esthetic results were obtained by full-thickness skin grafts, followed by transposition and advancement flaps. Transposition flaps were the best solution for the dorsum, followed by bilobed flaps and full-thickness skin grafts. For the sidewall, the best esthetic results were obtained by transposition flaps (Figure 2) followed by advancement flaps, glabelar flaps and full-thickness skin grafts.

Table 2

Esthetic results of different reconstructive methods

Site	Number and type	Color			Texture		Contour			Subjective assessment − patient			Subjective assessment − independent examiner		
		same	lighter	darker	same	different	same	below	above	excellent	good	fair	excellent	good	fair
Tip	5 TF	4	1	/	4	1	4	1	/	4	1	/	4	1	/
Tip	3 RF	2	1	/	2	1	2	1	/	2	1	/	2	1	/
Tip	3 RiF	2	1	/	1	2	1	2	/	2	1	/	2	1	/
Tip	2 FTSG	/	/	2	/	2	/	2	/	/	2	/	/	1	1
Alar lobule	2 FTSG	1	/	1	/	2	2	/	/	2	/	/	2	/	/
Alar lobule	3 TF	2	1	/	2	1	/	/	3	2	1	/	2	1	/
Alar lobule	3 AF	1	2	/	2	1	/	/	3	2	1	/	2	1	/
Dorsum	4 TF	3	1	/	3	1	3	/	1	3	1	/	3	1	/
Dorsum	4 BF	3	2	/	3	2	4	/	1	3	1	/	3	1	/
Dorsum	2 FTSG	/	/	2	/	2	/	1	1	1	1	/	1	1	/
Sidewall	5 TF	4	/	1	4	1	4	1	/	4	1	/	3	2	/
Sidewall	2 AF	2	/	1	2	1	/	/	3	1	1	/	1	1	/
Sidewall	4 GF	2	1	1	1	3	1	/	3	2	2	/	2	2	/
Sidewall	2 FTSG	/	/	2	/	2	1	1	/	2	/	/	2	/	/

TF − transposition flap; RF − rotation flap; RiF − Rintala flap; FTSG − full thickness skin graft; AF − advancement flap; BF − bilobed flap; GF − glabellar flap.

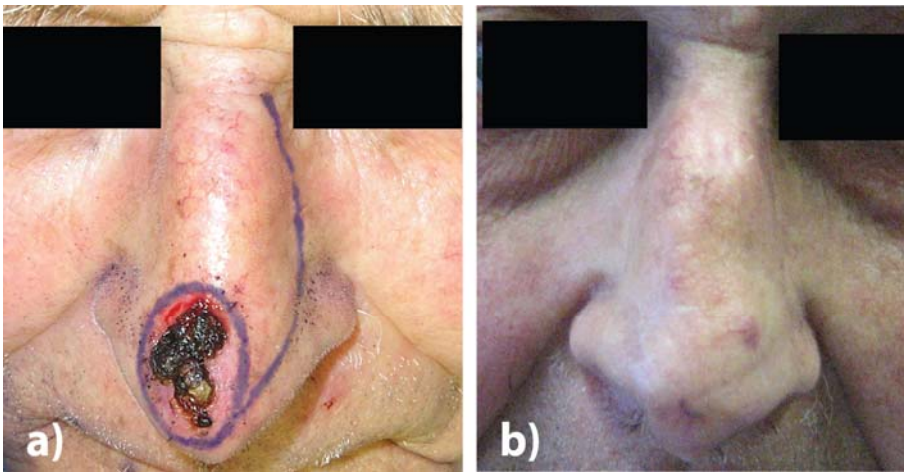

Fig. 1 − Rotation flap – nasal tip: a) before and b) a twelve months after the surgery.

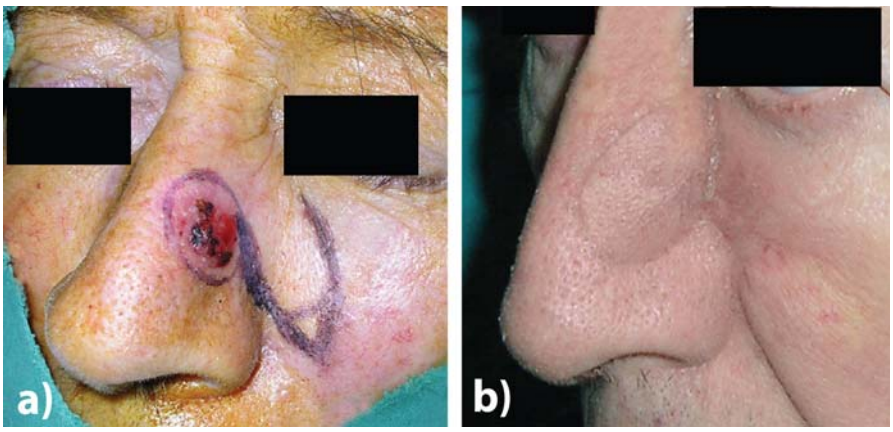

Fig. 2 − Transposition flap – sidewall: a) before and b) twelve months after the surgery.

Discussion

Functional characteristics

Recovery of sensation of local flaps and skin grafts was generally tested with qualitative psycho-physical methods, electrophysiological methods and quantitative methods [12]. Many authors indicate the time discrepancy of different types of sensation recovery, and the results of their examinations show that pain sensations are recovered first, followed by sensitiveness to thermal stimuli, and then light touch [12, 13]. Histochemical studies of the human skin grafts and flaps provide the basis for understanding of the mechanism of sensory recovery. Waris et al. [13] obtained biopsy samples from 9 patients who had undergone skin grafting and found histochemical evidence of regenerating nerves at the bed and margins of skin grafts 3 weeks after surgery. These nerves were orientated towards the denervated area, suggesting chemotactic factors in the orientation of neural regeneration. Similar findings in animal studies support the clinical observations of spontaneous sensory recovery in local flaps and skin grafts. Santoni-Rugiu [14] demonstrated neuroregeneration in recipient sites 25–30 days after skin grafting. This was followed by exuberant reinnervation within 8 weeks. Less complete degeneration was found in the skin flaps. Neuroregeneration was noted to begin at the base of recipient sites in all cases [15]. Ponten [16] proves that there is a sweat gland function recovery in the full-thickness skin grafts and local flaps. Local flaps and full-thickness skin grafts which lack the sensation, also lack the sweat gland function.

In our study we compared functional results of various reconstructive methods used in the nasal defects reconstruction. Spontaneous reinnervation did occur in local flaps and in full-thickness skin grafts used for the nasal defects reconstruction, although recovery was not always complete. The pattern of reinnervation was various with better recovery of pain and cold temperature sensation. It would appear that sensation to pain returns first, followed by cold temperature, then light touch. Sensation recovery is better with local flaps than with full-thickness skin grafts.

The present study demonstrates that functional recovery of local flaps and full thickness skin grafts depends on localization of defects in the nasal region. This is an important parameter that should be considered when selecting reconstructive method for nasal skin defects reconstruction.

Aesthetic characteristics

Millard [17] divided the face into facial aesthetic subunits and advocated the use of subunits in nasal reconstruction. Burget and Menick [9] further defined the nasal esthetic subunits. The reconstructive principle utilizing esthetic subunits promotes removal of an entire subunit if 50% or more is absent. Although the described approach to nasal reconstruction included an assessment of the skin color, texture and contour, the importance of these aspects has been neglected in the teachings and publications [18] subsequent to the introduction of Burget and Menick's [19] topographic nasal subunit principle. Singh and Bartlett [20] modify the nasal subunit principle taking into account local characteristics such as skin color, texture, contour, and actinic damage. Esthetic considerations, such as skin texture, color, and contour, used in the resurfacing of skin defects have been chronicled in the evolution of nasal reconstruction [21]. Skin color, texture and contour play a critical role in final determination of the reconstruction type [22]. Local flaps for the nasal skin coverage of defects evolved along the principle of "replacing like with like" in providing ideal skin color and texture match [23]. Local flaps typically offer better aesthetic results than full-thickness skin grafts [20, 22, 24].

The present study demonstrates that almost one-third of patients, who have local flaps inset into the nasal region, have all of the positive aesthetic parameters. Aesthetic parameters were better for local flaps than for full-thickness skin grafts, which is compatible with results of other authors [4, 20, 22, 25].

Conclusion

There are many reconstructive options for nasal skin defects. Our study demonstrates that different reconstructive methods produce different functional and esthetic results, in the same nasal subunits. In addition, the same reconstructive method produces different results in different nasal subunits. The results of our study could help surgeons in selecting the

appropriate reconstructive method for nasal skin defects. Estimation the postoperative functional and esthetic characteristics of different reconstructive methods is one of the fundamental prerequisites of successful reconstruction. Success of reconstruction lies in preoperative planning and strategy that will provide better functional and esthetic postoperative results.

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