Psychological, Functional and

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Psychological, Functional and Aesthetic Outcome after Nasal Reconstruction

.

Psychologische, functionele en esthetische resultaten na neusreconstructie

Proefschrift

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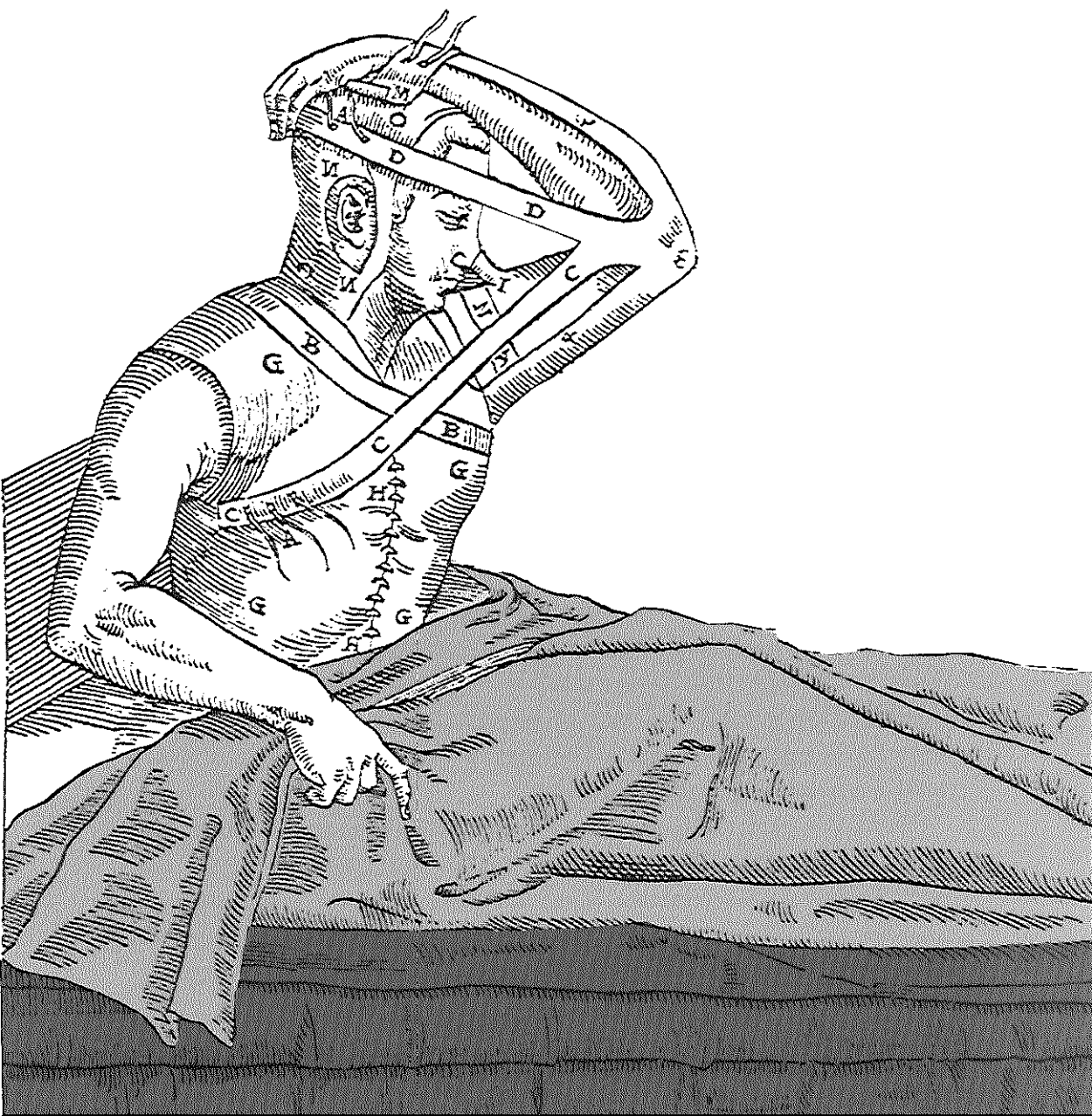
Contents

Chapter 1	General introduction	5
Chapter 2	Validation of a questionnaire assessing patient's aesthetic and functional outcome after nasal reconstruction: the patient NAFEQ-score	24
Chapter 3	Aesthetic and functional outcome following nasal reconstruction	35
Chapter 4	Aesthetic outcome after nasal reconstruction: Patient versus panel perception	53
Chapter 5	Facial attractiveness and abnormality of nasal reconstruction patients and controls assessed by laypersons	65
Chapter 6	The impact of nasal reconstruction following tumour resection on psychosocial functioning, a clinical-empirical exploration	77
Chapter 7	Interstitial radiation therapy for early-stage nasal vestibule cancer: A continuing quest for optimal tumour control and cosmesis	91
Chapter 8	Nasal reconstruction after malignant tumour resection: An algorithm for treatment	111
Chapter 9	General discussion	129
Chapter 10	Summary | Nederlandse samenvatting	139
Appendices	Dankwoord	**151**
	Curriculum Vitae	155
	List of Publications	156
	PhD Portofolio	159

Chapter 1
General introduction



GENERAL INTRODUCTION

The history of nasal reconstruction

The nose is without a doubt the most prominent feature of the face. In ancient times the nose was seen as the organ of reputation. Many different qualities have been ascribed to the size and shape of the nose. Rhinokopia or amputation of the nose was seen as the ultimate humiliation. It was inflicted on adulterers, thieves and other criminals in ancient India as a method of stigmatization. With its practice there came a need for nasal reconstruction. The first description of nasal reconstruction was therefore, not surprisingly, found in India. [1] It was dated approximately 600 years before Christ. The first treatment of nasal injuries and fractures was mentioned even much earlier, about 3000 BC in the Edwin Smith Surgical Papyrus. [2] However no actual nasal reconstruction methods were described herein. As far as we know, Sushruta was the first to describe a method of transferring skin from the forehead and cheek to reconstruct a nose. He described this technique in his 'Samhita' or encyclopedia. [1] For unknown reasons it seems from translations of the Samhita that he preferred a cheek flap over a forehead flap to reconstruct the nose: *"When a man's nose has been cut off or destroyed, the physician takes the leaf of a plant.... He places it on the patient's cheek and cuts out of this cheek a piece of skin of the same size in such a manner that the skin at one end remains attached to the cheek.... Then he freshens with his scalpel the edge of the stump of the nose and wraps the piece of skin from cheek carefully around it and sews it at all the edges.... As soon as the skin has sewn together with the nose, he cuts through the connection with the cheek".* [3,4] He used his own personalized instruments to perform these operations (see Figure 1).

This method of nasal reconstruction persisted in India, but little is known about the transmission of knowledge from India to the rest of the world. However, Aulus Cornelius Celsus, a famous Roman medical writer, used similar techniques to reconstruct mutilated lips, ears, and noses. [2] In the eighth century AC, the Byzantine emperor Justinian II, appears to have had a nasal amputation after he was overthrown. His disfigured appearance prohibited him from regaining the status of emperor. Legend has it that after reconstruction of his nose he regained his strength and became emperor again. The Carmagnola statue is believed to be his personification (Figure 2).

At closer look it reveals the presence of a forehead scar in addition to the reconstructed nose. [5] It took until the renaissance in the fourteenth century before nasal reconstruction techniques were practiced in Europe. In Italy and Germany two surgeons performed nasal reconstructions during the fifteenth century: Branca and Von Pfalzpaint. [2,6] Branca was very secretive about his Indian method of nasal reconstruction, which was only passed down

from father to son. Observers, who might steal the technique, were prevented from viewing the procedure. Von Pfalzpaint, however, wrote a detailed manual "Wund-Arznei" in which he described "*how to create a new nose if it has been chopped off and the dogs have been eating it away*", using an arm flap which predates Tagliacozzi's method more than 100 years. In 1597 the famous Italian surgeon and anatomy professor Gaspare Tagliacozzi introduced the principles of a distant pedicled flap and the delayed arm flap which later became known as the Italian method (Figure 3). [7]

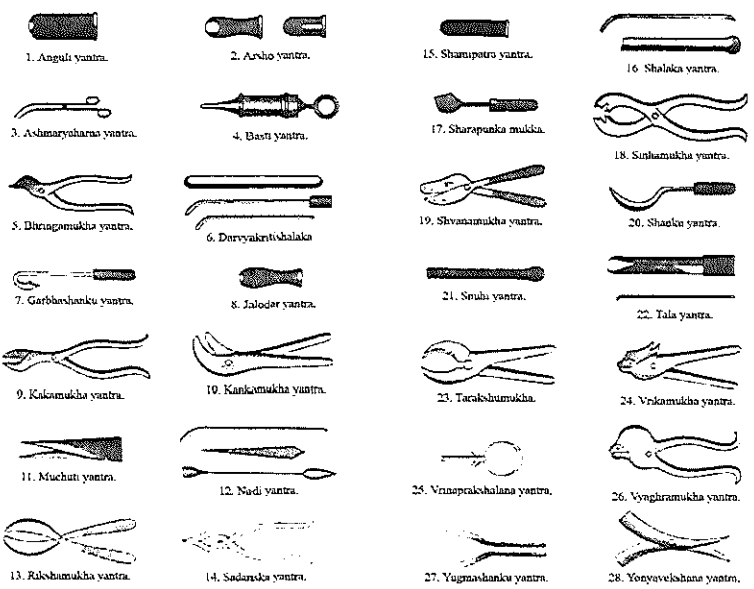


Figure 1. A selection of instruments described by Sushruta

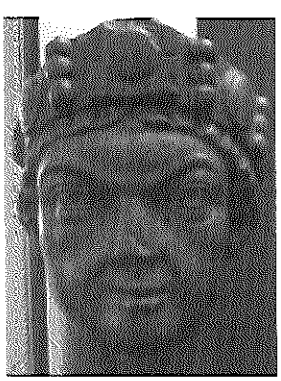


Figure 2. The Carmagnola statue that probably resembles emperor Justinian II

Figure 3. From Tagliacozzi's De Curtorum Chirurgia per Institionem

For the next 200 years there was no significant contribution noticed in the field of nasal reconstruction. Until 1794, when a British surgeon named Lucas described an operative method for reconstructing an amputated nose using a forehead flap, which was published in the Gentleman's Magazine (Figure 4). [8]

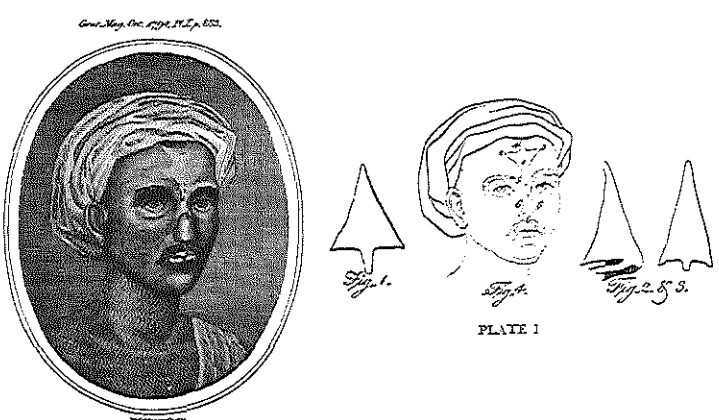


Figure 4. From Gentleman's Magazine, London, October 1794, plate 1, P.883

In 1816 another English surgeon Joseph Constantine Carpue described two cases of a successful nasal reconstruction with a median forehead flap. [9] Subsequently, the pedicled forehead flap gained great acceptance throughout Europe. In 1818 Carl von Graefe described the German method in his work entitled "Rhinoplastik". He modified the Italian method by dividing the proximal end of the arm flap and left it hanging on the arm for several weeks. The open flap became stiff and fibrotic and could be used as a skin graft without skeletal support because of the earned stiffness. In the same period Johann Friedrich advocated and refined the forehead flap as the ideal nasal reconstruction donor site. He was also one of the first to address inner lining and started using the folded forehead flap but only at columella level. True understanding of the importance of inner lining reconstruction did not evolve until World War I. The refined techniques that we take for granted nowadays had their beginning at the end of the nineteenth century, when the basic principles for successful nasal reconstruction were established: 1) providing a nasal framework, 2) fashioning proper lining and 3) applying viable nasal skin cover. These basic understandings were propagated by Weir, Roe and Joseph. [10] Independently, they wrote handbooks on nasal reconstruction and rhinoplasty. These books were mainly focused on cosmetic refinements of different shaped noses. The real breakthrough for nasal reconstruction came during World War I, when the largest number of facial injuries of any war occurred. Doctor Harold Delf Gillies, inspired by Europe's most famous surgeon of that time Hippolyte Morestin, made reconstructive surgery of the face, a forgotten issue during and after World War I, his sacred mission. In addition to using forehead flaps, his most important innovation in nasal reconstruction techniques was the use of the tubed pedicle. [11] During the twentieth century several modifications of the forehead flap were described. The classic midline forehead flap supplied by paired supratrochlear vessels was popularized in the United States by Kazanjian. [12] In 1969 Washio described a retroauricular-temporal flap for cover of nasal defects. The forehead, however, remains the most popular donorsite for nasal reconstruction because of its excellent vascularization, skin colour and texture match. [13] During this pioneering work it soon became apparent that the results of unlined flaps were poor. The shape of the nose and airway became distorted due to scar contracture of the underlying raw surface of the forehead flap. Some surgeons started to use a folded forehead flap, the same as already used by Dieffenbach in 1830, [14] to create its own inner lining, however normal hairline position limited the length of a vertical midline forehead flap. To overcome this problem and obtain a longer flap, modifications such as an oblique or horizontal positioned forehead flap supplied by unilateral supraorbital vessels were used. [15] Alternatively, in order to create a longer flap, Converse modified Gillies' up-and-down flap by creating a long pedicle that was camouflaged

within hair-bearing skin and that included the major blood supply of the scalp. Despite its limitations, the folding of covering skin for lining, and specifically the Converse scalping flap, became the most commonly used method for nasal reconstruction for most of the twentieth century. [16] Others tried to line the raw area on the deep surface by turning over portions of residual skin adjacent to the defect, [16] by rolling over bilateral nasolabial flaps to line both the alae as well as columella, [17] by using split or full thickness skin grafts 16, or by inserting composite chondrocutaneous or septomucoperichondrial grafts. [18] During the same period it became obvious that without a skeletal framework, the soft tissues of cover and lining would collapse in major reconstructions, impairing the airway and limiting projection. [16] The three layer concept: cover, structural support through a framework, and lining was first acknowledged by Converse, but generally condemned. [19] Concepts involving adequate structural support and inner lining were only slowly accepted. The problem of the short midline forehead flap was solved by modification of its design to paramedian so that central forehead tissue could be transferred on a unilateral paramedian blood supply. [16] Millard, who showed that bilateral pedicles were not essential for flap viability, should be credited for popularizing this idea. [20] In more recent history, Burget and Menick have introduced several paramedian forehead flap design refinements to improve the aesthetic results, using their modification of Millard's aesthetic subunit concept. [21-23] They conceptualized the idea of nine aesthetic subunits of the nose (tip, dorsum, soft triangles, alar lobules, columella, and lateral walls) when planning nasal reconstruction. [21,22,24] The borders of these subunits are ideal locations for placement of scars. Reconstruction of a complete aesthetic subunit with skin of uniform colour and texture generally yields a superior result. In addition, they showed that ample well-vascularized intranasal mucosa is available within most nasal defects that can provide lining for lateral, hemi-nasal, and total nasal defects. [21,24,25] These ipsilateral mucoperichondrial flaps are anterocaudally based on a narrow pedicle containing the septal branch of the superior labial artery. If both septal branches are included an anterocaudally based composite septal pivot flap with laterally peeled mucoperichondrial flaps containing the entire septum can be used to provide support as well as lining. [21,24,25] Alternatively Burget and Menick, realizing that the forehead consists of skin, subcutaneous tissue, and frontalis muscle, revisited the use of full thickness skin grafts for lining. [24] A skin graft is placed on the raw surface of a full thickness forehead flap without any primary support. Three weeks later, once the skin graft is revascularized, the covering flap is re-elevated, subcutaneous tissue and frontalis muscle are excised to normal lining thickness, and delayed primary cartilage grafts are placed for support. [16,24] The Menick folded forehead flap, a second paramedian forehead flap, prelaminated flaps, free flaps for inner lining, total nasal replantation, and

even composite tissue allotransplantation are the reconstructive developments at the present time. [26]

In summary, nasal reconstruction has evolved from surgical techniques that just simply filled a hole to an art form, which enables surgeons to actually produce a facsimile of the part of the nose that is missing.

Nasal anatomy and function

Anatomically the nose is made up of three layers: 1) nasal skin cover, 2) bone and cartilage framework, and 3) inner lining. Although nasal skin makes up for only a small part of the total facial skin, it has a complex and distinct structure at different sites of the nose. The upper part of the skin of the nose is thin and mobile. The lower part is thick, has sebaceous glands, and is adherent to the cartilage and therefore difficult to mobilize. The entire nasal skin has an excellent blood supply and therefore a superb quality to heal after it has been damaged.

The supporting framework of the nose consists of cartilage and bony structures. The cartilage framework consists of the upper and the lower lateral nasal cartilages, and the septal cartilage. These cartilage structures are attached to the nasal bones (see Figure 5).

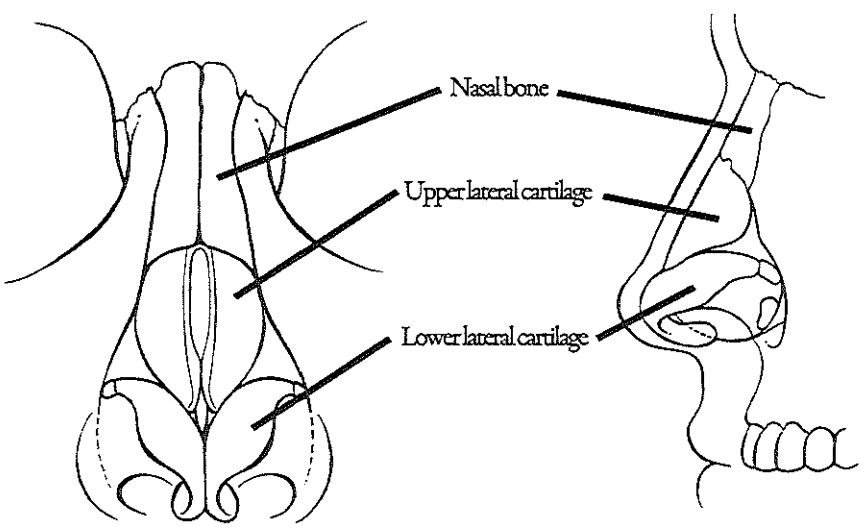


Figure 5. Nasal cartilage framework *(illustration by C.F. Wilbrink).*

The cartilage framework supports the skin as well as the underlying inner lining. The inner lining is formed by a thin and supple stratified epithelium and a mucous membrane. In the vestibule it consists of dry, hair bearing skin and in the nasal vault it contains moist mucosa. [27]

The nose has seven basic functions: respiration, humidification, temperature modification, particle filtration, olfaction, phonation, and secondary sex organ. [27] First, the nose plays a role in breathing, which is warming, moisturising and cleaning the inhaled air. Second, the nose is used for smelling. Third, the nose is important for speech; it works as a sound box and a resonance space where nasal sounds are being formed. Finally, the nose plays an important aesthetic and psychological role, as it is the most prominent feature in the face. [28] Deformation of the nose can therefore have a great emotional and social impact. [29]

Causes of nasal defects

Surgery for skin malignancies, trauma and burns are the most common causes of nasal defects, with excision of skin tumours exceeding the other two conditions by far. At this moment skin cancer is heading for pandemic sizes. [30] The incidence of non- melanoma skin cancer in the United States of America is one million new cases per year. [31] In the Netherlands the incidence of skin malignancies is expected to increase from 20.800 new cases per year in 2000 to 36.800 new patients per year in 2015. [32]

The nose has been shown to be the most prominent site for skin cancer to occur. Basal cell carcinoma has a relative frequency of 85-90% on the nose; squamous cell carcinoma has a frequency of less than 15%, and malignant melanoma less than 1%. [33] Although non-melanoma skin malignancies do not have the tendency to lead to mortality, the irreversible damage they can cause asks for optimal and early treatment. Usually this consists of surgical excision, radiation, cryotherapy, or Mohs' micrographic surgery. [34,35] Nasal reconstruction can only be started after optimal tumour control has been achieved. [33]

Principles of nasal reconstruction

Nasal reconstruction is more than meets the eye with respect to the need for structural support and inner lining. Concepts involving adequate structural support and inner lining in combination with the aesthetic subunit principles as advocated by Burget and Menick can lead to predictably good functional as well as aesthetic results.

The principles as outlined by Burget and Menick are: [21,24]

1. The nose can be divided in nine different subunits known as nasal tip, dorsum, paired sidewalls, alar lobules, soft triangles, and columella (Figure 6). Each subunit has its

specific contour due to the underlying soft and hard tissues. Each subunit is covered by skin with specific colour, texture and thickness. It is essential to replace missing nasal skin with skin that matches the nose in aforementioned qualities in exact right dimensions.

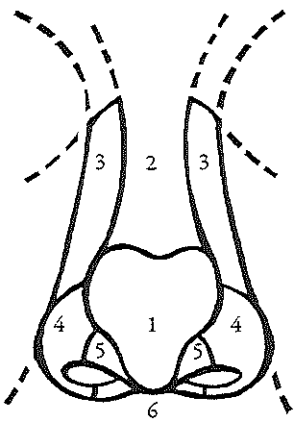


Figure 6: Nasal subunits 1. Nasal tip 2. Nasal dorsum 3. paired sidewalls, 4. alar lobules 5. soft triangles, 6. columella *(illustration by C.F. Wilbrink).*

2. Primary cartilage grafts need to be placed in order to re-establish a normal nasal shape, to support the soft tissues, and to support the reconstruction against the contractile effects of wound healing. These grafts are used to replace missing parts of the original nasal framework as well as to enhance existing nasal cartilages obtaining an optimal nasal contour and an open airway.
3. The restoration of thin, supple, vascular lining that permits placement of a complete supportive framework before the completion of wound healing.
4. The understanding that success in nasal reconstruction is not measured by the restoration of anatomy, but by the reestablishment of the expected skin quality, outline (subunits), and contour (support).

Guided by these principles nasal reconstruction has been performed many times all over the world. Until now many papers have been published on technical refinements of nasal reconstruction. The bottom-line of these papers is to learn from the authors' tips and tricks in establishing optimal results when reconstructing a nose. Regardless of the fact that it is extremely important that these experts' opinions are shared, there is a need for evidence-based outcome in nasal reconstructive surgery. A few papers on assessment of aesthetic and

functional outcome after nasal reconstruction have been published, however no standardized tools with known reliability and validity were used. [36-39] Beside the lack of studies on patient satisfaction there is also a lack of knowledge on the impact of nasal reconstruction on a patient's mental health. Although the commonly accepted idea that sustaining a major deforming injury to the face is one of the most devastating injuries one can suffer in terms of social interaction and quality of life, this has actually never been properly studied. It is important to know more about these issues. Therefore the psychological, aesthetic and functional outcome after nasal reconstruction were investigated in this thesis.

Outline and aims of the thesis

In determining patient satisfaction with functional and aesthetic outcome after reconstructive surgery, including nasal reconstruction, standardized assessment instruments are very important. These standardized tools are needed to adequately evaluate and compare outcome results. Since a literature search did not show the existence of such an instrument for nasal reconstruction, a standardized evaluation questionnaire – the Nasal Appearance and Function Evaluation Questionnaire (NAFEQ) – was developed to assess aesthetic and functional outcome after nasal reconstruction (**Chapter 2**).

Few reports on patient satisfaction and functional and aesthetic outcome after nasal reconstruction exist. Most publications merely contain descriptions, experiences, and opinions of the treating surgeon. There are no studies that have used standardized tools to assess aesthetic and functional outcome. In conclusion, to date there is still a shortage of studies on function and appearance after nasal reconstruction. The aim of the study in **Chapter 3** was to investigate subjective and objective functional and aesthetic follow-up results after reconstruction of subtotal nasal defects. Evaluation of aesthetic outcome after nasal reconstruction is difficult. There are different systems to measure aesthetic outcome, but there is no gold standard for outcome evaluation of a successfully reconstructed nose. Obviously a successful nasal reconstruction would be an exact copy of what is missing. The purpose of the study in **Chapter 4** was to evaluate subjective aesthetic outcome after nasal reconstruction using patient self-reports as well as panel assessments. Differences in subjective aesthetic outcome after nasal reconstruction as judged by patients and an independent panel were investigated. In addition, the severity of nasal defects was correlated with patient and panel satisfaction and established landmarks of nasal anatomy were evaluated as parameters of good aesthetic outcome.

The goal of nasal reconstruction after a partial or total amputation is to achieve a nasal appearance that is as natural and normal as possible. It is assumed that laypersons' opinion

on facial appearance could affect patient satisfaction or self-concept. The aim of the study in **Chapter 5** was to assess laypersons' opinions on aesthetic outcome after nasal reconstruction. This was compared with the opinion of a professional panel. Second, the effect of informing laypersons about the previous nasal reconstruction of patients on their assessment of facial attractiveness and abnormality was studied. Third, the effects of individual facial features on the assessment of facial attractiveness and abnormality were determined.

Total or partial nasal amputation following tumour resection is one of the more severe facial disfigurements. Successful nasal reconstruction can therefore be regarded as restoring a patient's psychosocial health. Therefore, the objective of the study in **Chapter 6** was to evaluate different determinants of patient's psychosocial functioning and their effect on patient satisfaction after nasal reconstruction. The level of satisfaction with nasal appearance and psychosocial functioning were assessed with validated questionnaires.

Chapter 7 reports on the effectiveness, aesthetic outcome and costs of interstitial high-dose-rate brachytherapy for early stage squamous cell carcinoma of the nasal vestibule and/or columella. This was done for all patients still alive by instructing a panel of non-medical and medical professionals to score the cosmetic result of each of these patients. Also, during an extra outpatient clinic follow-up session, all patients alive were seen in consultation to score the functional outcome. Finally, to put the brachytherapy technique for nasal vestibule cancer more in perspective, full hospital costs were computed and compared with costs of other modalities, such as plastic reconstructive surgery, Mohs' surgery, and external beam radiation therapy.

After analysis of 788 nasal reconstructions, which were performed at the Erasmus MC between 2001 and 2008, and a literature review, an algorithm for reconstruction of nasal defects after surgical excision of skin cancer was created (**Chapter 8**).

Summarizing, the aims of this thesis were:

— To develop a standardized evaluation questionnaire to assess aesthetic and functional outcome after nasal reconstruction.
— To assess the aesthetic and functional outcome after nasal reconstruction.
— To assess the difference between patients and professionals in rating outcome after nasal reconstruction.
— To assess laypersons' opinion about nasal appearance after nasal reconstruction.
— To assess the impact of nasal reconstruction following tumour resection on psychosocial functioning and to elucidate important determinants of psychosocial functioning and their effect on patient satisfaction after nasal reconstruction.

— To assess the effectiveness, aesthetic outcome and cost of interstitial high-dose-rate brachytherapy for early-stage cancer of the nasal vestibule and/or columella.
— To create an algorithm for reconstruction of nasal defects after surgical excision of skin cancer.

REFERENCES

1. McDowell F. The classic reprint. Ancient ear-lobe and rhinoplastic operations in India. Plast Reconstr Surg 1969: 43: 515-22.
2. Whitaker IS, Karoo RO, Spyrou G, Fenton OM. The birth of plastic surgery: the story of nasal reconstruction from the Edwin Smith Papyrus to the twenty-first century. Plast Reconstr Surg 2007: 120: 327-36.
3. Ortiz-Monasterio F, Olmedo A. Reconstruction of major nasal defects. Clin Plast Surg 1981: 8: 565-86.
4. From the Sushruta Samhita circa 600 BC translated from the sanskrit. Calcutta: K.K.L.Bhishagratna, 1907.
5. Remensnyder JP, Bigelow ME, Goldwyn RM. Justinian II and Carmagnola: a Byzantine rhinoplasty? Plast Reconstr Surg 1979: 63: 19-25.
6. Micali G. The Italian contribution to plastic surgery. Ann Plast Surg 1993: 31: 566-71.
7. Tagliacozzi. De curtorum chirurgia per institionem. Venice: In B. Gaspare, 1597.
8. Magazine Gs. London, 1794.
9. Carpue J. An account of two succesful operations for restoring a lost nose from the integuments of the forehead. London: Longman, Hurst, Rees, Orme & Brown, 1816.
10. Triana R. Jacques Joseph. Surgical sculptor. Arch Facial Plast Surg 1999: 1: 324-5.
11. Gillies HD. experiences with tubed pedicle flap. Surg Gynaecol Obstet 1935: 60: 291.
12. Kazanjian VH. Restoration of the nose, lip and maxilla by surgery and prosthesis. Plast Reconstr Surg 1947: 2: 531-7.
13. Washio H. Retroauricular-temporal flap. Plast Reconstr Surg 1969: 43: 162-6.
14. Mazzola RF, Marcus S. History of total nasal reconstruction with particular emphasis on the folded forehead flap technique. Plast Reconstr Surg 1983: 72: 408-14.
15. Converse J. introduction to plastic surgery. Philadelphia: Saunders, 1977.
16. Menick FJ. Nasal reconstruction: forehead flap. Plast Reconstr Surg 2004: 113: 100E-11E.
17. Millard DR, Jr. Reconstructive rhinoplasty for the lower half of a nose. Plast Reconstr Surg 1974: 53: 133-9.
18. Gillies HD. a new free graft applied to reconstruction of the nostril. Br J Surg 1943: 30: 305.
19. Converse J. the surgical treatment of facial injuries. Baltimore: Williams & Wilkins, 1974.
20. Millard DR, Jr. Total reconstructive rhinoplasty and a missing link. Plast Reconstr Surg 1966: 37: 167-83.
21. Burget GC, Menick FJ. The subunit principle in nasal reconstruction. Plast Reconstr Surg 1985: 76: 239-47.
22. Menick FJ. Artistry in aesthetic surgery. Aesthetic perception and the subunit principle. Clin Plast Surg 1987: 14: 723-35.
23. Millard DR, Jr. Aesthetic reconstructive rhinoplasty. Clin Plast Surg 1981: 8: 169-75.
24. Burget GC, Menick FJ. Aesthetic Reconstruction of the Nose. St Louis: Mosby, 1994.

25. Burget GC, Menick FJ. Nasal reconstruction: seeking a fourth dimension. Plast Reconstr Surg 1986: 78: 145-57.

26. Menick FJ. A new modified method for nasal lining: the Menick technique for folded lining. J Surg Oncol 2006: 94: 509-14.

27. Howard BK, Rohrich RJ. Understanding the nasal airway: principles and practice. Plast Reconstr Surg 2002: 109: 1128-46

28. Dropkin MJ, Malgady RG, Scott DW, Oberst MT, Strong EW. Scaling of disfigurement and dysfunction in postoperative head and neck patients. Head Neck Surg 1983: 6: 559-70.

29. Rankin M, Borah GL. Perceived functional impact of abnormal facial appearance. Plast Reconstr Surg 2003: 111: 2140-6

30. Ko CB, Walton S, Keczkes K, Bury HP, Nicholson C. The emerging epidemic of skin cancer. Br J Dermatol 1994: 130: 269-72.

31. Diepgen TL, Mahler V. The epidemiology of skin cancer. Br J Dermatol 2002: 146 Suppl 61: 1-6.

32. de Vries E, Coebergh JW, van der Rhee H. [Trends, causes, approach and consequences related to the skin-cancer epidemic in the Netherlands and Europe]. Ned Tijdschr Geneeskd 2006: 150: 1108-15.

33. Smeets NW, Krekels GA, Ostertag JU, et al. Surgical excision vs Mohs' micrographic surgery for basal-cell carcinoma of the face: randomised controlled trial. Lancet 2004: 364: 1766-72.

34. Rowe DE, Carroll RJ, Day CL, Jr. Mohs surgery is the treatment of choice for recurrent (previously treated) basal cell carcinoma. J Dermatol Surg Oncol 1989: 15: 424-31.

35. Thissen MR, Neumann MH, Schouten LJ. A systematic review of treatment modalities for primary basal cell carcinomas. Arch Dermatol 1999: 135: 1177-83.

36. Arden RL, Nawroz-Danish M, Yoo GH, Meleca RJ, Burgio DL. Nasal alar reconstruction: a critical analysis using melolabial island and paramedian forehead flaps. Laryngoscope 1999: 109: 376-82.

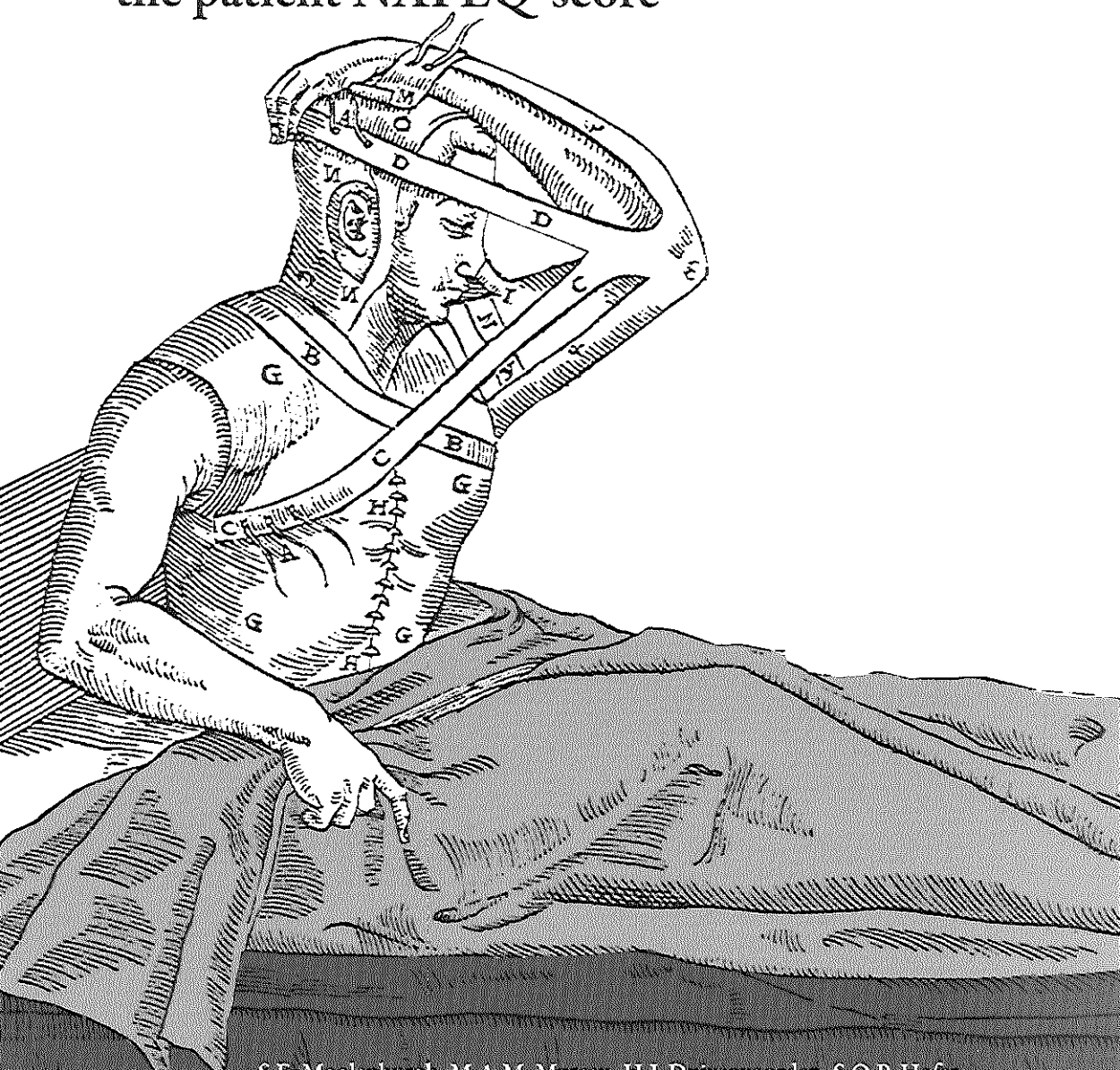
37. Quatela VC, Sherris DA, Rounds MF. Esthetic refinements in forehead flap nasal reconstruction. Arch Otolaryngol Head Neck Surg 1995: 121: 1106-13.

38. Rohrich RJ, Griffin JR, Ansari M, Beran SJ, Potter JK. Nasal reconstruction--beyond aesthetic subunits: a 15-year review of 1334 cases. Plast Reconstr Surg 2004: 114: 1405-16

39. Singh DJ, Bartlett SP. Aesthetic considerations in nasal reconstruction and the role of modified nasal subunits. Plast Reconstr Surg 2003: 111: 639-48

Chapter 2

Validation of a questionnaire assessing patient's aesthetic and functional outcome after nasal reconstruction: the patient NAFEQ-score



S.E. Moolenburgh, M.A.M. Mureau, H.J. Duivenvoorden, S.O.P. Hofer

J Plast Reconstr Aesthet Surg. 2009 May;62(5):656-62.

ABSTRACT

Background In determining patient satisfaction with functional and aesthetic outcome after reconstructive surgery, including nasal reconstruction, standardized assessment instruments are very important. These standardized tools are needed to adequately evaluate and compare outcome results. Since no such instrument existed for nasal reconstruction, a standardized evaluation questionnaire was developed to assess aesthetic and functional outcome after nasal reconstruction.

Methods Items of the Nasal Appearance and Function Evaluation Questionnaire (NAFEQ) were derived from both the literature and experiences with patients. The NAFEQ was validated on 30 nasal reconstruction patients and a reference group of 175 people.

Results A factor analysis confirmed the arrangement of the questionnaire in two subscales: functional and aesthetic outcome. High Cronbach's alpha values (>0.70) for both subscales showed that the NAFEQ was an internally consistent instrument.

Conclusion This study demonstrated that the NAFEQ can be used as a standardized questionnaire for detailed evaluation of aesthetic and functional outcome after nasal reconstruction. Its widespread use would enable comparison of results achieved by different techniques, surgeons and centres in a standardized fashion.

INTRODUCTION

Assessment of aesthetic and functional outcome after nasal reconstruction is of relevance to systematically evaluate the surgical result. In addition, in today's medical climate patient satisfaction with postoperative physical appearance and function has become an important variable used to establish quality-of-care parameters.

Until now, however, no standardized, reliable, and validated method is available to assess aesthetic and functional outcome of nasal reconstruction patients. Several papers have been published on aesthetic outcome after nasal reconstruction without using standardized questionnaires that were validated according to the scientific principles of psychometrics, [1-4] which makes it very hard to compare and interpret their results.

The objective of this study was to develop a standardized patient-report questionnaire to assess aesthetic and functional outcome after nasal reconstruction in a reliable, valid, and reproducible manner. Therefore the Nasal Appearance and Function Evaluation Questionnaire (NAFEQ) was constructed and its validity and reliability were tested.

PATIENT AND METHODS

Patients

A total of 39 consecutive patients were included. They were treated between November 2001 and May 2005 for (sub)total nasal defects by one surgeon (SOPH). Twenty-two male and 17 female patients were included. Thirty-four patients had a defect following radical tumour resection and five had a defect caused by other conditions, e.g. trauma. Defects were classified as skin only (13%), skin and cartilage (21%) and full thickness (66%). The defect involved one aesthetic subunit in six (15%), two in 14 (36%) and three or more in 19 (49%) patients according to the aesthetic subunit principle. [5-7] Nasal reconstructions were performed using basic principles of aesthetic nasal reconstruction as described by Burget and Menick. [7]

Comparison group

A comparison group to obtain normative data was recruited, by asking every accompanying person of patients (except for nasal reconstruction patients) that came to our outpatient clinic to participate. Exclusion criteria were age (<18 years) and visible facial deformity.

Assessment variables

The NAFEQ (Figure 1) comprises 14 items designed to assess satisfaction with aesthetic and functional outcome after nasal reconstruction (Figure 1). Pertinent items were derived from both literature and experiences with patients. [8,9] The NAFEQ consists of two parts. Part I includes seven questions (numbered 1-7) regarding nasal function. Six specific questions deal with, airway passage, snoring, olfaction, dry mucosa, epistaxis and phonation. Beside these six specific questions, there was one question with reference to overall satisfaction with nasal functioning. Part II contains seven items to assess satisfaction with nasal appearance (numbered 8-14), of which six are nose-specific and one is on overall satisfaction with nasal appearance.

All responses are rated on a 5-point Likert scale, where "1" equals "always" or "very dissatisfied", depending on the type of question and "5" equals "never" or "very satisfied". With the exception of question 6 of part I, the response varies from 1 "very poor" to 5 "excellent".

All seven questions of parts I and II were totalled individually. Before calculating the sum scores for parts I and II, the raw scores of question 3 (olfaction) were reversed. Consequently, sum scores could theoretically range from 7 to 35. Seven represents "very dissatisfied" with nasal function or appearance and 35 means "very satisfied" with nasal function or appearance.

Ethical approval was received from a Medical Ethical Committee of the Erasmus Medical Centre Rotterdam. Signed consent was obtained from all participants.

Analysis of psychometric properties

Factor analysis, exploring the required number of factors to be extracted, was performed to get insight into the empirical structure of the questionnaire. Subsequently, confirmatory factor analysis was applied to test and to estimate the loadings of the factors on the variables. Intercorrelation of these factors was estimated. This implies that the factors extracted will not be independent. Due to the relative small patient sample size, the determination of the empirical structure was based on the comparison group. Cronbach's alpha coefficient was used as a measure of reliability, i.e. internal consistency. Test-retest reliability was estimated by Bland and Altman's method for agreement. [10] These measures of reliability were estimated for the comparison group and the patients, respectively.

The concurrent validity of part I (function) was tested by assessing objective nasal function tests, including the Cottle test and anterior rhinoscopy to assess mucosal dryness, crusts, ulceration, adhesions or synechiae. Because there is no readily available objective criterion to validate satisfaction with nasal appearance, other self-report measures were utilized to test the validity of part II. These included the Body Cathexis Scale (BCS), [11]

which is a global measure of satisfaction with facial features and other body parts, and a visual analogue scale (VAS) measurement on overall satisfaction with nasal appearance. The VAS was calibrated from 0-100 mm and labelled as very dissatisfied (0) to very satisfied (100) with total nasal appearance. Spearman rank correlation coefficients were used because of the non-normal distribution of the data. These analyses were performed for both the patients and the comparison group Version 11.0 of the computer program SPSS (SPSS Inc, Chicago, Illinois) was used for statistical analyses.

	always	mostly	every now and then	hardly ever	never
1. How often do you have trouble breathing through your nose	1	2	3	4	5
2. How often do you snore?	1	2	3	4	5
3. How often can you smell odors?	1	2	3	4	5
3. How often do you have trouble with nasal crusts?	1	2	3	4	5
5. How often do you have a bloody nose	1	2	3	4	5
	very poor	poor	moderately	good	excellent
6. How do you assess your quality of speech	1	2	3	4	5
	very dissatisfied	dissatisfied	moderately	satisfied	very satisfied
7. How satisfied are you with your total nasal functioning?	1	2	3	4	5
8. How satisfied are you with your nasal tip appearance?	1	2	3	4	5
9. How satisfied are you with your nasal wing(s) appearance?	1	2	3	4	5
10. How satisfied are you with your nasal dorsum appearance?	1	2	3	4	5
11. How satisfied are you with the size of your nostril(s)	1	2	3	4	5
12. How satisfied are you with the color of your nasal skin?	1	2	3	4	5
13. How satisfied are you with your nasal position?	1	2	3	4	5
14. How satisfied are you with your total nasal appearance?	1	2	3	4	5

Figure 1. Items of the Nasal Appearance and Function Evaluation Questionnaire (NAFEQ).

RESULTS

Response

Of the 39 patients, 33 (87%) were seen in our outpatient clinic as part of a previous study. [9] Four patients refused to participate and two had died, one because of distant tumour metastasis. Of these 33 previously studied patients, 30 consented to do a retest, one refused to participate and two had died. There were 18 male and 12 female patients; their age ranged from 43 to 87 years (mean ±SD, 67 ±13.7years) and from 39 to 77 years (mean ±SD, 60 ± 14.5 years), respectively. Mean follow-up period after nasal reconstruction was 12 months (range, 6 to 35 months).

For the comparison group 200 people were approached of whom 175 consented to participate. Twenty-five eligible persons refused to participate because of lack of time. Sixty-nine of the respondents were males and 106 were females; their age ranged from 21 to 79 years (mean ±SD, 43 ± 14 years) and from 18 to 93 years (mean ±SD, 41 ± 17 years), respective

Empirical dimensional structure

An explorative factor analysis indicated that the empirical structure of the NAFEQ is two-dimensional: (1) nasal function and (2) satisfaction with nasal appearance. A confirmatory factor analysis on the two-dimensional structure showed that the factor loadings estimated were discernible. While the factor inter correlation was 0.43, the total variance explained by the two factors was 47%, with aesthetic outcome accounting for 33% percent and functional outcome for 14% (Table I).

Table I. Factor loadings of two different factors (1=nasal function; 2=nasal appearance) used to analyse the two -dimensional structure of the NAFEQ

Item	Factor 1	Factor 2
Part I: Nasal Function		
1. airway passage	0.72	
2. snoring	0.52	
3. olfaction	0.46	
4. dry mucosa	0.52	
5. epistaxis	0.20	
6. phonation	0.36	
7. overall function	0.62	
Part II: Satisfaction with Nasal Appearance		
8. nasal tip		0.74
9. ala nasi		0.86
10. nasal dorsum		0.80
11. nostril size		0.77
12. colour		0.66
13. nasal position		0.75
14. total nasal appearance		0.94
% explanation of variance	14%	33%

Reliability Analysis

Cronbach's alpha coefficients calculated for the two subscales (nasal function and satisfaction with nasal appearance) were respectively 0.70 and 0.92 in the patient group and 0.70 and 0.96 in the comparison group. These values are equal to or above the recommended criterion value of 0.70, indicating a good reliability for the nasal function subscale and an excellent reliability for the satisfaction with nasal appearance subscale.

Test-retest reliability

According to Bland and Altman, [10] the mean of test and retest against the difference of test and retest was visualized for nasal function for both patient group (figure 2a) and comparison group (figure 3a) Test and retest of aesthetic outcome was visualized as well (see

also figure 2b and 3b). First of all, neither for nasal function nor for satisfaction with nasal appearance mean values were associated with their differences (r=0.06, p=0.43 and r=-0.15, p= 0.78, respectively for the comparison group and r=-0.207, p=0.27 and r=-0.221, p=0.24 for the patient group). Therefore, according to Bland and Altman the lack of agreement can be summarized by calculating the bias, estimated by the mean difference and the standard deviation of the differences; 95% of the observations should be within the mean difference and ±2 times the standard deviation of the differences. These zones are called the limits of agreement. For both nasal function and satisfaction with nasal appearance, 95% of these test and retest values were between these limits of agreement for the patient group as well as the comparison group, indicating a good reproducibility of the NAFEQ subscales.

Validity analysis

The correlations between the NAFEQ part II (satisfaction with nasal appearance) and the other self evaluation questionnaires (BCS and VAS) are presented for patients as well as comparison subjects in Table II. All questionnaires showed high correlation coefficients with the NAFEQ, indicating the NAFEQ is a valid instrument for assessing satisfaction with nasal appearance in patients after nasal reconstruction.

There were no statistically significant correlations between the objective nasal function tests and subjective self-reported nasal function (data not shown).

Table II. Concurrent validity of part 2 (satisfaction with nasal appearance) assessed by Spearman correlations between the NAFEQ, Body Cathexis Scale (BCS) and Visual Analogue Scale (VAS)

	NAFEQ part 2 (total score)	
	Patient group	Reference group
BCS[a] (only nasal item)	0.51[c]	0.68[c]
VAS[b]	0.82[c]	0.73[c]

[a] BCS = Body Cathexis Scale

[b] VAS = Visual Analogue Scale

[c] All correlations are significant at the 0.01 level

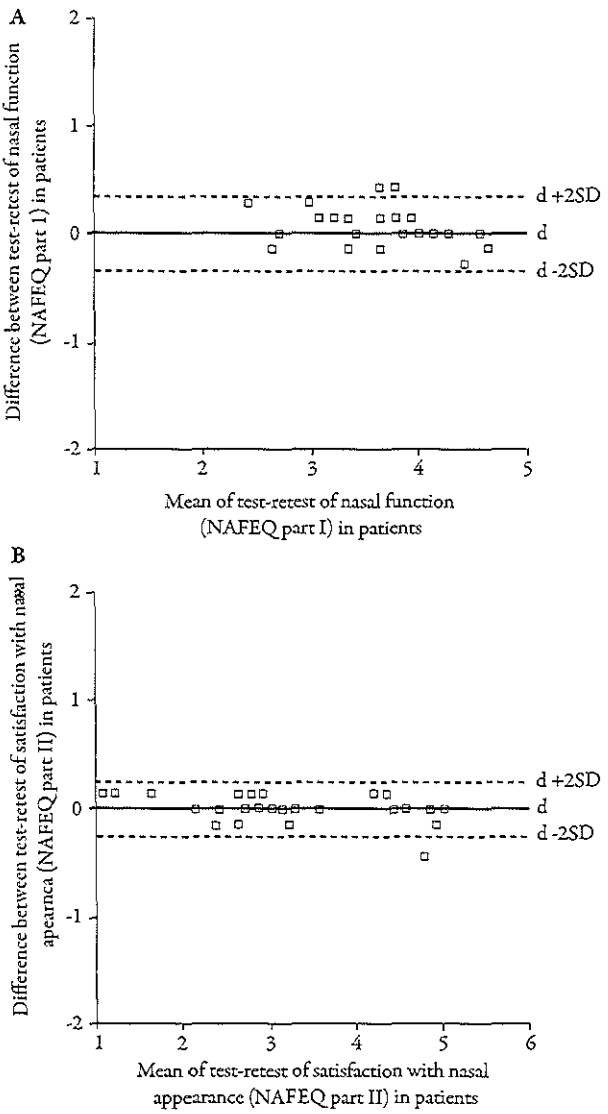


Figure 2. (**A**) Bland-Altman plot of difference between test and retest on the NAFEQ part I (functional outcome) as completed by patients. The three horizontal lines indicate mean individual difference (d) ±2SD. (**B**) Bland-Altman plot of difference between test and retest on the NAFEQ part II (aesthetic outcome) as completed by patients. The three horizontal lines indicate mean individual difference (d) ±2SD

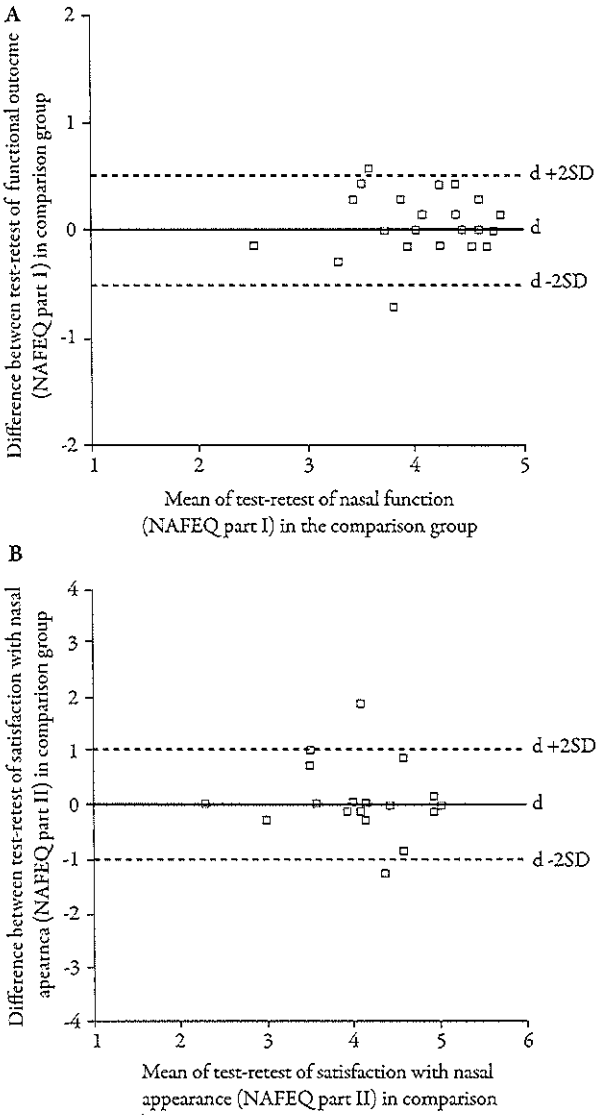


Figure 3. (**A**) Bland-Altman plot of difference between test and retest on the NAFEQ part I (functional outcome) as completed by the comparison group. The three horizontal lines indicate mean individual difference (d) ±2SD. (**B**) Bland-Altman plot of difference between test and retest on the NAFEQ part II (aesthetic outcome) as completed by the comparison group. The three horizontal lines indicate mean individual difference (d) ±2SD.

DISCUSSION

General need for standardized outcome measures in plastic and reconstructive surgery has been confirmed in literature. [12-15] This also holds true for an outcome measure regarding satisfaction with nasal reconstruction. There is one nose specific questionnaire, however, this was specifically designed for rhinoplasty outcome evaluation. [16] In spite of its clear design, this questionnaire is not focusing enough on every nasal subunit which makes it incomplete to use as a detailed evaluation questionnaire assessing satisfaction with nasal reconstruction. To evaluate nasal reconstruction outcome it is important to be able to distinguish and compare the quality of different nasal subunits. The Nasal Appearance and Function Evaluation Questionnaire was developed specifically to assess satisfaction with nasal function as well as nasal appearance in a more complete way.

The NAFEQ was validated in patients who underwent nasal reconstruction. A two-stage factor analysis yielded two factors, i.e. satisfaction with nasal function and appearance, with discernible loadings. These factors were shown to be reliable and valid. The high Cronbach's alpha values for both part I and II revealed that the NAFEQ (for both nasal function as well as appearance) was an internally consistent instrument to use in nasal reconstruction patients.

The good reliability of the questionnaire was further demonstrated with the Bland-Altman plot. The fact that 95% of the differences between the test-retest was between 0.34 (nasal function) and 0.25 (nasal appearance) points (on a 1-5 scale) in the patient group and between 0.51(nasal function) and 1.02 (nasal appearance) points in the reference group emphasized this.

Direct comparison of the NAFEQ part II (satisfaction with nasal appearance) with the BCS and the VAS supported the validity of this scale. On the other hand, the correlation between objective nasal function assessment by a professional and patient reported subjective nasal function was low. Although this finding may seem surprising, multiple outcome studies have demonstrated poor correlation between objective and subjective findings. [15,16,17] This strongly supports the notion that self-report outcomes such as NAFEQ are a distinct construct different from observer-rated assessments.

A limitation of this study is the rather small patient sample size. To address this problem a comparison group was used. Being aware of the fact that this comparison group had no nasal problems, they could still be used to establish internal consistency, reliability, and validity of the NAFEQ.

An important factor not measured in this questionnaire is patient education prior to the nasal reconstruction. This could also be of influence on the result of outcome satisfaction. When offering more time during the preoperative phase, to educate the patient carefully on what results they can expect and lowering their overall expectations might result in overall higher patient satisfaction.

In conclusion, this study demonstrates that the NAFEQ can be used as a standardized questionnaire for detailed evaluation of aesthetic and functional outcome after nasal reconstruction. Widespread use would enable us to compare the results between different techniques, surgeons, and centres in a standardized, reliable, valid, and reproducible way.

REFERENCES

1. Quatela VC, Sherris DA, Rounds MF. Aesthetic refinements in forehead flap nasal reconstruction. Arch Otolaryngol Head Neck Surg. 1995; 121: 1106-13.
2. Drisco BP, Baker SR. Reconstruction of nasal alar defects. Arch Facial Plast Surg. 2001; 3: 91-9.
3. Rohrich RJ, Griffin JR, Ansari M, Beran SJ, Potter JK. Nasal reconstruction--beyond aesthetic subunits: a 15-year review of 1334 cases. Plast Reconstr Surg. 2004; 114: 1405-16.
4. Arden RL, Nawroz-Danish M, Yoo GH, Meleca RJ, Burgio DL. Nasal alar reconstruction: a critical analysis using melolabial island and paramedian forehead flaps. Laryngoscope. 1999; 109: 376-82.
5. Burget GC, Menick FJ. The subunit principle in nasal reconstruction. Plast Reconstr Surg. 1985; 76: 239-47.
6. Menick FJ. Artistry in aesthetic surgery. Aesthetic perception and the subunit principle. Clin Plast. Surg. 1987; 14: 723-735.
7. Burget GC, Menick FJ. Aesthetic Reconstruction of the Nose. St. Louis: C.V. Mosby, 1994.
8. Howard BK, Rohrich RJ. Understanding the nasal airway: principles and practice. Plast Reconstr Surg. 2002; 109: 1128-46.
9. Mureau MAM, Moolenburgh SE, Levendag PC, Hofer SOP. Aesthetic and functional outcome following nasal reconstruction. Plast Reconstr Surg. 2007; 120: 1217-27
10. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet. 1986; 1: 307- 310.
11. Secord PF, Jourard SM. The appraisal of body-cathexis: body-cathexis and the self. J Consult Psychol. 1953; 17: 343-347.
12. Alsarraf R. Outcomes research in facial plastic surgery: a review and new directions. Aesthetic Plast Surg. 2000; 24: 192-197.
13. Wright JG. Outcomes research: what to measure. World J Surg. 1999; 23: 1224-6.
14. Stewart MG, Porter JP. Outcomes research and facial plastic surgery. Facial Plast Surg. 2002; 18: 73-6.
15. Stewart MG. Outcomes research: an overview. ORL J Otorhinolaryngol Relat Spec. 2004; 66: 163-6.
16. Alsarraf R. Outcomes instruments in facial plastic surgery. Facial Plast Surg. 2002;18: 77-86.
17. Stewart MG, Smith TL, Weaver EM, Witsell DL, Yueh B, Hannley MT, Johnson JT. Outcomes after nasal septoplasty: results from the Nasal Obstruction Septoplasty Effectiveness (NOSE) study. Otolaryngol Head Neck Surg. 2004; 130: 283-90.

Chapter 3

Aesthetic and functional outcome following nasal reconstruction

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ABSTRACT

Background Few reports on outcome of aesthetic nasal reconstruction exist. Therefore, subjective and objective aesthetic and functional outcome following nasal reconstruction was assessed.

Methods Outcome was assessed in 38 consecutive patients treated for (sub)total nasal defects using standardized semi-structured interviews. Standardized physical examination forms and photographs were used.

Results In 6 patients one aesthetic subunit was involved, in 14 two, and in 18 three or more. Defects were classified as skin only (13%), skin/cartilage (21%), and full thickness (66%). Some defects (32%) involved adjacent aesthetic units.

Inner lining was reconstructed with local mucosa or turn-over skin flaps. Support was provided with regional cartilage grafts and/or composite septal flaps. Skin defects were reconstructed with forehead (32x), nasolabial (6x), cheek advancement (7x), Abbe (3x), and facial artery perforator flaps (3x), and one free radial forearm flap. Nasal reconstructions required 116 procedures (mean, 3 operations/patient).

Thirty-three patients participated in the follow-up study (mean follow-up, 12 months). Mucosal crusting was noted (36%), passage difficulties (31%), and worse olfaction (16%). Phonation was unchanged. Eighty-one percent were (very) satisfied with nasal function.

Flap colour match was moderate to good in 97%; hair growth occurred in 61%. At critical inspection a thicker flap (58%), smaller ostium nasi (77%), thicker alar rim (86%), and minor alar rim retraction (46%) were noted. Seventy-nine percent were (very) satisfied with total nasal appearance.

Conclusions Although objective functional and aesthetic outcome following nasal reconstruction sometimes shows impairment compared to the normal situation, it gives high subjective patient satisfaction with function and aesthetics.

INTRODUCTION

Probably the first nasal reconstruction using a cheek flap was published in the *Sushruta Samhita* in India during 700 to 600 BC. [1] Many centuries later, different techniques using other donor-sites to reconstruct the nose as the forehead,1 the upper arm, [2] or retro-auricular area [3] were published. The forehead, however, eventually became the most popular donor-site for nasal reconstruction because of its excellent vascularization, skin colour and texture match. [4] The forehead flap has been brought close to perfection by different contributors improving each others techniques. [4]

Nasal reconstruction is more than meets the eye with respect to the need for structural support and inner lining. Concepts involving adequate structural support and inner lining were slowly accepted. [5,6] Once these concepts were combined with the aesthetic subunit principles, [7] as popularized by Burget and Menick, [8,9] predictable good aesthetic results of nasal reconstruction could be achieved.

In literature, emphasis exists on technical refinements to optimize aesthetic results following nasal reconstruction, however, little has been published on long-term aesthetic or functional outcome (PubMed search for "*outcome, nasal or nose reconstruction*"). [10-16] Only four outcome studies of nasal reconstruction actually presented any data on subjective aesthetic results: one without any statistical analyses, [11] one without finding any statistically significant results because of small sample sizes, [12] one with subjective nasal functional ratings by 32 patients and subjective aesthetic ratings by a panel, [14] and one for nasal alar defects only. [15] A PubMed search found no studies addressing objective functional outcome after (sub)total nasal reconstruction.

In conclusion, to date there is still a shortage of studies on function and appearance after nasal reconstruction. The aim of the present study was to investigate subjective as well as objective functional and aesthetic follow-up results after reconstruction of (sub)total nasal defects.

MATERIALS AND METHODS

Patient Sample Characteristics

A total of 38 consecutive patients treated between November 2001 and May 2005 for (sub) total nasal defects by one surgeon (SOPH) were included. There were 22 male and 16 female patients; their age ranged from 35 to 87 years (mean, 62 years). Thirty-three patients had a

defect following radical tumour resection (mainly squamous and basal cell carcinoma) and 5 patients had a defect caused by miscellaneous conditions requiring nasal reconstruction (see Table I).

Table I. Causes of subtotal and total nasal defects in 38 patients

	Number of Patients	Percentage
Basal cell carcinoma	15	39.5
Squamous cell carcinoma	12	31.6
Lymphoma	3	7.9
Keratoacanthoma	1	2.6
Lentigo maligna	1	2.6
Sweat gland carcinoma	1	2.6
Trauma	2	5.3
Post meningococcal sepsis	1	2.6
Burns	1	2.6
Post radiotherapy	1	2.6
Total	38	100.0

According to the aesthetic subunit principles, [8,9] in 6 patients (16%) the defect involved one aesthetic subunit, in 14 cases (37%) two, and in 18 subjects (47%) three to seven. Most typically the ala nasi (63%), nasal tip (47%), lateral sidewall (47%), or nasal dorsum (42%) were affected. In 11 subjects (29%) the columella was missing, in three cases (8%) both alae nasi were involved and in two patients (5%) both lateral sidewalls had to be reconstructed. Some defects also involved adjacent aesthetic facial units such as cheek (7 cases) or upper lip (5 patients). Defects were classified as skin only (13%), skin and cartilage (21%), and full thickness (66%).

Local and Systemic Risk Factors

A total of 23 cases (61%) had a history of previous nose surgery: tumour excision and primary closure (12x); tumour excision and skin graft (7x); tumour excision and local or regional flap (4x); and ethmoidectomy and dorsal onlay cartilage graft (1x). Fourteen patients (37%) had received local radiotherapy or brachytherapy in the past (40 to 60 Gy) and 14 cases (37%) had one or more systemic risk factors (hypertension, diabetes mellitus, systemic lupus erythematosus, post myocardial infarction, post PTCA or open heart surgery). In summary, 7 cases (18%) had none of the above mentioned risk factors, 22 patients (58%) had one such a risk factor, and 9 subjects (24%) two.

Nasal Reconstruction Techniques

Nasal reconstructions were performed using the basic principles in aesthetic nasal reconstruction as comprehensively described by Burget and Menick. [9]

Intranasal lining

Intranasal lining was reconstructed with ipsilateral mucoperichondrial flaps anterocaudally based on the septal branch of the superior labial artery [5,6] in 14 patients. Turnover skin flaps surrounding the defect [4,10] were used to provide inner lining in 12 cases where the size of the defect had to be enlarged to the total size of the involved aesthetic subunit. Five subjects required a hemi-nose reconstruction and a cranially based composite septal swing flap [5,6] was used for inner lining as well as sidewall cartilage support. In two patients following a total nose amputation an anterocaudally based composite septal pivot flap with laterally peeled mucoperichondrial flaps [5,6] was used for lining of both nasal vestibules as well as cartilage support. One of these latter two patients required a folded paramedian forehead flap for additional inner lining coverage.

Cartilage framework support

For restoration of a cartilage framework conchal, septal, or rib cartilage grafts were used 26, 13, and four times respectively in 31 patients. These cartilage grafts were used as alar batten grafts, nasal (supra)tip and columellar strut grafts, dorsal onlay or cantilever grafts, and lateral sidewall support grafts.

Nasal cover

Using the aesthetic subunit principles [8,9] skin defects were reconstructed with 32 para-median forehead flaps in 30 patients. In one patient two forehead flaps were used simultaneously after it appeared that the first flap had been designed without the alar unit and in another patient a second forehead flap was used for reconstruction of an ala nasi defect after necrosis of the first forehead flap following flap thinning. Ala nasi skin defects were reconstructed with cranially based nasolabial flaps in six patients. Paranasal cheek defects were covered using cheek advancement flaps in seven cases. Upper lip defects were reconstructed with Facial Artery Perforator flaps [17] (three times) or Abbe flaps (three times). In two of these latter patients an extended Abbe flap was used to simultaneously reconstruct the missing columella in one case and to cover the nasal floor in the other patient. One patient with basal cell nevus syndrome required a free radial forearm flap for total nasal skin coverage due to multiple previous basal cell carcinoma excisions followed by skin graft and local/regional flap reconstructions.

Second and third stages of nose reconstruction

Paramedian forehead flaps were typically divided and inset three weeks later in a second stage in the first 16 patients of the current series followed by flap thinning in a third stage in 10 of these cases. In the remaining six patients flap thinning was either not deemed necessary (2 times) or refused by the patient (4 times). With increasing experience a three stage approach according to Menick's later reports [4,18] was followed in the remaining 14 patients in whom a forehead flap was used. After three weeks the forehead flap was vigorously thinned and the cartilage framework was sculptured in the right shape while the flap remained attached distally as well as to its pedicle. Another three weeks later, in a third stage, the forehead flap was divided and inset in all 14 cases. Forehead flaps were further thinned during additional aesthetic improvements as scar revisions or cartilage tip grafts in eight patients. Nasolabial and Abbe flaps were divided and inset three weeks following the first stage in all nine patients.

Procedure

A letter was mailed to all patients explaining the study and asking them to participate. All consenting patients were invited to the outpatient clinic for a standardized interview, physical examination, and clinical photographs of their face. The study was approved by a Medical Ethics Committee.

Measures

Medical data

All patient files were retrieved and patient characteristics, medical history, surgical data, and complications were scored meticulously on a standardized form.

Subjective nasal function and satisfaction with appearance

To assess subjective nasal function and satisfaction with appearance, we developed a standardized semistructured interview with preformulated questions. Reported problems of nasal functioning [19] (airway passage, snoring, olfaction, dry mucosa, epistaxis, phonation) were scored. Satisfaction with the appearance of different nasal characteristics was measured using a 5-point scale (1=very dissatisfied; 5=very satisfied), as was satisfaction with donor-site scars (forehead, nasolabial fold, ear, and chest).

Objective nasal function and appearance

To determine objective nasal function and appearance, we developed a standardized physical examination form. Nasal function was assessed by scoring the occurrence of alar

collaps during forced inspiration and nasal whistling during phonation or respiration. In addition, anterior rhinoscopy was performed in all patients to look for mucosal dryness, crusts, ulceration, adhesions or synechiae. Nasal appearance was assessed by an independent investigator (MAMM) through scoring flap colour match (good, moderate, poor), flap hair growth (yes, no), flap thickness (too thick, adequate, too thin), ostium nasi size (smaller, equal, larger), alar rim thickness (too thick, equal, too thin), alar rim retraction (yes, no) and satisfaction with total nasal appearance (1=very dissatisfied; 5=very satisfied). Standardized pre- and postoperative clinical photographs of the face and nose were taken by a medical photographer.

Statistical Analysis

Data were analyzed as frequencies and percents or means and ranges. To detect possible differences between groups, Fisher's exact tests and Mann Whitney U tests were used. Two-tailed probabilities <0.05 were accepted as statistically significant.

RESULTS

Postoperative Complications and Results Requiring Revision Surgery

Twenty-one patients (55%) had a totally uneventful postoperative course following every procedure. Seven postoperative complications (18%) and 19 results requiring revision surgery occurred in 15 patients (40%, see Table II). In addition, two patients (5%) had a complication which resolved following conservative treatment. One patient with persistent bleeding from intranasal mucosal wound edges was successfully treated with a Merocel® tampon during 48 hours. Another case had a temporary lower eyelid ectropion following a cheek advancement procedure which resolved spontaneously.

Flap tip necrosis occurred three times following 32 paramedian forehead flaps (9%), of which two resulted from flap thinning during the second stage, once after two extended Abbe flaps, and twice following 14 mucoperichondrium flaps (Table II). Five out of six patients with flap tip necrosis had a risk factor compromising flap circulation (3x smoking, 1x local radiotherapy, 1x diabetes mellitus). Forehead flap tip necrosis resulted in infected cartilage which had to be removed in one patient, who developed insufficient tip projection due to retraction which was treated later with a secondary conchal cartilage tip graft (case 9, Table II, Figures 1a through 1d).

Table II. Postoperative complications and results requiring revision surgery in 15 patients

Procedure	Postoperative complication	Treatment	Patient No.
Paramedian forehead flap*	Flap tip necrosis with exposed and/or infected cartilage	– 1x cartilage removal and closure and secondary cartilage tip graft	9
	"	– 1x necrotectomy and 2nd FH flap	34
	"	– 1x necrotectomy and NL flap	5
Extended Abbe flap	"	– 1x necrotectomy and FTSG	31
Mucoperichondrium flap	"	– 2x inner lining transposition	6, 38
Cheek advancement	Lower eyelid ectropion	– 1x medial canthopexy	29
Procedure	**Result Requiring Revision**	**Treatment**	**Patient Number**
Dorsal onlay rib graft	Instable rib graft fixation	– 1x screw fixation to nasal bone	23
Conchal tip grafts	Insufficient tip support	– 1x rib cartilage strut graft	14
Full thickness alar reconstruction	17x a too small ostium nasi in 10 patients	– 4x caudally based paranasal transposition flap and lateral alar base transposition	14, 15, 24, 31
		– 4x ostium nasi widening and FTSG	2, 4, 24, 34
		– 2x Z-plasty	34, 35
		– 2x ala nasi thinning	24, 36
		– 4x alar batten cartilage graft	5, 14 34, 36
		– 1x alar cartilage graft thinning	4

*Flap tip necrosis occurred twice following flap thinning.

FH = forehead; NL = nasolabial; FTSG = full thickness skin graft.

A too small ostium nasi (=smaller than unaffected side) was the most encountered and resistant postoperative problem which had to be surgically corrected in 10 patients, sometimes on multiple occasions (Table II). A caudally based paranasal flap transposed into the nasal floor while the alar base was transposed laterally was performed four times to correct the stenosis (e.g., case 14, Table II, Figures 2a through 2d). Furthermore, ostium nasi widening using a full thickness skin graft, ala nasi thinning in combination with quilting

sutures, Z-plasties, alar batten cartilage grafts, and alar cartilage graft thinning were used (Table II).

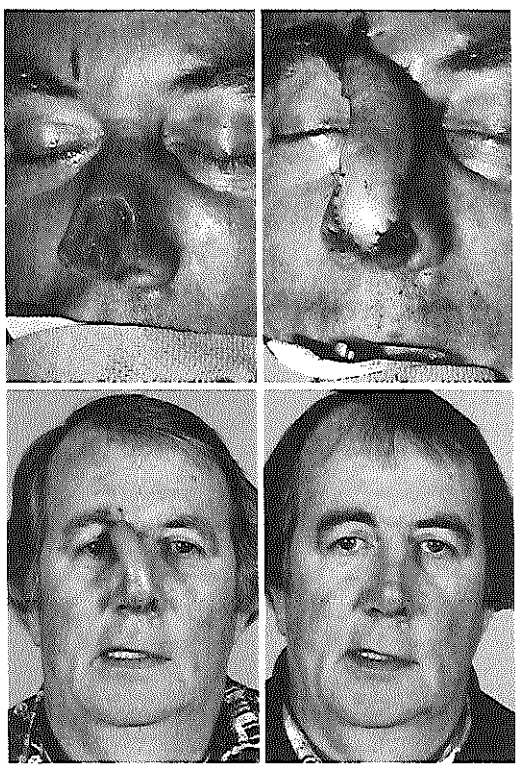

Figure 1. (**A**) Nasal tip and partial dorsum skin and cartilage defect after radical basal cell carcinoma resection in a 52-year-old man (case 9, Table 2). (**B**) Immediate postoperative result after reconstruction with a paramedian forehead flap in combination with conchal cartilage tip and strut grafts. (**C**) Paramedian forehead flap tip necrosis with infected cartilage grafts 28 days post-operatively. (**D**) Final result at 14 months follow-up after infected cartilage graft removal, flap inset and thinning, and a secondary conchal cartilage strut graft for tip projection improvement. The patient was satisfied with nasal appearance and very satisfied with nasal function.

In total 116 procedures were needed in 38 patients (mean, 3 operations per patient). Postoperative complications occurred in two of seven patients without risk factors (smoking, radiotherapy, systemic disease) and in five of 31 cases with one or more of these risk factors (Fisher's exact test, $p=0.592$). A total of 24% of the patients in whom a paramedian forehead flap was used compared to none of the cases in whom a nasolabial flap was used had

complications (Fisher's exact test, p=0.311). Results indicating revision surgery occurred in 14% of patients without risk factors and in 32% with one or more risk factors (Fisher's exact test, p=0.644).

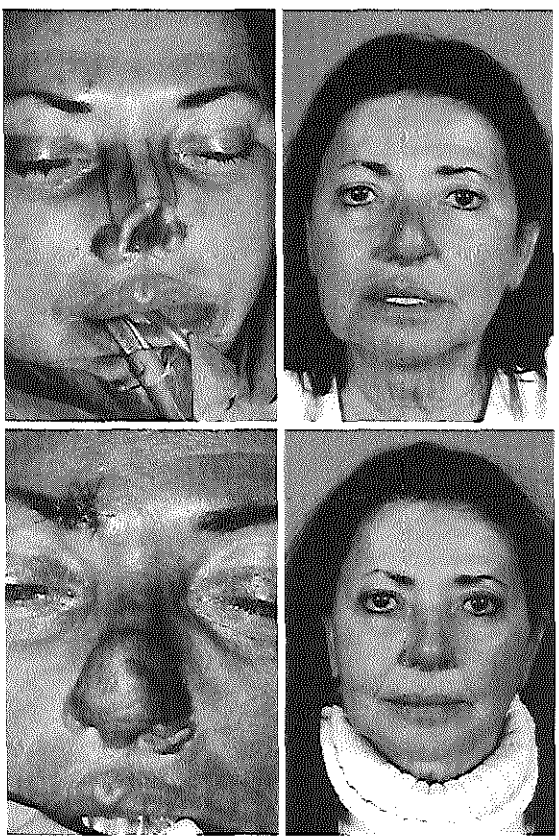

Figure 2. (**A**) Full thickness defect including the nasal tip, both alae nasi, and columella 5 months after radical excision of an aggressive keratoacanthoma which did not regress spontaneously in a 58-year-old woman (case 14, Table 2). (**B**) Left-sided ostium nasi stenosis, high riding left alar base, and lack of tip projection 11 months after reconstruction with mucoperichondrial and turnover skin flaps, septal and conchal cartilage grafts, and a paramedian forehead flap (**C**) A caudally based paranasal flap was transposed into the nasal floor while the alar base was transposed laterally to correct the stenosis. (**D**) Final result at 6 ½ months follow-up. The patient was very satisfied with nasal appearance and satisfied with nasal function.

Follow-up Results

Thirty-three patients (87%) participated in the follow-up study. Three patients refused to participate and two had died (one because of distant tumour metastasis). Mean follow-up period was 12 months (range, 6 to 35 months).

Subjective nasal function and satisfaction with appearance

Compared to before tumour resection and nasal reconstruction 31% reported to have more airway passage difficulties, 22% to have mucosal crusts or dry mucosa more often, 16% to have more difficulty smelling odours, 13% to snore more often, and 6% to have spontaneous nose bleedings more often. Phonation was unchanged in all 33 patients. Eighty-one percent reported to be (very) satisfied with nasal functioning (mean, 4.4; 1=very dissatisfied and 5=very satisfied).

Table III shows satisfaction results with the appearance of different reconstructed nasal units and donor-site scars. In general patients were most satisfied with flap colour match and appearance of the reconstructed nasal tip and least satisfied with ostium nasi size and flap hair growth (Table III). A total of 19 (10 male, 9 female) of 31 patients with a forehead, nasolabial, or free radial forearm flap showed flap hair growth. Eight out of these 19 patients were treated with Ruby laser hair removal therapy. Mean satisfaction with flap hair growth was lower following nasolabial flap reconstruction (2.0, range 1 to 5) compared to forehead flap reconstruction (3.7, range 1 to 5; Mann Whitney U test, Z=-2.0, p=0.046). Seventy-nine percent reported to be (very) satisfied with total nasal appearance. Subjective satisfaction with donor-site scars was generally very high (Table III). There was no statistically significant difference in satisfaction with total nasal appearance, flap colour match, and flap donor-site scars between the forehead and nasolabial flap reconstruction patients (Mann Whitney U tests, p=0.457, p=0.457, and p=0.595, respectively).

Objective nasal function and appearance

Six of 22 patients (27%) with a reconstructed ala nasi showed alar collaps during forced inspiration compared to two of 10 patients (20%) with a normal ala nasi (Fisher's exact test, p=1.000). Only one of these patients had unilateral airway passage difficulties during normal nasal respiration. None of the patients had symptoms of nasal whistling during phonation or respiration. Anterior rhinoscopy revealed dry mucosa in 15%, mucosal crusts in 36%, and mucosal adhesions/synechiae in none of all 33 patients.

Table III. Satisfaction with appearance of reconstructed nasal subunits and donor-site scars in 33 patients

(Very) satisfied with appearance of	N/Total number of patients*	Percentage
Reconstructed nasal tip	17/21	81
Reconstructed ala nasi	17/25	58
Reconstructed nasal dorsum	11/15	73
Reconstructed ostium nasi size	14/27	52
Flap colour match	27/33	82
Flap hair growth	6/19	32
Total nasal appearance	26/33	79
Donor-site		
Forehead/nasolabial fold scar	25/31	81
Ear scar	21/22	96
Chest scar	9/9	100
Brow appearance	20/25	80

*Total number of patients in whom the item is applicable.

Flap colour match was good in 20 patients (61%), moderate in 12 subjects (36%), and poor in one case (forehead flap in severely damaged skin following previous irradiation). Flaps were considered too thick in 19 of 33 patients, six of whom had already been scheduled for further flap thinning. Fifty-six percent of the forehead flaps compared to 80% of the nasolabial flaps were considered too thick (Fisher's exact test, p=0.622). Nasal scars were on the aesthetic subunit border in 21 patients (64%). When looked at critically, reconstructed ostium nasi size was smaller compared to the contralateral normal situation in 17 of 22 patients (77%), one of whom was treated for ostium nasi stenosis (10 patients in total, see Table II). Critical analysis also showed a thicker reconstructed alar rim and minor alar rim retraction in 19 (86%) and 10 (46%) cases, respectively (for typical examples, see Figures 3a through 4d). Mean satisfaction with total nasal appearance (3.6, range 1 to 5) as scored by the independent investigator was statistically significant lower compared to mean patient satisfaction (4.2, range 1 to 5; Mann Whitney U test, Z=-2.4, p=0.015).

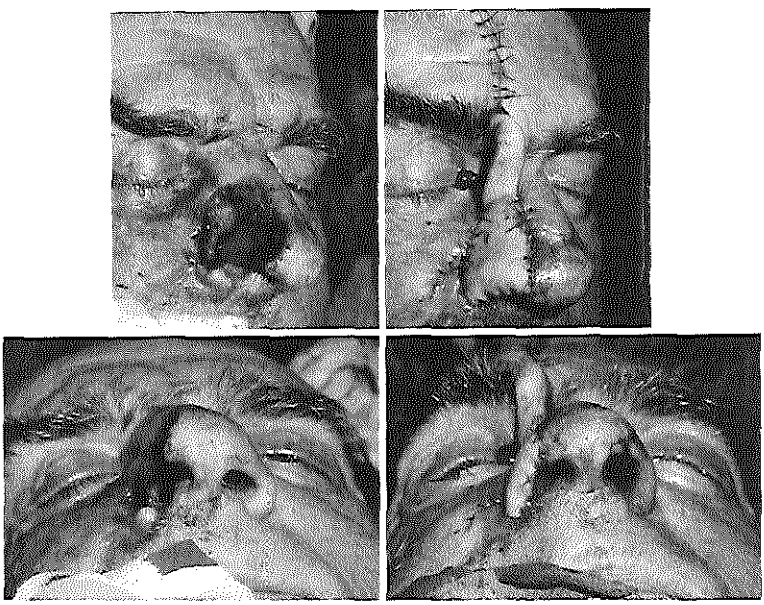

Figure 3. (A,B) Full thickness nasal defect including the right ala nasi and lateral sidewall after radical excision of a recurrent squamous cell carcinoma in a 75-year-old man. (C,D) Immediately after reconstruction with a paramedian forehead flap in combination with a composite septal swing and mucoperichondrium flap, and conchal cartilage grafts.

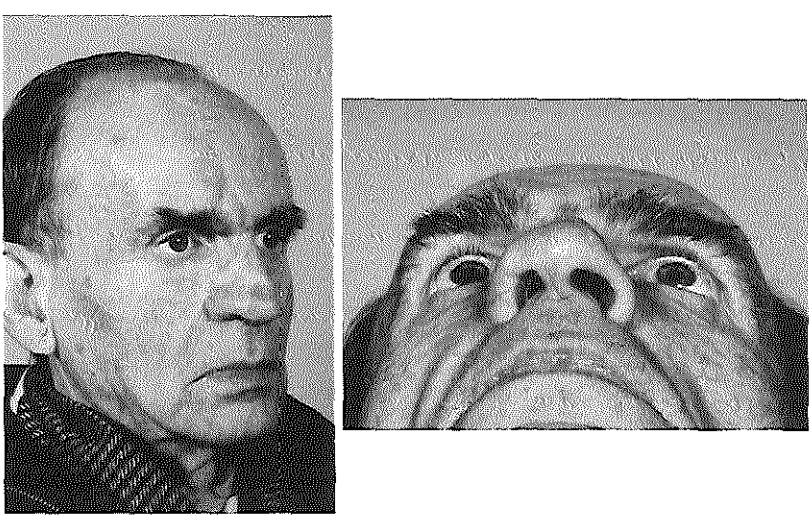

Figure 4. (A,B) Final result at 9 months follow-up after forehead flap inset and thinning during two separate procedures. At critical analysis, the right-sided reconstructed alar rim was scored as thicker than the contralateral normal one. The patient reported to be very satisfied with nasal appearance and function.

Another challenging problem is alar rim thickness. This problem improved in our series when we changed from a two-stage to a three-stage forehead flap approach, which allowed safer and more radical thinning. This needs to be combined with strategically positioned quilting sutures.

A mean number of three operations per patient were necessary to reach an acceptable aesthetic and functional result, which is comparable to other investigators reporting a mean number of 2.5 operations per patient, [12] necessary secondary revisions in 11% to 54%, [13,16] and one to three operations in 81% of all patients to reach optimal results. [10] It is important to emphasize that most of our patients were satisfied with their reconstructive outcome and refused further surgery after their forehead flap pedicle had been severed. This was somewhat to our discontent, since we sought for perfection in our surgical results. In general, we feel it is difficult to reach perfection in just a three-stage operation. A number of more critical patients, however, still wished further nasal improvement. These patients usually will need one or more additional surgeries to reach a more perfect result.

A total of 81% of all patients reported to be (very) satisfied with nasal function (mean, 4.4), which is in accordance with other investigators who also reported a mean satisfaction of 4.4 on comparable 5-point Likert scales. [12,14] Phonation was unchanged in all patients, 31% experienced more airway passage problems, and 22% reported to have mucosal crusts more often compared to before surgery. These results are in line with a previous study on subjective nasal function after reconstruction. [15] Twenty-seven percent of the patients with a reconstructed ala nasi showed alar collaps during forced inspiration compared to 20% with a normal ala nasi. Only one of these patients had unilateral airway passage difficulties during normal nasal respiration. These findings cast doubt upon the clinical usefulness of this test, which together with the Cottle test is promoted to detect nasal valve pathology. [19] It may be better to use cotton tip applicators to look for internal valve pathology. [21] We feel that objective measures for nasal valve patency still do not exist and that using self-report visual analogue scales may be more reliable. Although composite septal transposition flaps were used in seven instances resulting in a monolocular intranasal cavity, which may be a risk factor for nasal whistling sounds during phonation or respiration, none of the patients showed such symptoms. The relatively high incidence of dry mucosa and crusts, however, shows that the nasal air humidification mechanism may sometimes be affected or even impaired despite these efforts to reconstruct nasal lining.

A total of 79% of all patients were (very) satisfied with their nasal appearance, which is comparable to earlier reports in literature. [12,13,15] Other investigators either provided no data [10] or stated that "high aesthetic and functional goals were met in all patients" without further clarification. [16] In the present series patients were most satisfied with flap colour

match and appearance of the reconstructed nasal tip, and they were least satisfied with the occurrence of flap hair growth, ostium nasi size, and ala nasi shape. These results corroborate the results from an earlier report where patients reported to be least satisfied with nostril size and alar notching, [12] which is another indication that these structures are most difficult to reconstruct successfully.

Flap colour match was poor in one case in whom a forehead flap was used to reconstruct a nasal defect in severely damaged and discoloured (para)nasal skin following previous radiotherapy. Flaps were considered too thick in 58% without a statistically significant difference between the flaps used. Especially when the nasal skin is very thin in combination with delicate nasal cartilage contours, it is very challenging to obtain an adequate flap thickness, which often involves two or more additional flap thinning procedures. When looked at critically, reconstructed ostium nasi size, reconstructed alar rim thickness, and minor alar rim retraction were recurrent problems as discussed above. Moderate to severe alar notching was also previously found in 46% and 65% of all patients following ala nasi reconstructions using nasolabial and forehead flap, respectively. [12] Despite the liberal use of alar batten cartilage grafts in the current series, it remains very difficult to prevent the circular scar contraction forces from retracting and narrowing the ala nasi.

In the current study no statistically significant differences were found in satisfaction with total nasal appearance, flap colour match, and flap donor-site scars between the forehead and nasolabial flap reconstruction patients. These results contradict earlier results of two papers investigating a possible difference in aesthetic results between nasolabial and forehead flap reconstructions: both studies concluded that better results were obtained with nasolabial flap reconstructions. [11,12] Uchinuma et al. speculated that anatomical differences of the face between Caucasians and Orientals may be an explanation for this difference, since their study population only consisted of Japanese patients. [11] Another more general explanation may be that defects reconstructed with forehead flaps are typically larger and more complex, which makes any comparison difficult. Ideally, for a valid and reliable comparison between forehead and nasolabial flap reconstructions, size, depth, and location of defects should be standardized or statistically controlled for.

Similar to Drisco et al. [15] mean satisfaction with total nasal appearance as scored by the independent investigator was statistically significant lower compared to mean patient satisfaction in our series. Apparently, nasal reconstruction patients generally seem to be less critical about the aesthetic result compared to professionals.

In conclusion, although objective functional and aesthetic outcome following nasal reconstruction sometimes shows impairment compared to the normal situation, it leads to a high subjective patient satisfaction with function and aesthetics.

REFERENCES

1. McDowell, F. The classic reprint. Ancient ear-lobe and rhinoplastic operations in India. Plast. Reconstr. Surg. 1969; 43: 512.
2. Tagliacozzi, G. De Curtorum Chirurgia per Insitionem. Venice, Italy: Bindoni, 1597.
3. Washio, H. Retroauricular-temporal flap. Plast. Reconstr. Surg. 1969; 43: 162.
4. Menick, FJ. Nasal reconstruction: forehead flap. Plast. Reconstr. Surg. 2004; 113: 100e.
5. Burget, GC and Menick, FJ. Nasal support and lining: the marriage of beauty and blood supply. Plast. Reconstr. Surg. 1989; 84: 189.
6. Burget, GC, and Menick, F J. Nasal reconstruction: seeking a fourth dimension. Plast. Reconstr. Surg. 1986; 78: 145.
7. Millard, DR. Aesthetic reconstructive rhinoplasty. Clin. Plast. Surg. 1981; 8: 169.
8. Burget, GC and Menick, FJ. The subunit principle in nasal reconstruction. Plast. Reconstr. Surg. 1985; 76: 239.
9. Burget, GC and Menick, FJ. Aesthetic Reconstruction of the Nose, stad: C. V. Mosby, 1994.
10. Rohrich, RJ, Griffin, JR Ansari, M, et al. Nasal reconstruction – beyond aesthetic subunits: a 15-year review of 1334 cases. Plast. Reconstr. Surg. 2004; 114: 1405.
11. Uchinuma, E, Matsui, K, Shimakura, Y, et al. Evaluation of median forehead flap and the nasolabial flap in nasal reconstruction. Aesth. Plast. Surg. 1997; 21: 86.
12. Arden, RL, Nawroz-Danish, M, Yoo, GH, et al. Nasal alar reconstruction: a critical analysis using melolabial island and paramedian forehead flaps. Laryngoscope 1999: 109: 376.
13. Singh, DJ and Bartlett SP. Aesthetic considerations in nasal reconstruction and the role of modified nasal subunits. Plast. Reconstr. Surg. 2003; 111: 639.
14. Quatela, VC, Sherris, DA and Round, MF. Esthetic refinements in forehead flap nasal reconstruction. Arch. Otolaryngol. Head Neck Surg. 1995; 121: 1106.
15. Drisco, BP, and Baker, SR. Reconstruction of nasal alar defects. Arch. Facial Plast. Surg. 2001; 3: 91.
16. Boyd, CM, Baker, SR, Fader, DJ, et al. The forehead flap for nasal reconstruction. Arch. Dermatol. 2000; 136: 1365.
17. Hofer, SOP, Posch, NAS, and Smit, X. The facial artery perforator flap for reconstruction of perioral defects. Plast. Reconstr. Surg. 2005; 115: 996.
18. Menick, FJ. A 10-year experience in nasal reconstruction with the three-stage forehead flap. Plast. Reconstr. Surg. 2002; 109: 1839.
19. Howard, BK and Rohrich, RJ. Understanding the nasal airway: principles and practice. Plast Reconstr. Surg. 2002; 109: 1128.
20. Walton, RL, Burget, GC and Beahm, EK. Microsurgical reconstruction of the nasal lining. Plast. Reconstr. Surg. 2005; 115: 1813.
21. Khosh, MM, Jen, A, Honrado, C, et al. Nasal valve reconstruction. Experience in 53 consecutive cases. Arch. Facial Plast. Surg. 2004; 6: 167.

Chapter 4

Aesthetic outcome after nasal reconstruction: Patient versus panel perception

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ABSTRACT

Background Nasal reconstruction after extensive ablative therapy poses a reconstructive challenge. Aim of this study was to assess subjective aesthetic outcome after nasal reconstruction scored by patients and a panel. In addition, inter-rater variability as well as important parameters of good aesthetic outcome were analysed.

Methods A total of 39 consecutive patients treated between November 2001 and May 2005 for (sub) total nasal defects were included. All patients were photographed in a standardised setting. Subjective aesthetic outcome (eight different nasal characteristics on a 5-point Likert scale) was assessed by reconstructed patients individually as well as an independent professional panel consisting of 5 plastic surgeons

Results Thirty-three patients (87%) participated in the follow-up study. Questionnaire results demonstrated statistically significant lower panel satisfaction scores (3.5±0.9) with total nasal appearance than patients (4.2±1.3; p=0.03). There was a high agreement among panel members as judged by a low inter-rater variability. No relationship between severity of nasal defects and aesthetic outcome was found by patients or professionals.

Conclusion Patient subjective aesthetic outcome was significantly higher than that of a professional panel. Severity of nasal deformity was not an indicator for patient satisfaction.

INTRODUCTION

Nasal reconstruction after extensive ablative therapy poses a reconstructive challenge. Although evaluation of aesthetic outcome is of great importance, the emphasis in literature is mainly focused on surgical refinements of nasal reconstruction. [1-3] Only few papers have been published on long term subjective aesthetic outcome after nasal reconstruction. [4-10] Outcome assessment can provide evidence to improve clinical decisions. In addition, patient satisfaction is one of the predominant factors to determine success of plastic surgery in general. [11]

Evaluation of aesthetic outcome after nasal reconstruction is difficult. There are different systems to measure aesthetic outcome, such as anthropometric measurements using interfacial ratios and angels, [12] patient self reports, [11] and panel assessments. [6-8, 10,11] There is no gold standard for outcome evaluation of a successfully reconstructed nose. Obviously a successful nasal reconstruction would be an exact copy of what is missing. The purpose of the current study was to evaluate subjective aesthetic outcome after nasal reconstruction using patient self reports as well as panel assessments. Differences in subjective aesthetic outcome after nasal reconstruction as judged by patients and an independent panel were investigated. In addition, the severity of nasal defects was correlated with patient and panel satisfaction and established landmarks of nasal anatomy were evaluated as parameters of good aesthetic outcome.

PATIENTS AND METHODS

Patient Sample Characteristics

The patients of the present study are part of a larger follow-up study on different aspects of nasal reconstruction. A total of 39 consecutive patients treated between November 2001 and May 2005 for (sub) total nasal defects were included. There were 22 male and 17 female patients; their age ranged from 35 to 87 years (mean, 62 years ±SD 15 years). Thirty-four patients had a defect following radical tumour resection and 5 patients had a defect caused by miscellaneous conditions requiring reconstruction.

According to the aesthetic subunit principles, [1] table I shows the number of subunits involved, the extent of the defects, and the most typically involved subunits. Skin defects were reconstructed with paramedian forehead flaps in 33 patients, with cranially based nasolabial flaps in six patients, and with a free radial forearm flap in one patient. [6]

Table I. Extent of defect and number of aesthetic nasal subunits involved in 39 nasal reconstructed patients.

	N=39	%
Extent of nasal defect		
Skin	5	13
Skin + Cartilage	8	21
Skin + Cartilage+ Mucosa	26	66
Number of involved aesthetic subunits		
1	6	16
2	14	37
3-7	19	47
*Affected aesthetic subunit**		
Ala nasi	25	64
Nasal tip	21	45
Lateral side wall	18	46
Nasal dorsum	15	38
Columella	11	28
Paranasal cheek	7	18
Upper lip	5	13

* In 33 patients more than one subunit was involved.

Assessment of Aesthetic Outcome after Nasal Reconstruction

Subjective satisfaction with nasal appearance was assessed with a standardised structured questionnaire with eight preformulated questions. The patients as well as a panel consisting of five independent plastic surgeons were asked to score satisfaction with the appearance of six different nasal characteristics (nasal tip, ala nasi, nasal dorsum, nostril size, flap colour match, and total nasal appearance) and donor-site scars (forehead or nasolabial scar, eyebrow appearance) using a 5-point Likert scale (1=very dissatisfied; 5= very satisfied).

Mean panel satisfaction scores were computed by adding the raw item scores of each panel member divided by five (=total number of panel members).

Evaluation of Anatomical Landmarks as Common Parameters of Good Aesthetic Outcome

Satisfaction with seven items for each reconstructed nose were scored: nasal tip, ala and dorsum, nostril size, colour match, donor site scars and eyebrow appearance. In addition, satisfaction with total nasal appearance was scored. Each item was scored using a 5-point Likert scale. A Spearman correlation coefficient was computed for each landmark to investigate which of these anatomical landmarks had the largest effect on total aesthetic outcome.

Procedure

A letter was mailed to all patients explaining the study and asking them to participate. All consenting patients were invited to the outpatient clinic for a standardised interview, physical examination, and clinical photographs of their face. All patients had standardised pre-, intra- and postoperative photographs taken, each containing in total seven pictures of the face and nose. These photographs were saved on a CD-rom and sent to all panel members together with a standardised structured questionnaire similar to the patients' version to complete.

Statistical Analysis

Patient and panel scores were compared using Wilcoxon signed ranks tests. Possible effects of each panel member were analysed with Friedman's tests. Inter-rater variability was determined by computing interclass correlation coefficient. [13.14] To study relationships between different nasal characteristics and total nasal appearance bivariate Spearman correlation coefficients were computed. Two-tailed probabilities

<0.05 were accepted as statistically significant. Version 11.0 of the computer program SPSS (SPSS Inc, Chicago, Illinois) was used for statistical analyses.

RESULTS

Thirty-three patients (87%) participated in the follow-up study. Four patients refused to participate and two had died. Mean follow-up period was 12 months (range 6 to 35 months).

Mean satisfaction with different reconstructed nasal subunits and donor-site scars is presented in table II. Mean total nasal appearance score of the panel was significantly lower compared to the patients (3.5±0.9 vs. 4.2 ±1.3, Mann Whitney U test, p=0.031). Patient and panel perception can differ completely as illustrated in figure 1 (patient was dissatisfied and

panel satisfied) and figure 2 (patient was satisfied and panel dissatisfied). The panel scored four items significantly lower compared to the patients (nasal tip, colour match, donor site scars, and total nasal appearance, see table II). Remaining items were also assessed more negatively by the panel but did not statistically differ from patient assessment. In general, patients were most satisfied with flap colour match and appearance of the reconstructed nasal tip. The panel was in general most satisfied with the appearance of nasal tip and eyebrows. Nostril size and ala nasi received the lowest ratings from both panel and patients.

In Table III relationships between different subunits, colour match, and satisfaction with total nasal appearance are shown. There was a statistically significant positive correlation between all different subunits and total nasal appearance except for ala nasi appearance within the patient group. The highest correlations were found between nasal dorsum and total nasal appearance in the patient group (r_s=0.92). In the panel the highest correlation with total nasal appearance was seen for colour match (r_s=0.73) and ala nasi (r_s=0.61).

No statistically significant differences in patient and panel satisfaction could be found between patients with skin, skin and cartilage, or full thickness defects, indicating the lack of correlation between severity of preoperative nasal defect and perceived aesthetic outcome.

An interclass correlation (ICC) coefficient per question was calculated for the panel to evaluate inter rater variability (a value of zero means no agreement between at least 3 or more different raters and a value of one means 100% agreement between at least 3 different raters). ICC values ranged between 0.75 and 0.94 (data not shown) proving there was a high level of agreement among the five different panel members.

Table II. Mean satisfaction with appearance of reconstructed nasal subunits and donor-site scars in 33 patients.

Satisfaction with†	Patiënt (SD)	Panel (SD)	Z-value§	N*	P-value
Nasal tip	4.4 (1.2)	3.9 (0.6)	-2.749	21	0.048
Ala Nasi	3.9 (1.4)	3.2 (1.2)	-2.497	25	NS
Nasal dorsum	4.1 (1.6)	3.8 (1.2)	-1.109	15	NS
Nostril Size	3.5 (1.5)	3.0 (1.4)	-0.269	27	NS
Colour Match	4.3 (1.3)	3.7 (1.2)	-2.424	33	0.017
Donor site scars	4.3 (1.2)	3.8 (0.9)	-2.248	31	0.029
Eyebrow appearance	4.3 (1.2)	3.9 (1.1)	-0.808	25	NS
Total nasal appearance	4.2 (1.3)	3.5 (0.9)	-2.564	33	0.031

§Mann-Whitney U test.

*Total number of patients in whom the item is applicable.

† 5-point Likert scale (1= very dissatisfied; 5= very satisfied).

Figure 1. Each patient was presented to members of the panel using 7 standardised photographs on CD-rom. The panel members could allocate a score of 1=very dissatisfied to 5=very satisfied. Example of a patient who reported a 2 (dissatisfied) for her total nasal appearance in contrast to the panel which allocated a mean score of 5 (very satisfied).

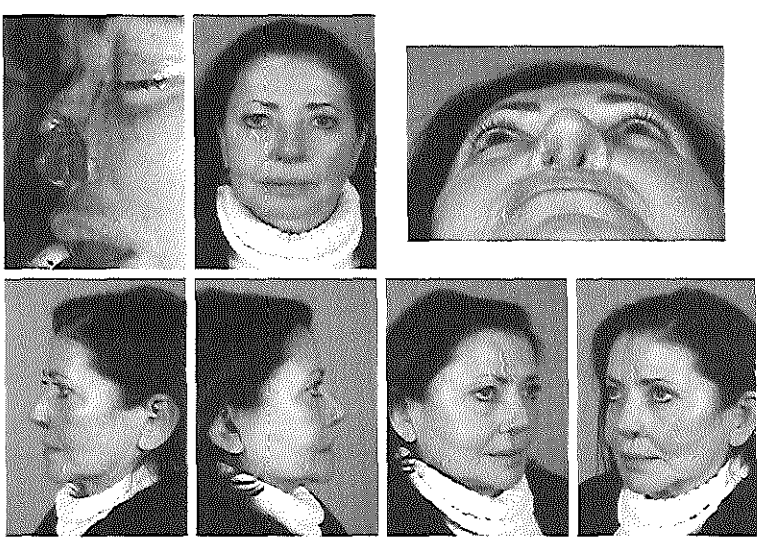

Figure 2. Each patient was presented to members of the panel using 7 standardised photographs on CD-rom. The panel members could allocate a score of 1=very dissatisfied to 5=very satisfied. Example of a patient who was very satisfied (score of 5) with her total nasal appearance in contrast to the panel which gave a mean score of 2.6 (dissatisfied).

Table 3. Correlations between satisfaction with nasal subunits and total nasal appearance.

Nasal sub unit	Spearman Correlation Coefficient	
	Patient	Panel
Nasal tip	0.59*	0.44*
Ala Nasi	0.36	0.61**
Nasal dorsum	0.92**	0.56*
Nostril Size	0.43*	0.46*
Colour Match	0.39*	0.73**

* Statistically significant at the 0.05 level (2-tailed).

** Statistically significant at the 0.01 level (2-tailed).

DISCUSSION

The present study assessed subjective aesthetic outcome following (sub)total nasal reconstruction in 33 patients with a mean follow-up of 12 months. Outcome was assessed by patients as well as an independent panel consisting of five plastic surgeons.

In almost half of the patients three or more aesthetic nasal subunits were involved and in two-thirds a full thickness nasal defect requiring reconstruction of all three layers was present. Most patients had an average of three operations to reach their desired aesthetic result (but not necessarily the surgeon's desired end-result), leading to a high mean subjective patient satisfaction with total nasal appearance (4.2 on a five point Likert scale). Patient scores were comparable to those of previous reports, where 81% to 96% of patients studied were very satisfied after nasal reconstruction. [7,10,15] Arden reported 27 of 33 patients were satisfied following reconstruction of an alar defect similar to Drisco who noted that 25 of 26 patients judged their result as good or excellent. [7,10] Arden divided his patients into two reconstruction types, leading to two very small groups which could not be evaluated statistically. Singh et al. [15] found excellent aesthetic results in 82% of 76 nasal reconstructions, however, no statistical analyses were presented. In general, nasal reconstruction is reported to lead to a high subjective patient satisfaction. This high patient satisfaction rate may be the combined result of an adequate nasal reconstruction for a nasal defect which preoperatively is considered as very hideous by the patients.

In the present study, the panel was significantly less satisfied with overall aesthetic outcome compared to patients. Most likely, the professional experience of plastic surgeons

leads to different expectations compared to patients. This could be because professionals react to improvements that could potentially be accomplished with additional surgery. In addition, professionals familiar with nasal reconstructions may focus exclusively on isolated features such as nasal alar asymmetries or nostril size instead of responding to the total face. The patient, on the other hand, might be more focused on the overall result. The current panel outcome is difficult to compare with previously published data, because of different panel compositions and different methods used. Only three other reports have actually used panels to assess subjective aesthetic outcome. [7,8,10] Drisco et al. had a panel consisting of one physician and two nurses. [10] They did not investigate the inter-rater variability. Quatela et al. used three otolaryngologists to assess aesthetic and functional results after nasal reconstruction. [8] On a five-point Likert scale an average score of 4.3 was measured for skin only and 3.8 for full-thickness defects. Their results differ from the current study; we could not find a relationship between extent of nasal defect and panel satisfaction. Arden et al. used three otolaryngologists to assess aesthetic results after nasal reconstruction. [7] With a mean patient satisfaction of 4.5 on a five point Likert scale their results corroborate our findings well. Unfortunately, the previous studies did not report the panel results in detail and inter-rater variability was not determined. In contrast, the panel of the present study consisted of five independent plastic surgeons with a very high level of agreement, increasing the reliability of the pooled panel results.

All five nasal subunits had a statistically significant positive correlation with total nasal appearance indicating that nasal reconstruction will be unsuccessful if a single detail is suboptimal. Nostril size and ala nasi appearance both received the lowest satisfaction scores from patients as well as panel (3.5±1.5 vs. 3.0±1.4 and 3.9±1.4 vs. 3.2±1.2, respectively) Therefore, these items may be the most important factors for judging nasal aesthetics since their appearance was more readily agreed upon by patients and panel. The rather low satisfaction scores are in line with our previous finding that an appropriate nostril size is very difficult to reconstruct. [6]

All measurements in this study were subjective. It would be interesting to translate this into an objective measurement with a validated scoring system. Ching et al. [11] reviewed articles which measured outcome in aesthetic surgery in general. They stated that instruments used to assess satisfaction in all these studies varied and that no appropriate instrument to directly evaluate patient satisfaction was found. Responses to such surveys are subjective and difficult to interpret, because they are a complex function of expectations that may vary greatly among individual patients with comparable outcomes.Future research should be aimed at the development and use of more standardised methods for assessing aesthetic

outcome. In this fashion it will be possible to improve comparison of different outcome studies. Furthermore, in addition to patient and professional opinions it seems relevant to be aware of the perception of non-professionals (general public), since patients have to deal with their reactions in daily life. According to social psychological models, facial appearance has a profound influence on people's social environments, which might influence their social and personality development. [16] No data are available for nasal reconstruction patients, but in cleft patients this has been reported previously. [17] Layman where more positive in their judgement towards facial appearance of cleft lip patients than professionals. This was attributed to the fact that unfamiliar judges respond more empathetically. On the other hand it is well known that facial appearance has an effect on what is expected from a person. In general, more positive qualities and abilities are attributed to attractive individuals. [18]

In conclusion, patient satisfaction with subjective aesthetic outcome after nasal reconstruction was significantly higher than that of a professional panel. Severity of nasal deformity was not an indicator for patient satisfaction. No single aesthetic subunit was most important for total aesthetic outcome indicating that every detail in nasal reconstruction is extremely important.

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REFERENCES

1. Burget GC and Menick FJ. The subunit principle in nasal reconstruction. Plast Reconstr Surg 1985; 76(2): 239-47.
2. Burget GC and Menick FJ. Nasal reconstruction: seeking a fourth dimension. Plast Reconstr Surg 1986; 78(2): 145-57.
3. Burget GC and Menick FJ. Nasal support and lining: the marriage of beauty and blood supply. Plast Reconstr Surg 1989; 84(2): 189-202.
4. Boyd CM, Baker SR and Fader DJ, et al. The forehead flap for nasal reconstruction. Arch Dermatol 2000; 136(11): 1365-70.
5. Rohrich RJ, Griffin JR and Ansari M, et al. Nasal reconstruction--beyond aesthetic subunits: a 15-year review of 1334 cases. Plast Reconstr Surg 2004; 114(6): 1405-16; discussion 1417-9.
6. Mureau MAM, Moolenburgh SE and Levendag PC, et al. Aesthetic and functional outcome following nasal reconstruction. Plast Reconstr Surg 2007; 120(5): 1217-27.
7. Arden RL, Nawroz-Danish M and Yoo GH, et al. Nasal alar reconstruction: a critical analysis using melolabial island and paramedian forehead flaps. Laryngoscope 1999; 109(3): 376-82.
8. Quatela VC, Sherris DA, and Rounds MF. Aesthetic refinements in forehead flap nasal reconstruction. Arch Otolaryngol Head Neck Surg 1995; 121(10): 1106-13.
9. Uchinuma E, Matsui K and Shimakura Y, et al. Evaluation of the median forehead flap and the nasolabial flap in nasal reconstruction. Aesthetic Plast Surg 1997; 21(2): 86-9.
10. Drisco BP and Baker SR. Reconstruction of nasal alar defects. Arch Facial Plast Surg 2001; 3(2): 91-9.
11. Ching S, Thoma A and McCabe RE, et al. Measuring outcomes in aesthetic surgery: a comprehensive review of the literature. Plast Reconstr Surg 2003; 111(1): 469-80.
12. Farkas LG, Kolar JC, and Munro IR. Geography of the nose: a morphometric study. Aesthetic Plast Surg 1986; 10(4): 191-223.
13. Perisic I and Rosner B. Comparisons of measures of interclass correlations: the general case of unequal group size. Stat Med 1999; 18(12): 1451-66.
14. Donner A, Eliasziw M, and Shoukri M. Review of inference procedures for the interclass correlation coefficient with emphasis on applications to family studies. Genet Epidemiol 1998; 15(6): 627-46.
15. Singh DJ and Bartlett SP. Aesthetic considerations in nasal reconstruction and the role of modified nasal subunits. Plast Reconstr Surg 2003; 111(2): 639-48; discussion 649-51.
16. Bull R and Rumsey N. Social psychology of facial appearance. 1988. New York: Springer-Verlag; 1988.
17. Eliason MJ, Hardin MA, and Olin WH. Factors that influence ratings of facial appearance for children with cleft lip and palate. Cleft Palate Craniofac J 1991; 28(2): 190-3.
18. Tobiasen JM. Social judgments of facial deformity. Cleft Palate J 1987; 24(4): 323-7.

Chapter 5

Facial attractiveness and abnormality of nasal reconstruction patients and controls assessed by laypersons

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ABSTRACT

Background The goal of nasal reconstruction after a partial or total amputation is to achieve a nasal appearance as natural and normal as possible. It is assumed that laypersons' opinion on facial appearance could affect patient satisfaction or self-concept. The aim of this study was to assess laypersons' opinion on aesthetic outcome of nasal reconstruction. This was compared with the opinion of a professional panel. Second, the effect of informing laypersons about the previous nasal reconstruction of patients on their assessment of facial attractiveness and abnormality was studied. Third, the effects of individual facial features on the assessment of facial attractiveness and abnormality were determined.

Methods A total of 39 consecutive patients treated between November 2001 and May 2005 for (sub) total nasal defects were included together with a control group of 39 persons without a facial deformity. A group of 20 randomly selected laypersons (10 men and 10 women) assessed facial appearance and abnormality of all 78 persons using standardised colour slides, not knowing who was a patient and who control. Two weeks later they were informed about the true study design and the same questions were asked. In addition, they assessed final treatment results of 39 patients.

Results No differences existed between assessment of aesthetic outcome after nasal reconstruction by laypersons and professionals (54% good to excellent). Patients were perceived significantly less attractive and more abnormal than controls. Prior knowledge had a significant positive effect on mean facial attractiveness and abnormality scores. High positive correlations were found between facial attractiveness and abnormality scores and the frequency of the item "nothing in particular", meaning if no particular facial feature was judged to be striking, a face was perceived more attractive and less abnormal.

Conclusion Nasal reconstruction patient were perceived significantly less attractive and more abnormal by laypersons than controls. Since faces without striking features were judged to be more attractive, the goal of nasal reconstruction would not only be to create a nose as normal as possible, but also as inconspicuous as possible.

INTRODUCTION

The nose is one of the most important features determining total facial appearance. A nasal defect cannot be camouflaged easily and has a huge effect on a patient's facial appearance. The goal of nasal reconstruction in patients after a partial or total amputation is to achieve a nasal appearance as natural and normal as possible.

Normal facial appearance is an important factor in our daily social interaction. Several psychological theories conclude that there is an interaction between patient and perceiver resulting in a self-fulfilling prophecy in which the patient incorporates the perceiver's expectations and behaviour into his or her self-concept. [1] In accordance with this theory a layperson's opinion on facial appearance after nasal reconstruction could therefore affect patient satisfaction or self-concept. However, studies on aesthetic outcome after nasal reconstruction have mainly focused on differences between surgeon and patient satisfaction without taking into account the perception of laypersons and its possible effect on patient satisfaction. [2-6]

The aim of this study was to assess laypersons' opinion on aesthetic outcome of nasal reconstruction. This was compared with the opinion of a professional panel. Second, the effect of informing laypersons about the previous nasal reconstruction of patients on their assessment of facial attractiveness and abnormality was studied. Third, the effects of individual facial features on the assessment of facial attractiveness and abnormality were determined.

MATERIALS AND METHODS

Design

A comparative design was used to evaluate the adult laypersons' first impression ratings of 39 nasal reconstruction patients and 39 persons without a facial deformity. At this time none of the laypersons were informed that the actual design of the study was to assess facial appearance of nasal reconstruction patients. Instead, they were informed that this study was about first impressions of facial appearances and none knew that any of the patients had been operated. Two weeks later the laypersons were informed that the study was actually about assessment of facial appearance of nasal reconstruction patients. They had to fill out the same questionnaire again and now were notified who were patients or controls. Informed consent was received from all clinical patients to utilise their photographs in the study.

Population and recruitment

Laypersons were recruited among 50 employees of our medical university who received a brochure in which they were informed about the research project and its purpose. Of the 25 respondents (17 responded voluntarily and 8 were approached) 10 men and 10 women were randomly selected. None of the laypersons were familiar with plastic surgery or any related field. Their age ranged from 24 to 60 years (mean, 39 years ±SD 12 years). Age, sex, and level of education were equally distributed between males and females. Since these variables had no statistically significant effect on facial attractiveness and abnormality assessment scores (data not shown), statistical controlling for these variables was not deemed necessary.

Patients in the present study were part of a larger follow-up study on different aspects of nasal reconstruction. A total of 39 consecutive patients treated between November 2001 and May 2005 for (sub) total nasal defects were included. There were 22 male and 17 female patients; their age ranged from 35 to 87 years (mean, 62 years ±SD 15 years). Thirty-four patients had a defect following radical tumour resection and 5 patients had a defect caused by miscellaneous conditions requiring reconstruction.

Skin defects were reconstructed according to the aesthetic subunit principles. [7] Paramedian forehead flaps were used in 33 patients, cranially based nasolabial flaps in six patients, and a free radial forearm flap in one patient.

In addition, 39 volunteers without facial deformities were recruited as controls. All patients visiting our plastic surgery outpatient clinic received a written form explaining the research project. The following inclusion criteria were used: no visible facial deformities and age between 35 to 87 years. In total, 48 people were contacted of whom 39 participated. Nine persons refused to participate because of lack of time. There were 14 male and 25 female controls; their age ranged from 35 to 85 years (mean, 56 years ±SD 11 years). The male/female distribution between patients and controls did not differ significantly. Mean age of patients was higher than that of controls (Student's t test, $p=0.001$).

After signing informed consent, six standardised medical photographs of the face were taken: two lateral views, one frontal view, two oblique views and one basal view. Medical photography was standardised. [8]

Slides

A standardised slide showing one frontal view, two oblique views and two lateral views was made of each of 78 participants (39 patients and 39 controls). These slides were combined at random in a PowerPoint (Microsoft 2003, Redmond, USA) slideshow. The same 15, 4" inch laptop screen was used for every layperson to assess facial appearance of 78 persons.

Rating procedure

The same experienced assessment instructor chaired every rating procedure. All instructions were standardised and read from a paper to make sure every layperson got the same information and they all received a questionnaire with 78 individual sheets corresponding with each slide. There was a no time-limited slide exposure.

Per slide three questions were asked. The first two questions were similar but had different answer options: "How would you assess the appearance of this face?" Possible extreme values were defined as "very abnormal" to "normal" for the first question and "very unattractive" to "very attractive" for the second. The third question was: "What is according to you the most striking feature of this face?" The first two questions could be answered on a Visual Analogue Scale (VAS) using a 10 centimetre line, without calibration. For the last question 6 possible answers were given: 1, nothing in particular; 2, eyes; 3, nose; 4, mouth; 5, ears; 6, something else. After two weeks every layperson was re-invited to score all slides again. However, now they were informed about which slides showed nasal reconstruction patients and controls. The same three questions were asked again and a fourth question was added; "How do you assess the result of treatment?", using a 4-point Likert-scale (1=excellent; 4=poor). Since in a previous study the same question was asked to a professional panel consisting of 5 independent plastic surgeons, [6] results could be compared.

Statistical analysis

To compare mean facial attractiveness and abnormality scores between laypersons and a professional panel Student's t-tests were used. The effect of prior knowledge on the assessment of facial attractiveness and abnormality was determined using Student's t-tests. To study the correlation between facial features and facial attractiveness and abnormality Spearman rank correlation coefficients were computed. Nominal answers of question three were converted to a binary score. Per patient the mean score of 20 laypersons was computed resulting in a score between 0 to1. A total mean score of 1 means that every layperson assessed that particular facial feature as most notable. This mean score was correlated with the mean score assessed by 20 laypersons on attractiveness and abnormality. To evaluate the effect of age, level of education, and sex Student's t-tests were used. Two-tailed probabilities <0.05 were accepted as statistically significant. Version 11.0 of the computer program SPSS (SPSS Inc, Chicago, Illinois) was used for statistical analyses.

RESULTS

No differences existed between assessment of aesthetic outcome after nasal reconstruction by laypersons and professionals. Laypersons judged aesthetic outcome "good to excellent" in 54%, "moderate" in 37%, and "poor" in 9% of nasal reconstruction patients. These results were 54%, 39%, and 7%, respectively as assessed by professionals (Chi-square test, p-value=0.68).

No statistically significant differences were found between reconstruction type and assessment of aesthetic outcome of nasal reconstruction patients, neither between reconstruction type and assessment of facial attractiveness and abnormality.

The effects of prior knowledge on mean facial attractiveness and abnormality scores of nasal reconstruction patients and controls assessed by 20 laypersons are shown in table I. After the laypersons had been informed which subjects were nasal reconstruction patients, their facial attractiveness as well as facial abnormality were assessed significantly better (table I). Interestingly, the same effect was noticed for controls (table I). Table I also shows a difference between patients and controls. Patients were judged significantly less attractive and more abnormal than controls.

Table II shows the effect of the extent of tissue defect on mean facial attractiveness and abnormality scores of nasal reconstruction patients. The larger the extent of tissue defect, the more abnormal a face was perceived. Similarly, mean facial attractiveness scores were lower when the tissue defect was full thickness, but this was not statistically significant (table II).

Table III shows the correlations between the frequencies of striking facial features and facial attractiveness and abnormality scores for patients as well as controls, stratified by the presence or absence of prior knowledge. High positive correlations were found between facial attractiveness and abnormality scores and the frequency of the item "nothing in particular", meaning if no particular facial feature was judged to be striking, a face was perceived more attractive and less abnormal. This was true for patients as well as controls (table III). If the nose was scored as most striking facial feature in patients, a negative correlation was seen with facial attractiveness (r=-0.34) and abnormality (r=-0.47). This means that these patients were perceived as less attractive and more abnormal. A negative correlation between the nose as most striking facial feature and facial attractiveness was also seen in controls (r=-0.31), but no correlation could be found with facial abnormality scores. Other facial features had no statistically significant correlations with assessment of facial attractiveness and abnormality. After laypersons were informed which subjects were nasal reconstruction patients and which were controls, all previously mentioned correlations increased and remained statistically significant (table III).

Table I. Mean facial attractiveness and abnormality scores of nasal reconstruction patients vs. controls assessed by 20 laypersons.

Group (N)	Without Prior Knowledge* Attractiveness† (SD)	Prior Knowledge§ Attractiveness† (SD)	p-value	Without Prior Knowledge* Abnormality¶ (SD)	Prior Knowledge§ Abnormality¶ (SD)	p-value
Patients (39)	3.79 (0.87)	4.15 (0.46)	<0.0001	4.82 (1.42)	5.26 (0.61)	<0.0001
Controls (39)	5.51 (0.90)	6.05 (0.42)	<0.0001	7.29 (0.85)	7.88 (0.53)	<0.0001
p-value	<0.0001	<0.0001		<0.0001	<0.0001	

*No prior knowledge of previous nasal reconstruction of patients.

§Raters were informed which subject was a nasal reconstruction patient and which was a control

†Attractiveness VAS score 0-10 (0 = very unattractive; 10 = very attractive)

Abnormality VAS score 0-10 (0 = very abnormal; 10 = normal)

¶Abnormality VAS score 0-10 (0 = very abnormal; 10 = normal)

Table II. Mean facial attractiveness and abnormality scores of 39 nasal reconstruction patients by extent of tissue defect.

	Skin (5)	Skin and cartilage (8)	Skin, cartilage and mucosa (26)	p-value
Attractiveness† (SD)	4.32 (0.47)	3.77 (1.10)	3.64 (0.82)	NS
Abnormality¶ (SD)	6.29 (0.55)	4.93 (1.58)	4.46 (1.34)	0.027

†Attractiveness VAS score 0-10 (0=very unattractive; 10=very attractive)

¶Abnormality VAS score 0-10 (0=very abnormal; 10=normal)

Table III. Spearman correlations coefficients between facial features and facial attractiveness and abnormality scores of 39 nasal reconstruction patients and 39 controls assessed by 20 laypersons.

Without Prior Knowledge				
Controls	**Attractiveness†**	**p-value**	**Abnormality¶**	**p-value**
Nothing in particular	0.49	0.001	0.52	0.001
Eyes	-0.24	NS	-0.25	NS
Nose	-0.31	0.057	-0.08	NS
Mouth	0.18	NS	0.22	NS
Ears	-0.17	NS	-0.12	NS
Patients	**Attractiveness†**	**p-value**	**Abnormality¶**	**p-value**
Nothing in particular	0.76	<0.0001	0.84	0.000
Eyes	0.01	NS	-0.11	NS
Nose	-0.34	0.035	-0.47	0.003
Mouth	-0.18	NS	-0.17	NS
Ears	0.02	NS	0.15	NS
Prior Knowledge				
Controls	**Attractiveness†**	**p-value**	**Abnormality¶**	**p-value**
Nothing in particular	0.65	<0.0001	0.57	<0.0001
Eyes	-0.07	NS	-0.16	NS
Nose	-0.46	0.003	-0.35	0.029
Mouth	0.16	NS	0.28	NS
Ears	-0.18	NS	-0.13	NS

Table III Continued

Patients	Attractiveness†	p-value	Abnormality¶	p-value
Nothing in particular	0.75	<0.0001	0.87	<0.0001
Eyes	0.20	NS	0.17	NS
Nose	-0.46	0.003	-0.52	0.003
Mouth	0.07	NS	-0.08	NS
Ears	-0.06	NS	0.06	NS

† Attractiveness VAS score 0-10 (0=very unattractive; 10=very attractive)

¶ Abnormality VAS score 0-10 (0=very abnormal; 10=normal)

DISCUSSION

The first aim of this study was to assess laypersons' opinion on aesthetic nasal reconstruction and compare this with the opinion of a professional panel. Laypersons and professionals gave comparative ratings when assessing aesthetic outcome of nasal reconstruction patients. These patients have not been studied in this fashion before. Similar studies, however, have been performed in cleft patients showing contradictory results. [9] In one study laypersons rated aesthetic outcome of cleft surgery more positively than professionals, [9] while Kane et al. reported no difference in outcome between laypersons and professionals. [10] In spite of these different results, though, both authors concluded that plastic surgeons should pay more attention to their patients' point of view when planning a surgical intervention.

Findings in the current study indicate that a layperson's view is not comparable to a patient's view since papers on aesthetic outcome after nasal reconstruction in general report high patient-satisfaction scores varying from satisfied to very satisfied. [3,5,11] These findings are in contradiction with the psychological theory that a layperson's opinion on facial appearance after nasal reconstruction could affect patient satisfaction through patient perceiver-interaction and/or self-concept. [1]

The second aim of this study was to determine the effect of laypersons' prior knowledge of previous nasal reconstruction of patients on their assessment of facial attractiveness and abnormality. The influence on outcome assessment through bias of prior knowledge is basis of psychological theories in which familiarity with the cause of a different appearance will result in a more positive judgement of it. [1] After laypersons were de-blinded and informed on patients' and controls' history, patient-ratings improved significantly in both groups, during the second assessment. The patient group had a significantly better improvement than controls. These findings, therefore, are in concordance with above-mentioned theories.

The third aim of this study was to assess the effect of individual facial features on the assessment of facial attractiveness and abnormality. A reconstructed nasal defect is a single facial disfigurement, which had a significant negative effect on facial attractiveness and assessment of facial abnormality as judged by laypersons. This was a novel finding for this type of facial disfigurement and is in contrast to a previous report which stated that multiple facial disfigurement was responsible for negative outcome judgement. [12] Also the extent of the tissue defect had a negative effect on laypersons' assessment of facial abnormality. In those cases patients were more critical and less satisfied, especially with their reconstructed nostril size and alar notching. [2,11] This was also reflected in a more negative evaluation of these patients by a professional panel. [6] This indicates that full thickness nasal alar defects are technically very challenging to reconstruct.

Different facial features have a different effect on assessment of facial attractiveness and facial abnormality. Nasal size is one of the main features, which influences assessment of facial attractiveness. A small nose has a positive effect on ratings of facial attractiveness. [13,14] In agreement with these current opinions, our study showed a significant difference in facial attractiveness and facial abnormality if the nose was perceived as the most striking facial feature of patients and controls. Although eyes and cheeks were also seen as predictors of facial attractiveness, [13,14] any other facial features besides the nose, showed no statistically significant correlation with facial attractiveness or abnormality in our study.

A "close-to-average" face is assessed as more attractive. [13,14] Results of the present study confirm this statement: if laypersons scored "nothing-in-particular" of the face was striking, a significant positive correlation with facial attractiveness existed. In addition, these faces were also assessed as less abnormal.

In conclusion, nasal reconstruction patients were assessed significantly less attractive and more abnormal by laypersons than controls. In addition, if the nose was perceived as the most striking facial feature, patients as well as controls were scored less attractive and more abnormal. Since faces without striking features were assessed as more attractive, the goal of nasal reconstruction would not only be to create a nose as normal as possible, but also as inconspicuous as possible.

DISCLOSURE

Hofer hereby declare that they have no financial interest in any product, device, or procedure used in the present report.

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REFERENCES

1. Bull R and Rumsey N. Social psychology of facial appearance. New York: Springer Verlag; 1988.
2. Arden RL, Nawroz-Danish M, Yoo GH, Meleca RJ and Burgio DL. Nasal alar reconstruction: a critical analysis using melolabial island and paramedian forehead flaps. Laryngoscope 1999; 109: 376-82.
3. Singh DJ, Bartlett SP. Aesthetic considerations in nasal reconstruction and the role of modified nasal subunits. Plast Reconstr Surg 2003; 111: 639-48.
4. Quatela VC, Sherris DA and Rounds MF. Aesthetic refinements in forehead flap nasal reconstruction. Arch Otolaryngol Head Neck Surg 1995; 121: 1106-13.
5. Drisco BP and Baker SR. Reconstruction of nasal alar defects. Arch Facial Plast Surg 2001; 3: 91-9.
6. Moolenburgh SE, Mureau MAM and Hofer SOP. Aesthetic outcome after nasal reconstruction:Patient versus panel perception. J Plast Reconstr Aesthet Surg. 2008;61(6):676-80.
7. Burget GC, Menick FJ. The subunit principle in nasal reconstruction. Plast Reconstr Surg 1985; 76: 239-47.
8. Galdino GM, Vogel JE and Vander Kolk CA. Standardizing digital photography: it's not all in the eye of the beholder. Plast Reconstr Surg 2001; 108: 1334-44.
9. Eliason MJ, Hardin MA and Olin WH. Factors that influence ratings of facial appearance for children with cleft lip and palate. Cleft Palate Craniofac J 1991; 28: 190-3.
10. Kane AA, Pilgram TK, Moshiri M and Marsh JL. Long-term outcome of cleft lip nasal reconstruction in childhood. Plast Reconstr Surg 2000; 105: 1600-8.
11. Mureau MAM, Moolenburgh SE, Levendag PC and Hofer SOP. Aesthetic and functional outcome following nasal reconstruction. Plast Reconstr Surg 2007; 120: 1217-27.
12. Okkerse JM, Beemer FA and Cordia-de Haan M, et al. Facial attractiveness and facial impairment ratings in children with craniofacial malformations. Cleft Palate Craniofac J 2001; 38: 386-92.
13. Baudouin JY and Tiberghien G. Symmetry, averageness, and feature size in the facial attractiveness of women. Acta Psychol (Amst) 2004; 117: 313-32.
14. Honn M and Goz G. The Ideal of Facial Beauty: A Review. J Orofac Orthop 2007; 68: 6-16

Chapter 6

The impact of nasal reconstruction following tumour resection on psychosocial functioning, a clinical-empirical exploration

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ABSTRACT

Objective Total or partial nasal amputation following tumour resection is one of the more severe facial disfigurements. Successful nasal reconstruction can therefore be regarded as restoring a patient's psychosocial health. The objective of this study, therefore, was to evaluate different determinants of patient's psychosocial functioning and their effect on patient satisfaction after nasal reconstruction.

Methods A cross-sectional study with a case–control study design was conducted. Level of satisfaction with nasal appearance and psychosocial functioning were assessed with validated questionnaires.

Results A total of 30 consecutive patients were recruited. They were treated between November 2001 and May 2005 for (sub)total nasal defects following radical tumour resection. For the control group 99 consented to participate. Social anxiety and avoidance were scored significantly higher within the patient group ($p=0.01$). Patients cope significantly more passive than controls ($p=0.04$). Self-esteem levels did not differ significantly between patients and controls ($p=0.22$). Determinants of satisfaction with nasal reconstruction were self-esteem ($p=0.0001$), active coping strategy ($p=0.001$), and passive coping strategy ($p=0.0001$).

Conclusion Nasal reconstruction has an impact on psychosocial functioning of nasal reconstruction patients. In addition, self-esteem and coping strategy are important determinants of satisfaction with nasal reconstruction, and should be held in mind when treating a patient.

INTRODUCTION

Skin cancer is the most common malignancy in man, with cancer of the nasal skin accounting for approximately 12% of all skin tumours. Most skin tumours are superficial and well circumscribed;however, 2–18% of this population develop lesionsthat require partial or total nasal amputation to achieve tumour control [1]. These extensive fullthickness defects require complex reconstructionsby experienced surgeons in specialized centres.

Total or partial nasal amputation following tumour resection is one of the more severe facial disfigurements [2]. Lack of normal facial appearance can have major impact on patient's daily andpsychosocial functioning [3,4]. Successful nasalreconstruction, apart from the obvious aestheticand functional benefits, can also be regarded asrestoring a patient's psychosocial health.Inevitably, people respond to patients with nasaldeformity, either implicitly or explicitly. Severalpsychological theories conclude that there is an interaction between patient and perceiver often resulting in a self-fulfilling prophecy in which the patient incorporates the perceiver's expectations and behaviour into his or her self-concept [3]. This can have a negative effect on a patient's self-esteem and self-image, resulting in feelings of anxiety and depression, and subsequently in social isolation. These and other negative psychosocial effects have been reported in patients with congenital abnormalities, facial burns, and head and neck cancer [5–7], but have never been evaluated in patients with nasal reconstruction following tumour resection. It is of clinical interest to evaluate psychosocial functioning of nasal reconstruction patients, in order to better understand the psychological impact of nasal deformity and the effect of nasal reconstruction. There is already a consistent evidence that impaired psychological functioning is associated with negative surgical outcome across a broad range of surgical procedures [8,9]. Only a few studies have attempted to identify surgical determinants of patient satisfaction after nasal reconstruction [10–12]. There are no outcome studies, however, that have tried to identify different determinants of patient's psychosocial functioning and their influence on satisfaction after nasal reconstruction. Since psychosocial functioning is inherently multifaceted, the focus was on the following aspects: self-esteem, coping style, depression, social anxiety, and fear of negative evaluation.

The objective of this study, therefore, was to evaluate different determinants of patient's psychosocial functioning and their effect on patient satisfaction after nasal reconstruction.

MATERIALS AND METHODS

The aforementioned two study objectives were addressed by conducting a cross-sectional study with a case–control study design. Level of satisfaction with nasal appearance and psychosocial functioning was assessed with validated questionnaires.

Patients and controls

A total of 34 consecutive patients were recruited. They were treated between November 2001 and May 2005 for (sub)total nasal defects following radical tumour resection (mainly basal and squamous cell carcinomas). Twenty male and 14 female patients were included. Defects were classified as skin only (13%), skin and cartilage (21%), and full thickness (66%). According to the aesthetic subunit principles [13–15], in six (15%) patients the defect involved one aesthetic subunit, in 12 (36%) cases two and in 17 (49%) subjects three or more. Nasal reconstructions were performed using the basic principles of aesthetic nasal reconstruction as described by Burget and Menick [15]. A control group was recruited by asking, every accompanying person of a patient, except for nasal reconstruction patients, who visited our outpatient clinic to participate. Exclusion criteria were age (<18 years) and a visible facial deformity.

Procedure

Between June 2006 and March 2007, a letter was mailed to all patients, explaining the objectives, design, and conduct of the study and asking them to participate. About 1 week later, they were phoned to enquire about participation. When the patient refused, the motives for refusal were asked. All consenting patients received a package by mail, containing a cover letter, self-report questionnaires, an informed consent to be signed, and a stamped return envelope. Control persons were asked to fill out the same questionnaires, either at the outpatient clinic or at home.

Ethical approval was received from the board of the Medical Ethical Committee of our university medical center.

Measures

Psychometrically tested questionnaires as listed below were used to assess satisfaction with nasal appearance and psychosocial functioning. For an overview of measures used, see

Table I. Reliability estimates of psychological scales

Scale	No. items	$\alpha 1^{*}$	$\alpha 2^{\S}$	$\alpha 3^{\dagger}$
Nasal Appearance and Function Evaluation Questionnaire [16]	7	0.96	0.70	0.96
Social Avoidance and Distress Scale [17]	28	0.70	0.92	0.95
Fear of Negative Evaluation Scale [19]	6	0.96$	0.87	0.88
Rosenberg Self Esteem Scale [20]	10	0.82	0.83	0.81
Utrecht Coping List [23]				
Active coping strategy	7	0.70	0.84	0.91
Passive coping strategy	7	0.79	0.82	0.89

*Cronbach's α in original study.

§Cronbach's α in this study for patient group.

†Cronbach's α in this study for control group.

$ was measured for a 30 item version; in the current study 6 questions were used.

Satisfaction with nasal appearance

The Nasal Appearance and Function Evaluation Questionnaire (NAFEQ), which demonstrated to be a valid and reliable questionnaire with a high internal consistency (Cronbach's a50.96)[16], was used to assess satisfaction with nasal appearance of patients as well as comparison persons. This 14-item questionnaire comprises two parts, i.e. (1) items about nasal function and (2) items about nasal appearance. Each item is scored on a fivepoint Likert-scale. Minimum score is 5 and maximum score is 35. Higher scores correlate with higher levels of function or satisfaction with nasal appearance.

Social anxiety, avoidance, and self-esteem

Three questionnaires were administered to determine the multiple aspects of psychosocial functioning.

1. The Social Avoidance and Distress Scale (SADS) was used [17,21]. Reported reliability and validity are sufficient with a high internal consistency (Cronbach's α50.95) [21]. This 28-item selfreport questionnaire assesses social anxiety and avoidance behaviour. Each item is rated on a fivepoint scale. High scores indicate a high level of social anxiety.
2. The Fear of Negative Appearance Evaluation Scale (short version) was used [18,21]. This 6-item self-report questionnaire assesses cognitive aspects of social anxiety. It was demonstrated to be valid and reliable with a high internal consistency (Cronbach's a50.87) [18]. Each item is rated on a five-point scale. Higher scores indicate more fear of negative evaluation.

3. The Rosenberg Self-esteem Scale was used to determine the level of self-esteem [19]. The scale was demonstrated to have good reliability and validity with high internal consistency (Cronbach's α50.83) [19]. This 10-item scale assesses perceived self-esteem and satisfaction and has been widely used across different age, ethnic, and socio economic groups [22,23]. Higher scores on the scale reflect higher levels of self-esteem.

Coping with abnormal nasal appearance

Coping was assessed with the Utrecht Coping List (UCL) [20]. It is a self-report questionnaire that measures coping behaviour in daily life. In this study, the active coping (observe the problem, think of different options, make directed action plans) and passive coping subscales (pessimistic view, feeling overwhelmed, feeling incapable of dealing with it), each consisting of 7 items with a four-point Likert scale, were used. The scales are valid and reliable with high internal consistencies (Cronbach's α were 0.84 and 0.82 for active and passive coping, respectively) [20,24]. High scores indicate a more prominent coping style.

Statistical analyses

All tests were performed two-sided and a p-value of o0.05 was considered significant. The software used was SPSS for Windows, version 14.0. Demographic characteristics between patients and controls were analysed using unpaired two-tailed T-tests. Unpaired two-tailed T-tests were performed to compare means of different psychological tests between patients and controls. To explore the relationship between satisfaction and different psychological factors, Pearson correlation coefficients were calculated.

RESULTS

Response

One of the 34 patients was untraceable, two patients refused to participate, and two had died, one because of distant tumour metastasis. Thirty patients (88%) participated in our study. There were 18 male and 12 female patients; their age ranged from 43 to 87 years (mean, 67 years7SD 13.7years) and from 39 to 77 years (mean, 60 years ±SD 14.5 years), respectively. Mean followup period after nasal reconstruction was 12 months (range, 6–35 months).

For the control group 200 persons were contacted of whom 175 consented to participate. Twenty-five eligible persons refused to participate because of lack of time. Sixty-nine of the respondents were males and 106 were females; their age ranged from 21 to 79 years (mean,

43 years ±SD 14 years) and from 18 to 93 years (mean, 41 years ±SD 17 years), respectively. After we restricted the control group to an age range from 37 to 87 years, a group of 99 controls was used for calculations in the rest of the study.

Sample characteristics

Characteristics of patients and controls are shown in Table 2. There existed no statistically significant differences between patients and controls in sex (p=0.07), working status (p=0.06), marital status (p=0.35), and physical complaints (p=0.41). However, in general patients were older and had a lower level of education (Table 2). Therefore, statistical adjustments for these variables were performed.

Table II. Sociodemographic characteristics of patients and controls

Characteristics	Control (n=99)	Patient (n=30)	p-value
Gender (male/female)	40/59	18/12	0.07
Age, mean (±SD)	53 (±11)	64 (±14)	0.01
Level of education			
Elementary school	25%	53%	
Vocational school	51%	30%	0.01
Highschool or university	24%	17%	
Working	55%	33%	0.06
Marital status			
Married or cohabiting	76%	67%	0.35

Assessment of satisfaction with nasal appearance and psychosocial functioning

Table 3 comprises two categories of outcome variables: nasal perception and psychosocial functioning. With respect to nasal perception patients differed from the control group on two of the three outcome variables. Patients scored lower on the 'NAFEQ aesthetic' outcome variable. This means that patients were less satisfied with their nasal appearance than the control group. Regarding psychosocial functioning, patients differed from the control group on two out of six outcome variables. Patients scored higher on 'SADS' and 'UCL passive'. In other words, patients reported more social avoidance and a more passive coping strategy than the control group (see Table 3 for detailed information).

Table III. Mean nasal perception and psychosocial scale scores of controls and patients

Outcome variables	Controls Mean (±SD)	Patients Mean (±SD)	P-values[1] for differences between groups
NAFEQ[2]	30.61 (5.69)	23.27 (8.03)	0.001
SADS[3]	31.76 (19.95)	43.56 (24.48)	0.01
FNAES[4]	9.60 (3.81)	10.73 (4.79)	0.24
RSE[5]	23.32 (4.29)	21.87 (5.95)	0.22
UCL[6] passive	10.15 (2.99)	11.66 (3.72)	0.04
UCL [6] active	20.43 (4.07)	19.27 (3.42)	0.12

1) Unpaired T-test (two-tailed) with adjustment for age, gender and level of education.

2) Nasal Appearance and Functional Evaluation Questionnaire; higher scores correlate with higher levels of satisfaction with nasal appearance.

3) Social Anxiety and Distress Scale; high scores indicate a high level of social anxiety.

4) Fear of Negative Appearance Evaluation Scale; higher scores indicate more fear of negative evaluation.

5) Rosenberg Self Esteem Scale; higher scores on the scale reflect higher levels of self esteem.

6) Utrecht Coping List; high scores indicate a more prominent coping style.

Association between psychological factors and satisfaction with nasal reconstruction

Table 4 shows that self-esteem ($r=0.33$, $p<0.0001$), active coping strategy ($r=0.30$, $p=0.001$), and passive coping ($r=-0.45$, $p=0.0001$) are the determinants of satisfaction with nasal reconstruction. This means, patients with high levels of selfesteem were more satisfied with their reconstruction results. An active coping style resulted in a more positive perception of nasal reconstruction results in contrast to a passive coping style that showed to have a negative influence on the perception of nasal reconstruction results. Considering the levels of Pearson correlation coefficient, passive coping is of even more importance than an active coping style.

Table IV. Association between psychological factors and satisfaction with nasal reconstruction[1] by patients

Psychological factors	Pearson Correlation
Social Avoidance	-.41
Fear of negative appearance	-.34
Self esteem	.33
Passive coping	-.45
Active Coping	.30

[1] As defined by the NAFEQ (nasal appearance and function evaluation questionnaire), score ranging from 1 (very dissatisfied) to 5 (very satisfied).

DISCUSSION

This study is the first to assess the impact of nasal reconstruction on psychosocial functioning of patients. By first assessing the level of satisfaction with nasal appearance, statistical testing for differences between patients and controls showed that nasal reconstruction clearly had an impact on nasal perception: patients were less satisfied with their nasal appearance than healthy control persons. Although most studies on aesthetic outcome after nasal reconstruction have reported high patient satisfaction, [10–12,25–29] it has never been compared with satisfaction with nasal appearance of persons without a facial deformity.

In the present study, nasal reconstruction patients were significantly more afraid of negative evaluations of their appearance compared with controls. Several psychological theories state that interaction between patient and perceiver results in a self-fulfilling prophecy whereby the patient incorporates the perceiver's expectations and behaviour into his or her self-concept [3]. This underlines the more negative perception of nasal appearance by patients. It is of clinical interest that the nasal reconstruction patients were socially more afraid than their healthy counterparts. This underlines the theory that, when a person feels that he is judged negatively about his appearance, he will isolate himself [3]. This could also induce substantial depressive feelings and anxiety [3,5]. Problem coping styles differed

significantly between patients and controls. We found that patients had a more passive coping style than the control group. The passive coping strategy also had a negative relationship with the assessment of satisfaction with nasal appearance. For active coping style no statistical difference was found.

Contrary to what was expected, nasal reconstruction patients did not suffer from low levels of self-esteem. This could be explained by the fact that self-esteem is developed during early puberty, and is unlikely to change discernibly after puberty. As this patient group developed a facial deformity at the mean age of 64 years, it is more plausible that their self-esteem was not affected. These findings are in contrast with, for example, patients with facial clefts who grew up with the belief that they were different, which induced lower levels of selfesteem. Berk et al. found that adult patients with facial clefts had significantly lower levels of selfesteem not only than their siblings, but also than a normal control group [30]. The findings of the current study confirm that there is a difference between the level of satisfaction with nasal appearance and psychosocial functioning of patients and controls. All psychological factors used in this study could be identified as determinants of satisfaction with nasal appearance. Patients who had high levels of self-esteem were more likely to positively assess their nasal appearance; patients with an active coping style were also positive, patients who had a passive coping style were negative about their nasal appearance. Moreover, passive coping had a stronger impact on the level of satisfaction with nasal appearance than active coping. The fact that a passive coping style could be of even more importance than only a lower satisfaction level was also found by De Boer et al. [7], who found that survival in patients with a passive coping style was lower after head and neck cancer than in patients who had an active coping style. The psychological determinants turned out to be of importance.

Given the fact that this is the first study to assess the impact of nasal reconstruction on psychosocial functioning of patients, this study has some limitations. First, due to the small sample size, no firm conclusions may be drawn. Therefore, the present study has to be considered as exploratory of character. Second, ideally the control group differs from the patient group in just one characteristic. For our study this would imply that the control group is similar to our patient group except for one characteristic (i.e. surgical nasal reconstruction). This would give us three options: (1) no surgical intervention, (2) another type of intervention, and (3) the same type of surgical intervention at another location in the face. As a frame of reference we have chosen for the first option, since this group reflects the non-affected nose best. Since the nose is a unique part in the face and no other facial part could in our belief reflect the impact of a nasal reconstruction.

In conclusion, nasal reconstruction has an impact on psychosocial functioning of nasal reconstruction patients. Patients are more negative about their nasal appearance than

controls. This results in greater social anxiety. In contrast, selfesteem and passive coping strategy are important determinants of satisfaction with nasal reconstruction. These findings may have considerable implications for the treatment and counselling of nasal reconstruction patients. For example plastic surgeons might be encouraged to consider the importance of preoperative psychological screening to identify those reconstruction patients who may be at risk for low satisfaction levels with the postoperative results. We suggest identifying those patients with a passive coping style, and discussing referral to a professional for evaluation and counselling. All of these steps could lead to a higher level of satisfaction for patients overall.

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REFERENCES

1. Johnson JT. Management of advanced cancers of the external nose. Oncology (Williston Park) 1993;7(7): p. 73–77; discussion 77–80, 82.
2. Dropkin MJ, Malgady RG, Scott DW et al. Scaling of disfigurement and dysfunction in postoperative head and neck patients. Head Neck Surg 1983;6(1):559–570.
3. Bull R, Rumsey N. Social Psychology Of Facial Appearance. Springer: New York, 1988.
4. Rankin M, Borah GL. Perceived functional impact of abnormal facial appearance. Plast Reconstr Surg 2003;111(7): p. 2140–2146; discussion 2147–2148.
5. Macgregor FC. Facial disfigurement problems and management of social interaction and implications for mental health. Aesthetic Plast Surg 1990;14(4):249–257.
6. Fukunishi I. Relationship of cosmetic disfigurement to the severity of posttraumatic stress disorder in burn injury or digital amputation. Psychother Psychosom 1999; 68(2): 82–86.
7. De Boer MF, McCormick LK, Pruyn JF et al. Physical and psychosocial correlates of head and neck cancer: a review of the literature. Otolaryngol Head Neck Surg 1999;120(3): 427–436.
8. Johnston M, Carpenter L. Relationship between preoperative anxiety and post-operative state. Psychol Med 1980;10(2):361–367.
9. Kiecolt-Glaser JK, Page GG, Marucha PT et al. Psychological influences on surgical recovery. Perspectives from psychoneuroimmunology. Am Psychol 1998;53(11):1209–1218.
10. Arden RL, Nawroz-Danish M, Yoo GH et al. Nasal alar reconstruction: a critical analysis using melolabial island and paramedian forehead flaps. Laryngoscope 1999;109(3):376–382.
11. Boyd CM, Baker SR, Fader DJ, et al. The forehead flap for nasal reconstruction. Arch Dermatol 2000;136(11): 1365–1370.
12. Drisco BP, Baker SR. Reconstruction of nasal alar defects. Arch Facial Plast Surg 2001;3(2):91–99.
13. Burget GC, Menick FJ. The subunit principle in nasal reconstruction. Plast Reconstr Surg 1985;76(2):239–247.
14. Menick FJ. Artistry in aesthetic surgery. Aesthetic perception and the subunit principle. Clin Plast Surg 1987;14(723).
15. Burget GC, Menick FJ. Aesthetic Reconstruction of the Nose. C.V. Mosby: St. Louis, 1994.
16. Moolenburgh SE, Mureau MA, Duivenvoorden HJ et al. Validation of a questionnaire assessing patient's aesthetic and functional outcome after nasal reconstruction: the patient NAFEQ-score. J Plast Reconstr Aesthet Surg 2008; DOI: 10.1016/j.bjps.2007.07.024.
17. 17. Willems EP. Behavioral validity of a test for measuring social anxiety. Psychol Rep 1967;21(2):433–442. The impact of nasal reconstruction on psychosocial functioning 751 Copyright r 2008 John Wiley & Sons, Ltd. Psycho-Oncology 18: 747–752 (2009) DOI: 10.1002/pon
18. Leary MR. A brief version of the Fear of Negative Evaluation Scale. Pers Soc Psychol Bull 1983;9:371–375.
19. Rosenberg M. Society And The Adolescent Self-Image. Princeton University Press: Princeton, NJ, 1965.

20. Schreurs PJG, Willige GVD, Brosschot JF et al. Utrechtse coping lijst: omgaan met problemen en gebeurtenissen, herziene handleiding [Utrecht-Coping List: Coping With Problems And Events—Revised Manual]. Swets & Zeitlinger: Lisse, The Netherlands, 1993

21. Watson D, Friend R. Measurement of Social-Evaluative Anxiety. J Consult Clin Psychol 1969;33(4): 448–457.

22. Carpenter JS, Brockopp DY. Evaluation of self-esteem of women with cancer receiving chemotherapy. Oncol Nurs Forum 1994;21(4):751–757.

23. Carpenter JS, Brockopp DY, Andrykowski MA. Selftransformation as a factor in the self-esteem and wellbeing of breast cancer survivors. J Adv Nurs 1999; 29(6):1402–1411.

24. van Oostrom I, Meijers-Heijboer H, Duivenvoorden HJ et al. The common sense model of self-regulation and psychological adjustment to predictive genetic testing: a prospective study. Psycho-Oncology 2007;16:1121–1129. DOI: 10.1002/pon.1178.

25. Singh DJ, Bartlett SP. Aesthetic considerations in nasal reconstruction and the role of modified nasal subunits. Plast Reconstr Surg 2003;111(2): p. 639–648; discussion 649–651.

26. Quatela VC, Sherris DA, Rounds MF. Esthetic refinements in forehead flap nasal reconstruction. Arch Otolaryngol Head Neck Surg 1995;121(10):1106–1113.

27. Uchinuma E, Matsui K, Shimakura Y et al. Evaluation of the median forehead flap and the nasolabial flap in nasal reconstruction. Aesthetic Plast Surg 1997; 21(2):86–89.

28. Mureau MA, Moolenburgh SE, Levendag PC et al. Aesthetic and functional outcome following nasal reconstruction. Plast Reconstr Surg 2007;120(5): p. 1217–1227; discussion 1228–1230.

29. Moolenburgh SE, Mureau MA, Hofer SO. Aesthetic outcome after nasal reconstruction: patient versus panel perception. J Plast Reconstr Aesthet Surg 2007; DOI: 10.1016/j.bjps.2007.09.018.

30. Berk NW, Cooper ME, Liu YE et al. Social anxiety in Chinese adults with oral–facial clefts. Cleft Palate Craniofac J 2001;38(2):126–133.

Chapter 7

Interstitial radiation therapy for early-stage nasal vestibule cancer: A continuing quest for optimal tumour control and cosmesis

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ABSTRACT

Introduction This article reports on the effectiveness, cosmetic outcome, and costs of interstitial high-dose-rate (HDR) brachytherapy for early-stage cancer of the nasal vestibule (NV) proper and/or columella high-dose-rate (HDR).

Methods and Materials Tumour control, survival, cosmetic outcome, functional results, and costs were established in 64 T1/T2N0 nasal vestibule cancers treated from 1991-2005 by fractionated interstitial radiation therapy (IRT) only. Total dose is 44 Gy: 2 fractions of 3 Gy per day, 6-hour interval, first and last fraction 4 Gy. Cosmesis is noted in the chart by the medical doctor during follow-up, by the patient (visual analog scale), and by a panel. Finally, full hospital costs are computed.

Results A local relapse-free survival rate of 92% at 5 years was obtained. Four local failures were observed; all four patients were salvaged. The neck was not treated electively; no neck recurrence in follow-up was seen. Excellent cosmetic and functional results were observed. With 10 days admission for full treatment, hospital costs amounted to €5772 ($7044).

Conclusion Excellent tumour control, cosmesis, and function of nasal airway passage can be achieved when HDR-IRT for T1/T2N0 NV cancers is used. For the more advanced cancers (Wang classification: T3 tumour stage), we elect to treat by local excision followed by a reconstructive procedure. The costs, admission to hospital inclusive, for treatment by HDR-IRT amounts to €5772 ($7044 US). This contrasts substantially with the full hospital costs when NV cancers are treated by plastic reconstructive surgery, being on average threefold as expensive.

INTRODUCTION

The nasal vestibule (NV) is the beginning of the nasal cavity. It is a distinct triangularly shaped space, approximately 1.5 cm in diameter, located in front of the limen nasi. It is defined laterally by the alae with their supporting lateral cartilage, medially by the (partly) membranous septum and the columella, and caudally by the lining of the floor of the nasal cavity. It is covered by skin, which contains numerous hair follicles and sebaceous glands; malignant tumours at this location are essentially of squamous cell carcinoma (SCC) or basal cell carcinoma (BCC) types. Small carcinomas of the NV usually present as asymptomatic (nodular) lesions, often accompanied by excessive crustae formation; tumours rarely advance beyond the anatomic borders of the NV to infiltrate distant anatomic structures like the orbital apex (see below for staging). First-order lymphatic drainage of the NV is essentially to the submandibular and submental nodes; there is also a potential pathway to the facial, pre-auricular, and level II nodes. It is generally accepted that NV cancers presenting with synchronous pathologic lymph nodes in the neck (*N*+) carry a grim prognosis. However, most authors agree that the overall incidence of regional metastasis at presentation is low, that is, it varies between 5–15%. Moreover, the development of metachronous lymph node metastases during the course of the disease is in approximately the same range. Therefore, it is commonly suggested that there is no need for elective neck treatment of the N0 neck in NV cancer. Overviews of several of these issues regarding NV cancer can be found in the literature. [1-8]

The T-stage classification according to the American Joint Commission for Cancer (AJCC) classification system (2002 edition for the naso-ethmoidal complex), denotes 4 subsites of the nasal cavity; that is the septum, lateral wall, nasal floor, and nasal vestibule [1,9] T1 corresponds to one subsite with or without bony invasion, T2 to two subsites or involvement of an adjacent region with or without bony invasion, and T3 extends into the medial wall/floor of orbit, sinus complex, palate, cribriform plate, and subcutaneous tissues. Tumours of the T4 category harbor even more advanced lesions, with extensions into the cheek, orbit, nasopharynx, clivus, and cranial fossa. During the study period, the other frequently used T-stage classification system for NV cancer, that is the classification according to C. C. Wang, [10] was implemented in our institution. It proposes guidelines that are basically very similar to the AJCC for the early T1 and T2 cases: T1 involves one or more sites within the NV proper, T2 extends to one or more adjacent structures, and T3 comprises massive lesions with deep muscle and bone involvement. Surgery (S), [11,12] brachytherapy (BT), [6,13,14] and external beam radiation therapy only (ERT), [15,16], and/

or a combination of these, are the most commonly used therapy modalities, but no gold standard has been defined so far. In the selection process of the preferred modality, extent of the disease (volume, T-stage) and BT expertise are important prognosticators. [17] This report first updates tumour control rate and overall survival of a large single institutional experience with early-stage tumours, that is, primary T1/T2N0 cancer of the NV, treated with HDR interstitial radiation therapy (IRT).

A special study aim was to assess the cosmetic results and functional nasal sequelae after IRT. This is done for all patients still alive by instructing a panel of nonmedical and medical professionals to score the cosmetic result of each of these patients. Also, during an extra outward clinic follow-up session, all patients alive were seen in consultation to score the functional outcome. Finally, to put the IRT technique for NV cancer more in perspective, full hospital costs are computed and compared with costs of other modalities used in NV cancer, such as plastic reconstructive surgery (RS), Moh's surgery (MS), and ERT.

METHODS AND MATERIALS

Treatment protocol and patient characteristics

The charts were reviewed of all 133 patients treated with radiation therapy between 1991 and 2005 in the Erasmus Medical Centre – Daniel den Hoed Cancer Centre for BCC or SCC of the NV. Patients were seen in joint consultation by the radiation oncologist and head-and-neck surgeon. Diagnosis was established by clinical examination in the outpatient clinic, and all lesions were biopsied. Ultrasound examination of the neck (and, if appropriate, fine-needle guided aspiration cytology of suspicious lymph nodes) was performed. Staging was done according to the C. C. Wang classification rules. [10] For the purpose of the present investigation, only primary T1/T2N0 NV cancers treated by HDR-IRT were eligible. In the 15-year time period, 133 patients with NV cancer were treated. Patients with a combination of the following disease or treatment modality characteristics were excluded from the present analysis: patients with *N*+ disease at presentation (29/133 [22%]), T3 tumours (17/133 [13%]), tumours of non-BCC or non-SCC origin (15/133 [11%]), patients treated with ERT only (19/133 [14%]), or patients treated with a BT mould technique (10/133 [8%]). In summary, of the 133 patients with primary NV cancers treated with radiation therapy, 69 were considered noneligible. Of the 64 (44 T1N0, 20 T2N0) remaining patients, 3 (5%) had a BCC and 61 (95%) were of SCC origin; 51 (80%) were of male gender. Mean age was 68, range 46-87 years. Treatment of the primary NV cancer was performed by IRT only (50

[78%] patients; so-called "nonsurgical" group) or by IRT after an "extensive excision biopsy" had been performed (14 [22%] patients; denoted as "surgical" group).

For details regarding the rationale and interstitial technique per se are referred to in previous articles. [6,18] The total dose of 44 Gy is given in an accelerated fashion; that is 2 fractions of 3 Gy per day in an overall treatment time (OTT) of 10 days. With regard to the technique of this conformal type of radiation therapy first a needle with outer diameter of 1.5 mm is introduced. Subsequently, after retracting the needle, a plastic afterloading catheter (outer diameter 4 French [1.3 mm]) is inserted into the puncture (guide) channel of the retracted needle. Likewise, in general 3-4 (sometimes as many as 7) afterloading catheters are introduced approximately 0.5 cm apart but well into the "heart" of the cancer. Obviously, the exact configuration and number of catheters are determined by the extent, depth, and shape of the lesion. The afterloading tubes are fixed by suturing the buttons to the skin or, more recently, using a heat-sealing technique (Nucletron; catheter ends are heat-sealed flush with the outside of the button). The active length is generally about 4 cm. Finally, after dose optimization, the dose is prescribed to dose points 0.5 cm from the implanted sources, therewith encompassing the full extent of the lesion and eliminating as much dose as possible from the surrounding normal nasal skin and/or mucosal structures (Figure 1c). For that purpose the (optimized) dose is calculated in different planes (e.g., plane I and plane II in Figure 1 a, b); in some cases the given dose distribution even necessitates the implant of an extra catheter for adequate dose coverage (see Figure 1b, compare type C with type D and E). Figure 1c depicts a patient with a large implant of the NV and, because of tumour infiltration, an additional catheter for adequate dose coverage was implanted in the lip. The tumour is irradiated by a standardized fractionated HDR protocol: 44 Gy total dose, 3 Gy per fraction, 2 fractions per day, 6 hours interval between the fractions, with the first and the last fraction being 4 Gy. [18]

The dose is given by means of a micro-Selectron HDR containing an Ir-192 point-source (370 MBq), in conjunction with a PLATO brachytherapy Treatment Planning System. Patients are seen in regular follow-up by the radiation-oncologist and head-and-neck surgeon, alternately. In the beginning, these follow-ups occur every 3 months, but at a later stage with 6 months, and up to 1-year intervals. After 5 years of follow-up, patients are dismissed. Actuarial LRFS and overall survival (OS) were computed according to Kaplan-Meier.

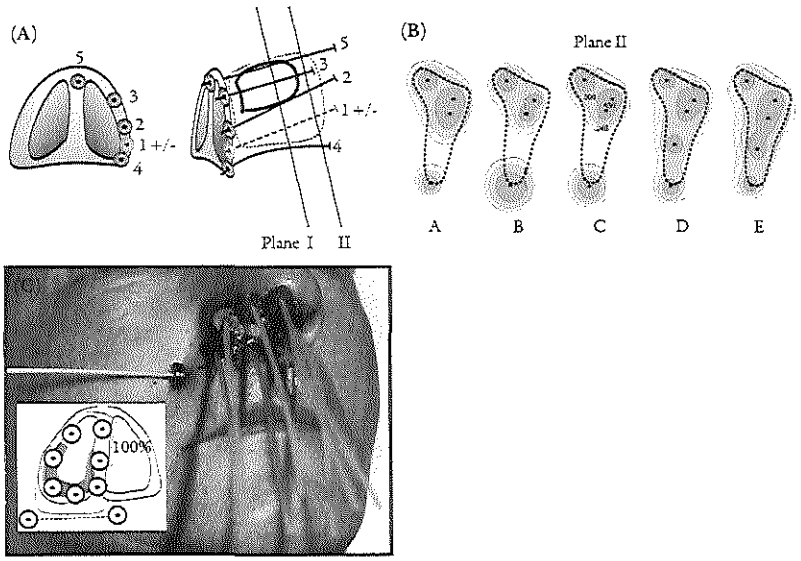

Figure 1. Panel (A) Schematic diagram implant of the nasal vestibule. I, II: planes of calculation in periphery of target. Panel (B) Five types of dose distributions (A, B, C, D, E) are compared. A: 5 catheters, constant dwell times and dwell positions. B: 4 catheters, dwell times geometrically optimized. (C) 4 catheters, optimized on dose points 0.5 cm from catheters. Constant dwell times and dwell positions, extra (=total of 5) catheters. Fraction size 3 Gy.

Evaluation of cosmesis and nasal function after interstitial radiation therapy

For the current investigation, at one point in time (March 2005) after long follow-up times for the majority of cases, we called on all patients alive with no evidence of disease (n=40). Twenty patients (58%) showed up (Group B, see also Figure 2). Of these 24 patients, three belonged to the "surgical group" (see before, this section). All patients were seen at the extra outward clinic dedicated to the evaluation of cosmesis and the nasal airway function. Two groups of patients were identified: group A and group B. Group B contrasted with group A in that group A (n=41) could only be evaluated by chart review because patients had either died intercurrently (n=24) or did not show up for the extra outward clinic visit (n=17).

Both physician (M.D.) and patient scored objective and functional study parameters of the nasal airways function as being "satisfactory" or "nonsatisfactory" (Table I).

Posttreatment cosmetic outcome is assessed by a panel consisting of nonmedical professional workers (n=5) and medical professionals (n=8).

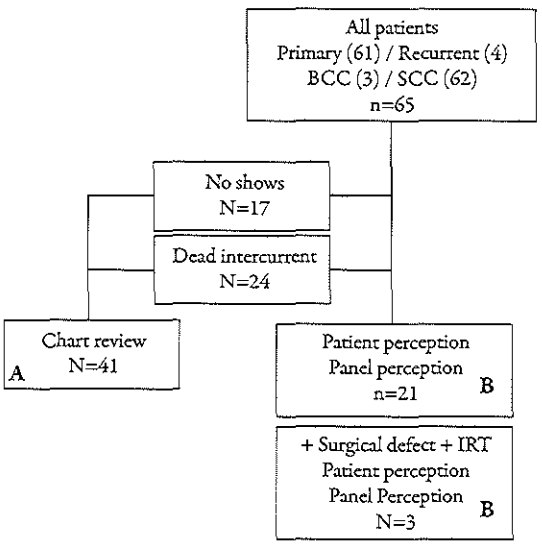

Figure 2. Flow diagram Group A and Group B patients. Figure self explanatory; see also text.

Table I. Findings at last follow-up after treatment of nasal vestibule cancer by interstitial radiation therapy*

Objective findings (0%=poorest, 100%=best)	Satisfactory result (%)	Functioning of nasal airways (0%=poorest, 100%=optimal)	Satisfactory result (%)
Dryness	*29**	Blocked nose	58
Crustae	*38**	Dry nose	77
Collapse Alae	79	Bloody discharge	77
Fibrosis	83	Speech	77
Erythema mucosa lining	88	Snoring	81
Teleangiectasia mucosa lining	92	Cottle test§	88
Defect nasal septum	96	Nasal whistling	92
Ulcer	96	Extra nasal sounds	92
Defect Alae	100		
Defect/ulcer upper lip	100		

* Only with regard to the objective finding of dryness and crustae of the nose the medical doctors were dissatisfied with the results.

§ Cottle test: positive Cottle test, meaning collapse of the nostrils when inhaling.

The panelists (data manager, manager [Department of Radiation-Oncology], technician [Dental Department], medical photographer, secretary, radiation-oncologist, resident in training for radiation-oncologist, outside physician, two reconstructive surgeons, dermatologist, head-and-neck surgeon) were to score each patient on a 3-point scale: 1=poor, 2=moderate/fair, and 3=good/excellent. For scoring purposes each face, including the upper lip and/or nasal tip (implanted sites) of each patient is represented by six standardized digital photographs on a CD-ROM (Figure 3, Figure 4, Figure 5, Figure 6, Figure 7 and Figure 8; also column 1, Group B, Table 2II). In addition, each patient was asked to mark their appreciation of the cosmetic end-result on a visual analog scale (VAS), ranging from 1 (minimum) to 10 (maximum), (column 2, Group B, Table II). Also, the scores of the medical specialist (M.D.) written in the charts at the last follow-up date, were taken as a cosmetic outcome measure (column 3, Group B, Table II). Similar findings on cosmetic outcome were retrieved from the charts of Group A (column 4, Group A, Table II). This last group consisted of the charts of patients that had died because of intercurrent disease (n=24) or were alive but could not be analyzed by the panel because of "no show" for non-tumour-related reasons (n=17) (see also Figure 2).

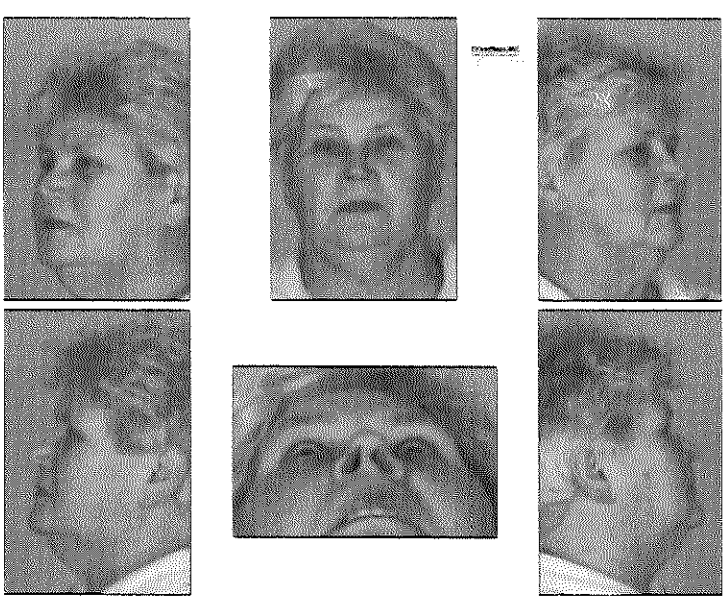

Figure 3. Figure 3, Figure 4, Figure 5, Figure 6, Figure 7 and Figure. 8 each contain 6 standardized photographs per patient; this way each patient was presented to members of the panel on CD-ROM and allocated a score of "1" (poor), "2" (moderate), and "3" (good). This figure is an example of a nonsurgical patient allocated a score of "1" by the panel. Explanation of "surgical" vs. "nonsurgical": see text.

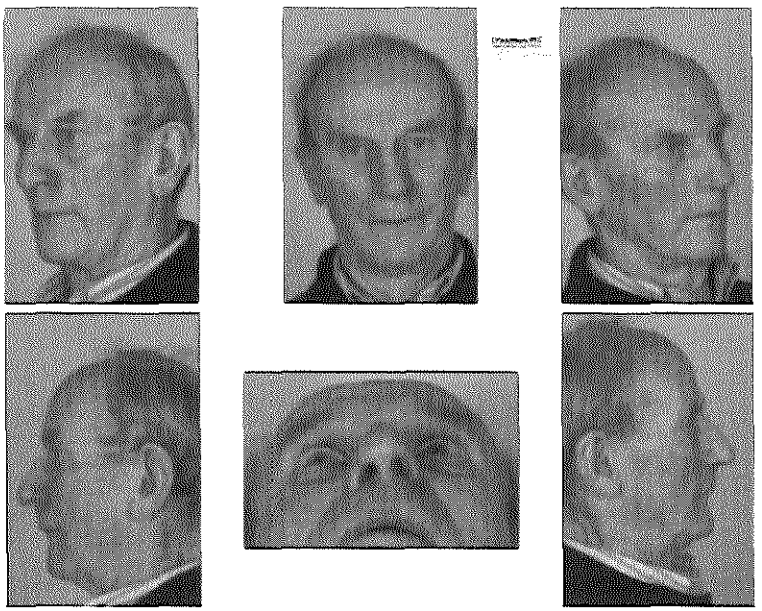

Figure 4. See legend Figure 3: example of a nonsurgical patient allocated a score of "2" (fair, moderate).

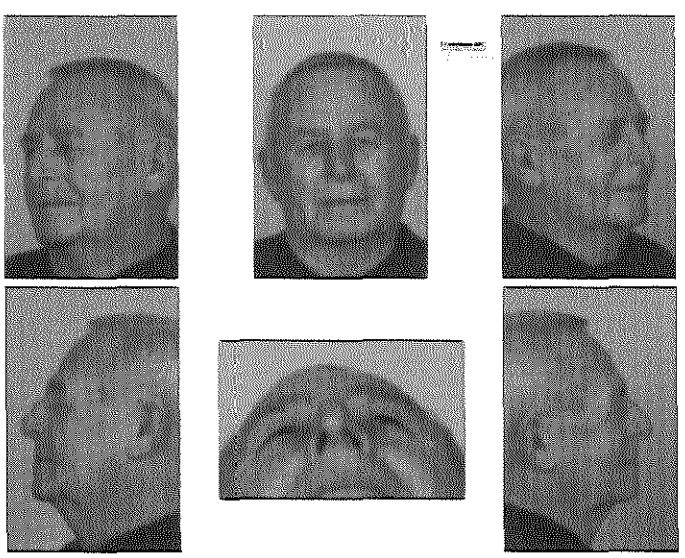

Figure 5. See legend Figure 3: example of a nonsurgical patient allocated a score "3" (good).

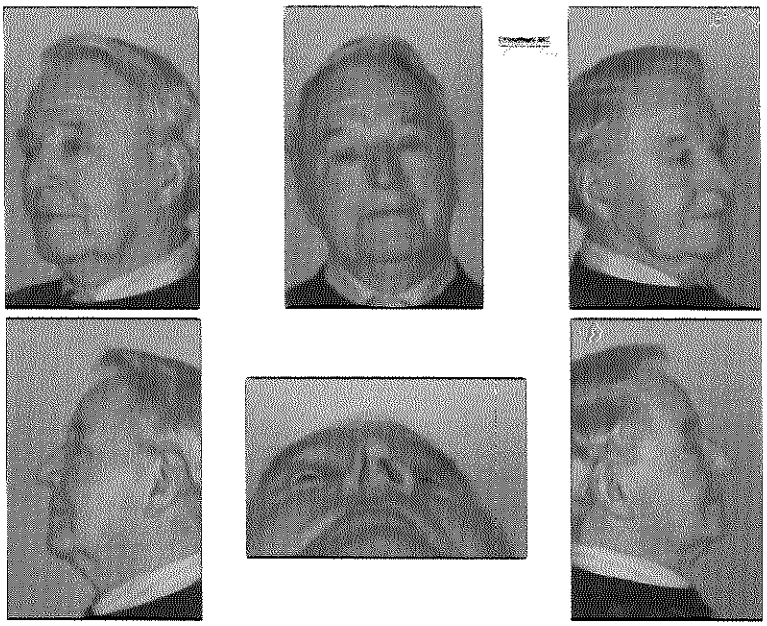

Figure 6. See legend Figure 3: example of a surgical patient allocated a score "1" ("poor").

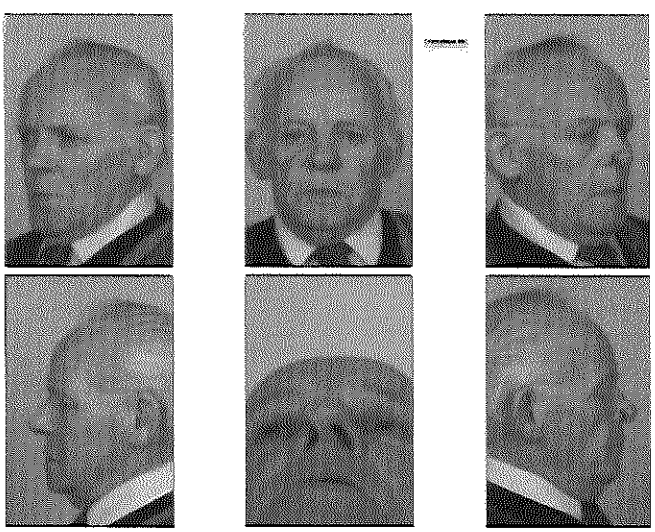

Figure 7. See legend Figure 3: example of a surgical patient allocated a score of "2" (fair, moderate).

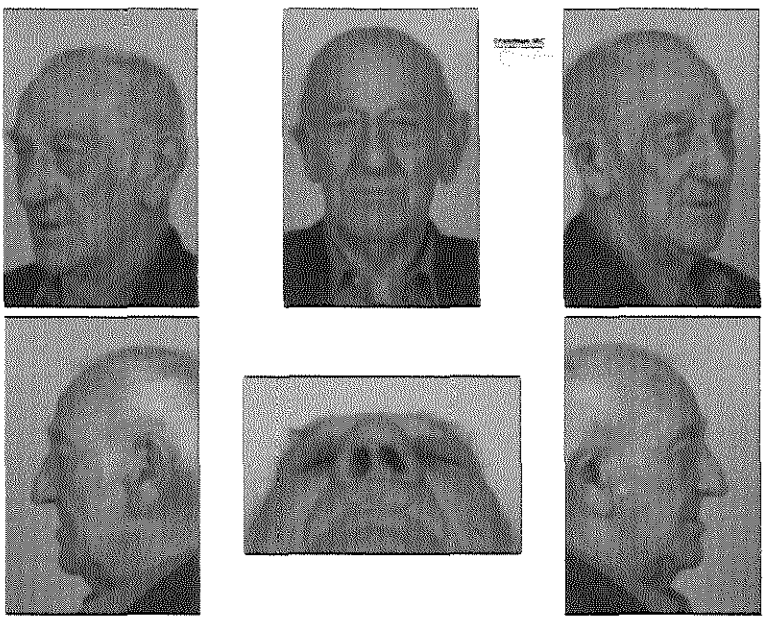

Figure 8. See legend Figure 3: example of a surgical patient allocated a score "3" (good).

Total costs of treatment by interstitial radiation therapy

The direct medical costs of IRT of the NV cancers are calculated and summed for the most important items within the work-up (diagnosis and staging) and for the treatment, as well as for the hospital admission. The costs for diagnosis and staging are based on the Dutch tariff system. The direct medical costs (materials and manpower) are based on average unit costs. To determine the unit costs, we followed the microcosting method, i.e., a detailed inventory and measurement of resources consumed.

Wholesale prices were used to determine costs of materials. Also costs related to use of equipment and operating room (integrated brachytherapy unit) are included in material costs. The number of radiation sessions for IRT is according to the protocol typically used in case of NV cancer (see before). We also estimated the number of admission days based on this protocol, as was the number of follow-up visits. To calculate manpower costs, the time spent for the various procedures was estimated by the medical disciplines involved. The time invested was multiplied by salary (including wages, social premium, and extra fees for irregular working hours). Costs per minute were then calculated under the assumption of 1,540 working hours per year. The specialist activities were divided into direct and indirect

time. Direct time was estimated to be 70% of the specialist's working time. Indirect time is estimated to be approximately 30%. All direct costs were multiplied by 16.4% to cover overhead costs (e.g., depreciation costs of the building, cleaning costs, etc.). The valuation of resources and overhead costs are based on financial data obtained from the Erasmus Medical Centre, Rotterdam. Costs were based on 2001 pricings and stated in Euros (€); for some of the amounts (see "Discussion" section), the Euro is converted to US dollars ($) (exchange rate December 2005). (The cost calculation serves the purpose of comparing the (low) cost of interstitial radiation therapy for early cancers of the NV with costs of other treatment modalities, such as reconstructive surgery [see also the paragraph on cost in the "Discussion" section]. This relative comparison should also be of interest to readers of other nations given the importance of cost-effectiveness data in the healthcare section overall.

Table II. Cosmetic scores after interstitial radiation therapy for nasal vestibule cancer

Scores	Cosmetic results group B			Cosmetic results group A
	Panel CD-ROM	Patient VAS	M.D. chart review	M.D. chart review
Mean score all patients (SD)	2.6 (0.5)		2.9 (0.3)	3 (0)
Mean VAS all patients (SD)		8.7 (2.1)		
Good: 3 (number of Pts. [%])	15 [65]†		18 [90]*	40 [100]
VAS: 7–10 (number of Pts. [%])		18 [86]		
Fair: 2 (number of Pts. [%])	8 [35]		2 [10]	0
VAS: 4–6 (number of Pts. [%])		2 [9]		
Poor: 1 (number of Pts. [%])	0		0	0
VAS: 0–3 (number of Pts. [%])		1 [5]		

Abbreviation: VAS = Visual Analogue Scale score.

* Out of 23 charts, after excluding missing values (3), 18 charts were scored as "good" (score of 3), that is 90% (score 3).

† 65% of patients score 3 by panelists.

RESULTS

Survival

The LRFS and OS rates of patients treated with an interstitial implant for NV cancer (Figure 1c) at 5 years are 89% and 58% for T1 tumours, and 100% and 78% for T2 tumours, respectively. For all 64 tumours combined, these survival rates accumulate to 92% and 59%, respectively. Four patients failed locally; none of the N0 patients experienced a failure in the neck. All four local failures were salvaged.

Nasal airway functions

Detailed examination of the nasal tip and nasal airway functions were scored by the medical specialist and patient, respectively (see Table I for study parameters), at a dedicated last follow-up clinic. Table I shows that the great majority of study parameters were considered (scored) "satisfactory" posttreatment by the specialist.

Cosmesis

All 23 patients were presented in a standardised fashion (6 photographs per patient) to 13 panel members on a CD-ROM. Examples of the so-called "nonsurgical group" of patients (n=20) are shown by Figure 3 (score 1; poor), Figure 4 (score 2; fair), and Figure5 (score 3; good). The "surgical group" of patients (n=3) is shown in Figure 6 (poor), Figure 7 (fair), and Figure 8 (good). In summary, 65% of the patients were scored by the 13 panel members as having an "excellent" or "good" result (score 3) in terms of cosmesis after IRT of the NV.

Moreover, 90% of the cases were appreciated in the chart by the physician at last follow-up as "good" (maximum score 3).

Total costs of treatment by IRT

The total hospital costs are divided in costs for diagnosis and staging (Table III) and IRT brachytherapy including admission days (Table IV). In case the patient (tumour) is implanted and treated as an outpatient, the admission amounts to only 2 days with the IRT-brachytherapy given twice daily. Most patients, however, preferred clinical admission during treatment. For a full clinical treatment, the number of admission days is 10.

Table III. Hospital costs for diagnosis and staging NV cancers.

	Costs
Diagnostics/staging	Euro
Consultation radiation-oncologist	95
Consultation head & neck surgeon	95
Radiograph thorax	39
Blood chemistry	38
Preoperative consultation anesthesiologist	44
Grand (Consultation) rounds	0
Subtotal (Euro)1	310
(US Dollars)	$372

Table IV. Hospital costs related to IRT for NV cancers.

	Costs
Brachytherapy/Clinical admission	Euro
Patient education	
Anesthesiology	
Simulation (integrated brachytherapy unit)	
Brachytherapy PLATO treatment planning system	
Total preparation brachytherapy + personnel	46
Total preparation surgery/anesthesiology + personnel	101
Material (catheters)	30
Operating room	216
Overhead 16.4%	64
$Subtotal_2$ preparation, equipment, materials, personnel	457
$Subtotal_3$ Radiation fraction # 14 (Euro 79/fraction)	1111
$Subtotal_4$ Admission days # 2 (Euro 389/day)	779
$Subtotal_{1+2+3+4}$ Outpatient therapy	2657
(US Dollars)	$3227
$Subtotal_5$ Admission days # 10 (Euro 389/day)	3894
$Subtotal_{1+2+3+5}$ Inpatient	5772
(US dollars)	$7011

Abbreviations: IRT = intenstitial radiation therapy; NV = nasal vestibule.

DISCUSSION

Surgery and radiotherapy may provide similar chances for cure in NV cancers. Primary local control (LC) rates have been variably reported. Data on external beam radiation therapy (EBRT) and BT show an LC of approximately 79–95%. [5,6,15] For EBRT alone they amount to 77–86%, [7,10] and for primary surgery the data are in essence comparable to primary EBRT. [11,19,20] Detailed objective reports on results concerning cosmetic sequelae and nasal airway function posttreatment are, however, frequently absent or biased; the choice of modality and results often seem to depend on the specialty of the physician in charge of the patient. The purpose of this article is to report on the results of fractionated HDR-IRT to a total dose of 44 Gy for T1/T2N0 SCC or BCC tumours of the NV. Over many years, this protocol has proven to be a straightforward, simple, reliable, and effective treatment approach in controlling NV tumours. A LRFS rate of 92% at 5 years was obtained. The four local failures observed over time were salvaged. Moreover, the neck was not treated electively; this policy has been proven right because no neck recurrences were seen during follow-up. Given the proximity of major and minor salivary glands to the clinical target volume, and to part of the upper neck and not having to treat the lymph nodal regions electively by radiation, safe-guards the patient from serious potential side effects such as xerostomia. Importantly, at this time and age, not only the local regional failure rates are important; many physicians now try to obtain good tumour control in combination with optimal quality of life for their patients. This means that good cosmetic outcome and preservation of the (functions of the) nasal airway passage are becoming of paramount importance as well. Finally, with the severe budget constraints and deficits present in many of the major hospitals, the preferred modality should be at low cost without compromising the efficacy and quality of the treatment.

When comparing the notes in the charts of group B patients still alive and seen in the last follow-up with charts of group A patients (no show or dead of intercurrent disease), it can be concluded that the IRT technique produces excellent cosmetic outcomes across the board (100% maximum score of 3, Table II).

What was achieved in Group B? In the majority of patients, panel scores were "good to excellent" (65% maximum score of 3; Table II). Similarly, "good" (VAS scores 7-10) cosmetic outcome can be observed in the majority (86%) of cases when looking at patient appreciation; overall, a mean score of 8.7 on a scale of 10 (Table II) was found. Also, the functional aspects of the nasal cavity passage after IRT are excellent (see Table I).

Of interest is the difference between the "nonsurgical" group (20 patients) and "surgical" group scores (3 patients with extensive biopsies) when taking into account the profession of

the panelist (Figure 9). Although the question posed was to objectify the cosmetic result by scoring the effect of IRT *per se*, surgeons appreciated the cosmetic results of the "surgical" patients as being worse, probably biased because of the presence of a surgical defect (Figure 9). It demonstrates to some extent the difficulties encountered when trying to objectively score cosmesis.

Lastly, when computing the cost (diagnosis and staging [€310, $372], IRT [€1568, $1905], and admission 10 days [€3894, $4730]), implantation of these cancers is really at relatively low cost (€5772, $7044). This is particularly true if the patient is willing to go home and return to the IRT unit twice daily on an outpatient basis for actual treatment. In that case, the cost of 8 days' admission can be saved; total remaining cost is €2657 ($3227). These data are on costs by interstitial radiation therapy. Obviously, in case of EBRT, the amounts will be different. Due to the number of fractions in case of EBRT, the price will increase. However, this will be cancelled out because EBRT is usually given on an outpatient basis. A detailed discussion on BT vs. EBRT in terms of cost has been presented by Nijdam et al. [21]

In our view the more diffuse and advanced lesions (T3-stage C. C. Wang, T3T4 stage AJCC 2002) are more difficult to cure with IRT alone. Probably wide excision and reconstructive surgery with or without ERT have more to offer in these cases in terms of local tumour control. We are presently evaluating a series of patients treated in a similar time frame with reconstructive surgery after wide surgical excision and performed in one or multiple sessions (mean, 3) compared with the current series (this article), the patient population [22] is more advanced, with 14 of 34 (47%) being a recurrent lesion and only 5 of 34 (15%) being a T1/T2N0 tumour. Not surprisingly, the latter treatment (reconstructive surgery, in 6 cases combined with Mohs surgery) is at a much higher cost (€15,000; $18,181) in these 34 patients, mainly due to the complex multistep procedure.

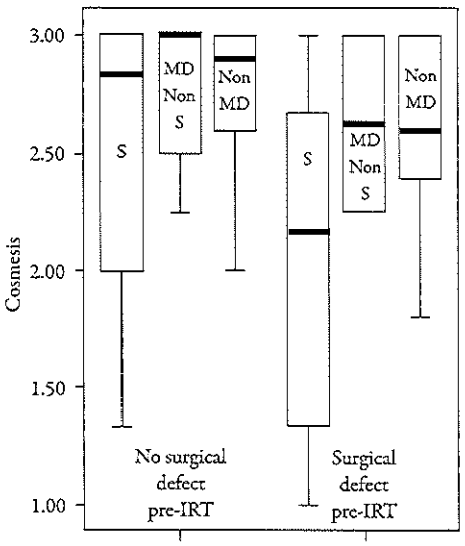

Figure 9. Box-plot of panel scores of patients with nasal vestibule cancer of either the "nonsurgical" group or "surgical" group, respectively. Both groups were scored by members of the panel being medical doctors (surgeons and nonsurgeons) or nonmedical doctors. The good rating overall is apparent. It is interesting that the median score on cosmesis is lower for the surgeons scoring the patients of the surgical group as opposed to the other medical doctors or nonmedical doctors of the panel scoring the patients of both (surgical and nonsurgical) groups.

CONCLUSION

Excellent tumour control rates, good cosmetic results, and optimal nasal function at relatively low cost can be achieved when using IRT alone for early T1/T2N0 NV cancers. Elective treatment of the neck is not warranted. Although not the topic of the present paper, we feel reconstructive surgery should be the modality of choice for the more advanced lesions. [22]

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REFERENCES

1. In: De Vita VT, Hellman S and Rosenberg SA. Editors, Cancer principles & practice of oncology (7th edition), Lippincott, Williams & Wilkins, Philadelphia 2005; 713–721.
2. Horsmans JDJ, Godbalie C and Jorgensen KE, et al., Squamous cell carcinoma of the nasal vestibule, Rhinology 1999; 37: 117–121.
3. Johansen LV, Hjelm-Hansen M and Andersen AP. Squamous cell carcinoma of the nasal vestibule. Treatment results, Acta Radiol Oncol 1984; 23: 189–192.
4. Kagan AR, Nussbaum H and Rao A. et al. The management of carcinoma of the nasal vestibule, Head and neck surgery 1981; 4: 125–128.
5. Langendijk JA, Poorter R and Leemans CR, et al. Radiotherapy of squamous cell carcinoma of the nasal vestibule, Int J Radiat Oncol Biol Phys 2004; 59: 1319–1325.
6. Levendag PC and Pomp J., Radiation therapy of squamous cell carcinoma of the nasal vestibule, Int J Radiat Biol Phys 1990; 19: 1363–1367.
7. Mendenhall WM, Stringer SP and Cassisi N et al. Squamous cell carcinoma of the nasal vestibule, Head Neck 1999; 21: 385–393.
8. Wong CS and Cummings BJ. The place of radiation therapy in the treatment of squamous cell carcinoma of the nasal vestibule: A review, Acta Oncol 1988; 27: 203–208.
9. TNM AJCC classification system; edition 2002; Nasal Cancers.
10. Wang CC. Treatment of carcinoma of the nasal vestibule, Cancer 1976;38: 100–106.
11. Patel P, Tiwari R and Karim AB et al. Squamous cell carcinoma of the nasal vestibule, J Laryngol Otol 1992; 106: 332–336.
12. Weinberger JM, Briant TD and Cummings BJ et al. The role of surgery in the treatment of squamous cell carcinoma of the nasal vestibule, J Otolaryngol 1988; 17: 372–375.
13. Evensen EF, Jacobsen AB and Tausio E. Brachytherapy of squamous cell carcinoma of the nasal vestibule, Acta Oncol (Suppl 8) 1996; 35: 87–92.
14. Chassagne D and Wilson JF. Brachytherapy of carcinoma of the nasal vestibule, Int J Radiat Biol Phys 1984; 10: 761.
15. Mazeron JJ, Chassagne D and Crook J et al. Radiation therapy of carcinomas of the skin of nose and nasal vestibule: A report of 1676 cases by the Groupe European de Curietherapie, Radiother Oncol 1988; 13: 165–173.
16. Mendenhall NP, Parsons JT and Cassisi NJ et al. Carcinoma of the nasal vestibule treated with radiation therapy, Laryngoscope 1987; 97: 626–632.
17. Wong CS, Cummings BJ and Elhakim T et al. External irradiation for sqaumous cell carcinoma of the nasal vestibule, Int J Radiation Biol Phys 1986; 12: 1943–1946.
18. Kummer E, Rasch C and Keus RB et al. T stage as prognostic factor in irradiated localized squamous cell carcinoma of the nasal vestibule, Head Neck 2002; 24: 268–273.
19. Levendag PC, Schmitz PIM and Jansen PP. Fractionated high-dose-rate and pulsed-dose-rate brachytherapy: First clinical experience in squamous cell carcinoma of the tonsillar fossa and soft palate, Int J Radiat Oncol Biol Phys 1997; 38: 497–506.
20. Goepfert H. The vex and fuss about nasal vestibule cancer [editorial comment], Head Neck 1999; 21: 383–384.

21. Nijdam WM, Levendag PC and Noever I et al. Cost analysis comparing brachytherapy versus surgery for primary carcinoma of the tonsillar fossa and/or soft palate, Int J Radiat Oncol Biol Phys 2004; 159: 488–494.

22. Mureau MAM, Moolenburgh SE and Levendag PC et al. Aesthetic and functional outcome following nasal reconstruction, Plast Reconstr Surg 2007; 120(5): 1217-27.

Chapter 8

Nasal reconstruction after malignant tumour resection: An algorithm for treatment

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Submitted for publication

ABSTRACT

Background The current incidence of non-melanoma skin cancer in the US is one million new cases per year. Seventy five percent of these malignancies are located in the head and neck area of which 30 percent occur on the nose (225,000 new cases per year). Aim of this study was to develop a nasal reconstruction algorithm for nasal defects, based on experience with 788 consecutive nasal reconstructions, which were performed in a multidisciplinary University Medical Centre based setting over the past seven years. These results were put in perspective with those acquired from literature.

Methods Medical files of 788 consecutive patients who were operated for various nasal pathologies between January 2001 and December 2008 were reviewed. In addition, a literature search on treatment of nasal defects and outcome after nasal reconstruction was conducted by using Pubmed.

Results The algorithm divides nasal defects in simple, small, skin only or larger, skin and cartilage, or full thickness. Small defects can be closed primarily or with various local flaps depending on defect size, shape, and location. For larger defects the three-stage paramedian forehead flap is the flap of choice with or without the use of cartilage grafts. For small inner lining defects full thickness skin grafts or turn down lining flaps with delayed primary cartilage grafts at the intermediate stage currently have our preference. For medium to larger inner lining defects the folded forehead flap with delayed primary cartilage grafts at the intermediate stage is our preferred technique. For (sub)total nasal reconstructions with very large inner lining requirements we would now consider free vascularized tissue transfer.

Conclusion Nasal skin cancer is an increasing problem. Proper treatment of nasal skin cancer including nasal reconstruction requires a structured multidisciplinary approach in order to achieve excellent tumour control and a satisfactory aesthetic and functional end result.

INTRODUCTION

The incidence of non-melanoma skin cancer in the United States of America at this moment is one million new cases per year; 83,333 per month, 19,230 per week, 2,739 per day, 114 per hour, or one per minute [http://www.cancer.gov/cancertopics/types/skin]. [1-3] Seventy five percent of these malignancies are located in the head and neck area of which 30 percent occur on the nose (225,000 new cases per year). [1-3] Dermatologists and plastic surgeons are experiencing a sharp increase in the numbers of patients, who need treatment because of the tremendous increase in the incidence of skin cancer. [3,4] Non-melanoma skin cancer is mostly slowly growing and unlikely to metastasize, however if neglected, tumour related destruction of anatomic features can create difficult reconstructive challenges. This holds especially true for the nose. [3,4]

The first description of nasal reconstruction was documented around 700-600 BC by Sushruta. [5] Since then the emphasis in nasal reconstruction has shifted from just simply filling a hole towards trying to accomplish an end result that resembles the natural situation as closely as possible. Burget and Menick have further refined nasal reconstruction techniques by introducing the aesthetic subunit principles. [6]

Despite tremendous technical enhancements in nasal reconstruction techniques, a lack of empirical evidence as to which type of defect requires which type of reconstruction still remains. A guideline was derived by developing a nasal reconstruction algorithm for every type of nasal defect, based on experience with 788 consecutive nasal reconstructions, which were performed in a multidisciplinary University Medical Centre based setting during the last seven years. These results were put in perspective with those acquired from a literature review.

PATIENTS AND METHODS

Medical files of 788 consecutive patients who were operated for various nasal pathologies between January 2001 and December 2008 were reviewed. In our setting facial skin tumours were mainly treated by surgical excision. Either dermatologists or plastic surgeons performed conventional excisions. Dermatologists performed Mohs' micrographic surgery when tumour characteristics were unfavourable e.g. aggressive subtype (sclerosing, morpheaform, micronodular, basal cell carcinoma with squamous differentiation, trabecular, infiltrative), location on H-zone (which includes the whole nose), and tumour size of at least 1 cm in

diameter. [3] Dermatologists or plastic surgeons reconstructed small and less complicated defects. Large, composite, or complex defects were reconstructed by plastic surgeons. Patient data were retrieved from medical files, operative notes, and photographs. The following criteria were scored: age, sex, type of surgical excision (conventional or Mohs'), defect location according to the subunit principle, defect size, type of tissue involved (skin, cartilage, mucosa), number of operations, and type of nasal reconstruction. All histology reports from nasal skin malignancies were evaluated as well. After data evaluation we developed an algorithm for treatment based on defect size, location (according to the subunit principle), and complexity (according to which tissues were involved).

All large, composite, or complex surgical defects were reconstructed using the principles of aesthetic nasal reconstruction as comprehensively described by Burget and Menick. [7,8]

In addition, a literature search was conducted by using Pubmed. Initial search term was "nasal or nose reconstruction". We combined this term with "reconstruction technique" and "outcome". These two terms were separately combined with all different nasal subunits "ala", "sidewall", "dorsum", "tip", "columella", and "vestibulum nasi". Finally, "nasal or nose reconstruction" was also combined with terms "complex" or "simple".

RESULTS

Patient and tumour characteristics

The group consisted of 370 men and 418 women with a mean age of 67 years (SD=13 yrs, range =20 to 100 yrs) at the time of removal of a nasal skin malignancy. Four hundred and ten patients (52%) were treated using Mohs' micrographic surgery; 403 were basal cell carcinomas, six squamous cell carcinomas and one melanoma. The remainder of the patients were treated by conventional excision (309 basal cell carcinomas, 43 squamous cell carcinomas and three melanomas). Conventional surgical excisions, which in many cases were marginal excisional biopsies of non-biopsy proven lesions, primarily showed positive resection margins in 93 cases that needed subsequent re-excision. Another 23 cases of squamous cell nasal vestibule cancer were treated with interstitial radiotherapy and did not need further reconstructive therapy.

The distribution of nasal tumours on the different nasal subunits is outlined in Table 1. The most frequent location was the nasal ala (227) followed by dorsum (188), tip (162) and sidewall (129). Less frequent locations were columella (10) and vestibulum nasi (25). In 47 cases the initial tumour had already spread widely over more than one subunit.

Table I. Overall distribution of nasal tumours and defects across nasal subunits

Subunit	Tumour type			No of defects	Male	Female
	BCC[a]	SCC[b]	Melanoma			
Dorsum	174	13	1	188	86	102
Lateral sidewall	123	6	0	129	60	69
Tip	156	6	0	162	69	93
Ala	224	3	0	227	113	114
Columella	7	3	0	10	5	5
Vestibulum nasi	3	20	2	25	13	12
Hemi nose	16	15	0	31	14	17
Total nose	8	7	1	16	10	6
Total	711	73	4	788	370	418

a BCC = Basel cell carcinoma

b SCC = Squamous cell carcinoma

Reconstruction of Skin Only Defects (Table 2)

Primary closure

Small defects on the nose, especially in the upper two thirds of the nose, were often closed primarily (n=121). On the distal third of the nose only very small defects <1cm were closed primarily. (n=86)

Full thickness skin grafts (FTSG)

FTSGs were used on a regular basis to reconstruct small defects on the nasal dorsum (n=56), tip (n=51), or ala nasi (n=45). FTSGs were regularly used (n=178) either as temporary reconstruction, because it was unclear whether surgical margins were tumour-free, or as a definite reconstruction in case patients wanted a simple one-stage solution.

Local and regional flaps

A wide range of local transposition flaps to reconstruct small skin-only defects was used. Ninety-two bilobed flaps were mainly used for tip (n=37), alar (n=30), and supratip (n=16) defects. One stage nasolabial flaps were primarily used for alar defects (n=71), but were occasionally also performed to reconstruct nasal sill (n=1) and lateral sidewall defects (n=7). Dorsonasal or Miter flaps (n=30) were almost exclusively used for defects of the nasal dorsum (n=27); in 15% of all dorsonasal defects this type of reconstruction was chosen. V-Y advancement flaps (n=8) were occasionally chosen to reconstruct defects on the nasal dorsum (n=2), tip (n=5) and columella (n=1).

Table II. Reconstruction of skin only defects categorized by subunit

Subunit	No of defects	Type of reconstruction	No	(%)
Dorsum	185	Primary closure	74	(40%)
		Full thickness graft	56	(30%)
		Dorsonasal flap	27	(15%)
		Bilobed flap	16	(9%)
		Forehead flap	6	(3%)
		Nasolabial flap	2	(1%)
		V-Y advancement flap	2	(1%)
		Banner flap	1	(0,5%)
		A-T flap	1	(0,5%)
Lateral sidewall	126	Primary closure	47	(37%)
		Lateral advancement	36	(29%)
		Full thickness graft	24	(19%)
		Bilobed flap	9	(7%)
		Nasolabial flap	7	(6%)
		Forehead flap	3	(2%)
Tip	152	Full thickness graft	51	(34%)
		Primary closure	41	(27%)
		Bilobed flap	37	(24%)
		Forehead flap	7	(5%)
		Nasolabial flap	5	(3%)
		V-Y advancement flap	5	(3%)
		A-T flap	4	(3%)
		Dorsonasal flap	2	(1%)
Ala	193	Nasolabial flap	71	(37%)
		Full thickness graft	45	(23%)
		Primary closure	44	(23%)
		Bilobed flap	30	(15%)
		A-T flap	2	(1%)
		Dorsonasal flap	1	(1%)
Vestibulum nasi	2	Nasolabial flap	1	(50%)
		Extended Abbe flap	1	(50%)
Columella	5	Full thickness graft	2	(40%)
		Primary	2	(40%)
		V-Y flap	1	(20%)
Lateral sidewall, ala and tip	6	Forehead flap	6	(100%)
Lateralsidewall and dorsum	1	Forehead flap	1	(100%)
Total	670		670	

Larger skin-only defects comprising more than one nasal subunit (n=7) were always reconstructed using the paramedian forehead flap.

Reconstruction of Skin and Cartilage Defects (Table III)

Auricular concha was used as donor site in 36 cases. In one case nasal septum was used as donor site. In seven cases a cartilage reconstruction was not necessary because of the small size of the defect. These cartilage grafts were used as alar batten grafts (62%), nasal supratip grafts (26%), columellar strut grafts (7%) and dorsal onlay grafts (5%). In three patients more than one graft was used at the time of reconstruction.

After restoring the nasal cartilage framework, nasal skin cover was accomplished with a paramedian forehead (n=12), nasolabial (n=23), bilobed (n=1), or a facial artery perforator flap (n=2). Larger defects were mainly reconstructed with a forehead flap. In cases where other flaps were used these would be nasolabial-based flaps for isolated alar or columellar defects. If the defect involved more than one aesthetic subunit (n=6), a paramedian forehead flap was selected as nasal cover in all the cases.

Table III. Reconstruction of skin and cartilage defects categorized by subunit or combination of subunits

Subunit	No of defects	Type of reconstruction	No	(%)
Dorsum	2	Forehead flap in combination with a cartilage graft	1	(50%)
		Nasolabial flap in combination with a cartilage graft	1	(50%)
Tip	4	Forehead flap in combination with a cartilage graft	3	(75%)
		Nasolabial flap in combination with a cartilage graft	1	(25%)
Ala	423	Forehead flap in combination with a cartilage graft	2	(9%)
		Nasolabial flap in combination with a cartilage graft	20	(87%)
		Bilobed flap in combination with a cartilage graft	1	(4%)
Columella	3	Facial artery flap in combination with a cartilage graft	2	(75%)
		Nasolabial flap in combination with a cartilage graft	1	(25%)
Ala, lateral sidewall and tip	3	Forehead flap in combination with a cartilage graft	3	(100%)
Tip and both ala	1	Forehead flap in combination with a cartilage graft	1	(100%)
Both ala, lateral sidewalls and tip	2	Forehead flap in combination with a cartilage graft	2	(100%)
Total	38		38	

Reconstruction of full thickness, composite or complex defects (Table IV)

Intranasal lining

Inner lining reconstruction was required in 56 patients. These flaps consisted of turnover skin flaps surrounding the defect, ipsilateral mucoperichondrial flaps, contralateral mucoperichondrial flaps, composite septal hinge flaps, composite septal pivot flaps, folded forehead flaps, a combination of multiple lining flaps, and FTGSs. The distribution of occurrence for these flaps is presented in table IV.

Cartilage defect reconstruction

All cartilage grafts used in the full thickness defects were auricular concha, septal or rib cartilage grafts in 56 cases. These cartilage grafts were used as alar batten grafts (70%), nasal supratip grafts (64%), columellar strut grafts (4%) and dorsal onlay grafts (10%).

Table 4. Reconstruction of skin, cartilage and mucosal defects categorized by subunit or combined subunits

Subunit	No of defects	Type of reconstruction	No	(%)
Dorsum	1	Nasolabial flap, Innerling and Cartilage graft*	1	(100%)
Tip	7	Forehead flap, Innerlining*, Cartilagegraft*	7	(100%)
Ala	11	Nasolabialflap, Innerling and Cartilage graft*	6	(51%)
		Forehead flap, Innerlining, Cartilagegraft*		
Ala, lateral sidewall	21	Forehead flap, Innerlining*, Cartilagegraft*	5	(49%)
and tip		Forehead flap, Innerlining*, Cartilagegraft*	21	(100%)
Tip and both ala	1	Forehead flap, Innerlining* and Cartilagegraft*	1	(100%)
Tip, ala and columella	2	Forehead flap, Innerlining*, Cartilagegraft*	2	(100%)
Total nose	14	Free radialforearmflap	4	(29%)
		Innerlining*, Cartilage graft*	1	(7%)
		Implant retained nasal prosthesis	7	(50%)
		Nasal prosthesis without implant	2	(14%)
Total	57		57	

*more specified in text

Nasal skin cover

Skin defects were reconstructed with a paramedian forehead flap according to aesthetic subunit principles in 71% of patients. In six patients an alar defect was covered with a two-stage nasolabial flap (11%). In one patient, who suffered from basal cell nevus syndrome and had been operated for facial skin malignancies multiple times, nasal skin cover was reconstructed using a free radial forearm flap.

In nine patients after total nasal amputation, it was not possible to perform a nasal reconstruction because of severe co-morbidity and high age or a patient's explicit whish not to be operated. In seven patients an implant retained nasal prosthesis was placed and in two cases a nasal prosthesis without implants was used.

Literature Review

Table V shows a brief survey of published studies on nasal reconstruction techniques. Three reports favoured primary closure, secondary healing, or FTSGs for small skin only defects smaller than 1 cm. For larger skin only defects up to 1.5 to 2 cm local flaps were preferred. Alar defects were preferably reconstructed with nasolabial flaps in three articles. Two papers preferred a nasolabial flap for alar defect reconstruction after comparing it to a forehead flap. All studies agreed upon reconstruction with a paramedian forehead flap for large nasal defects. Inner lining was reconstructed using several different techniques varying from FTSGs to microsurgical free flaps (Table V).

Algorithm for treatment

Figures 1 and 2 outline the surgical options for reconstruction of nasal defects based on our personal experience with 788 cases and a literature review. Defects are divided in skin only, skin and cartilage, and full thickness defects. Per subunit is shown what reconstructive tools are available and preferred.

Table V. Literature review on reconstruction techniques of nasal defects

Author	Defect	Technique	No	Outcome
Van der Eerden et al (2008)[36]	Skin only <1cm (all subunits)	Secondary healing	89	43% excellent
Gurunluoglu et al (2003)[13]	Skin only <2 cm (all subunits)	Full thickness skin graft	15	99% good-excellent-
Guo et al (2006)[9]	Skin only<2 cm (all subunits)	Local flaps	300	Algorithm of treatment per nasal zone
Arden et al (1999)[20]	Alar (skin only)	Forehead flap and Melolabial flap	38	Melolabial flap more preferred
Drisco (2001)[37]	Alar (full thickness)	Forehead flap, septal mucoperichondrium flap and free cartilage grafts	50	Highly aesthetical and functional outcome
Singh et al (2003)[23]	Alar (full thickness)	Nasolabial and Forehead flaps	0	<1,5 cm nasolabial flap >1,5 forehead flap Experts opinion, no outcome was measured
Thornton et al (2008)[38]	Nasal tip (skin only)	Two-stage Nasolabial flap	80	3 complications no outcome measured
Rohrich et al (2004)[22]	All subunits all defects	Local, Forehead, Nasolabial flap	1334	Excellent outcome
Quatela et al (1995)[39]	Various nasal defects	Forehead flap	32	Good to excellent
Menick (2002)[26]	Various nasal defects	Forehead flap	0	Experts opinion, no outcome was measured
Zhang YX (2008)[40]	Alar, tip and columella	Composite graft helical rim	63	Reliable method
Klingensmith et al (1994)[17]	Nasal tip (full thickness)	FTG, local flap, Forehead, Nasolabial flap	165	<1 cm FTG, >2cm bilobed, forehead, nasolabial flap
Menick (2006)[30]	Nasal lining	Folded Forehead flap	1	Excellent
Taghinia et al (2006)[34]	Nasal lining	Review of all techniques	0	Review of all inner lining possibilities
Walton et al (2005)[31]	Nasal lining	Microsurgical flaps	11	Mainly used when previous inner lining reconstruction failed.
Beahm et al (2005)[41]	Nasal lining	Free first dorsal metacarpal artery flap	1	Excellent
Flood et al (1998)[42]	Total nasal defect	Implant retained prosthesis	14	Surgical pleasing end result

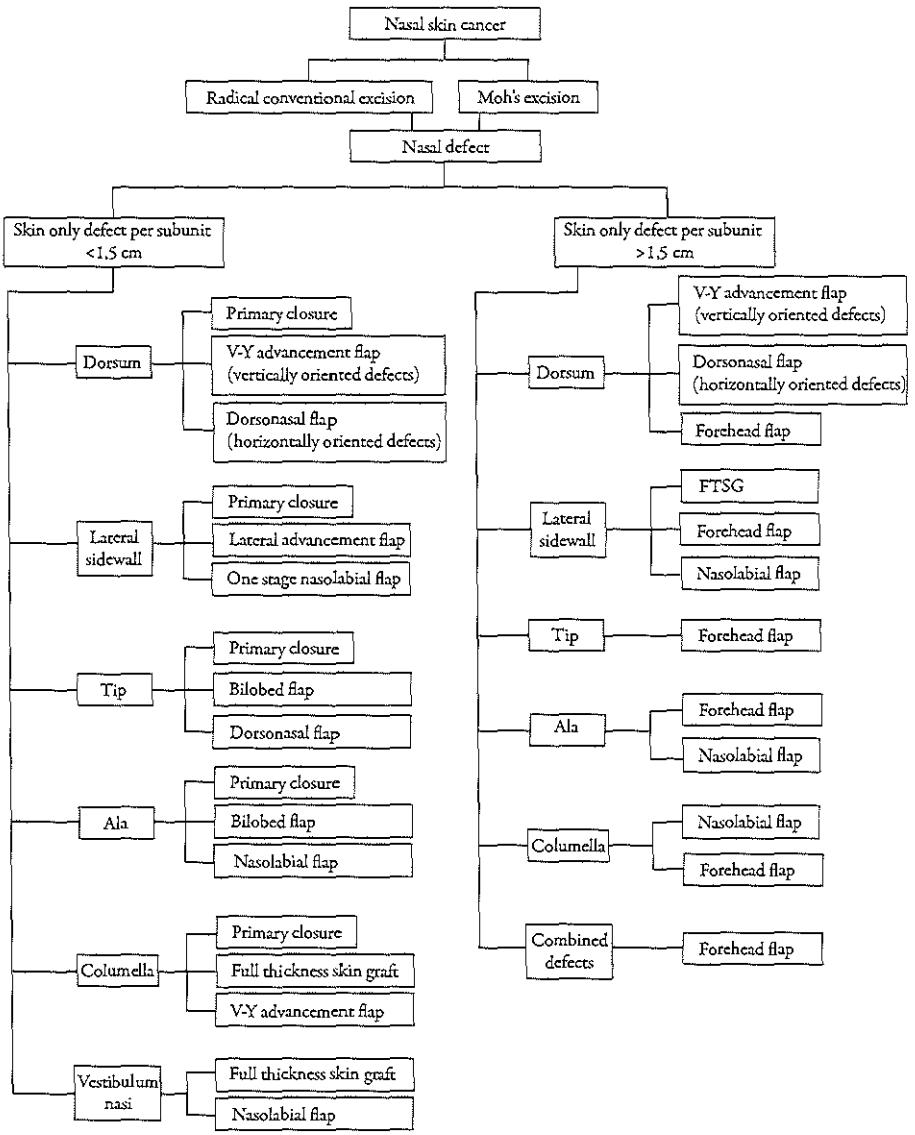

Figure 1. Treatment algorithm for skin only nasal defects

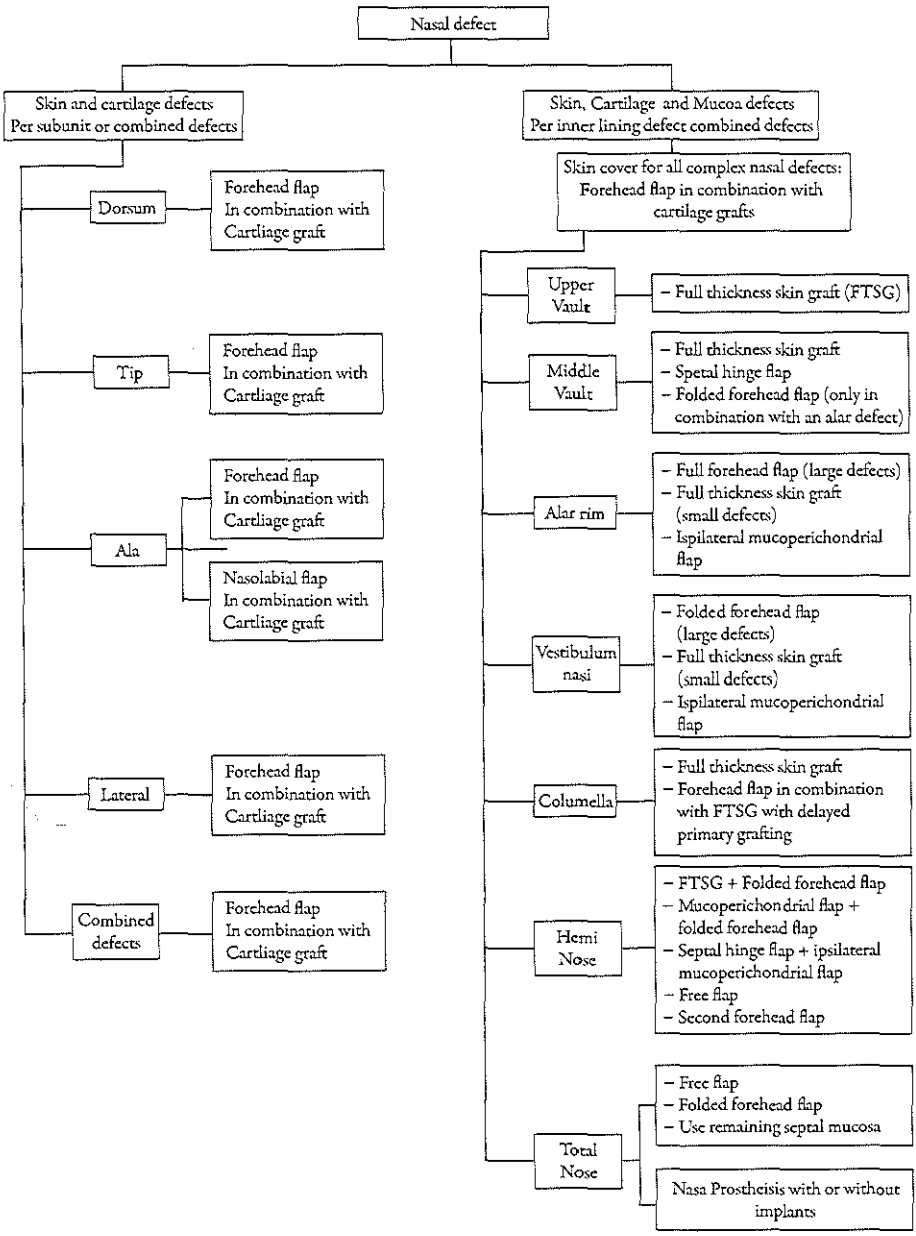

Figure 2. Treatment algorithm for complex nasal defects

DISCUSSION

The incidence of nasal skin cancer is increasing rapidly worldwide. [1,2] Clear guidelines and a multidisciplinary approach for treatment of nasal skin cancer are important to ensure that patients receive optimal care with satisfactory end results for tumour control as well as reconstructive outcome. One element in the guidelines for nasal skin cancer treatment is the reconstructive plan after tumour control has been achieved. For this purpose, we developed a reconstructive algorithm for all types of nasal defects based on personal clinical experience combined with a literature review.

Radical tumour resection prior to complex nasal reconstruction is extremely important. This can be achieved with either Mohs'surgery or conventional excision awaiting final pathology, which usually takes three to seven days. In the present study Mohs' surgery was used in about fifty percent of cases, which is less than in previously published reports. [9] The main explanation for this discrepancy is that Mohs' surgery was only introduced to our institution in 2002. Currently, the use of Mohs' micrographic surgery has increased to 90% at our centre. Most nasal skin cancer patients are now seen by a dermatologist and plastic surgeon in a multidisciplinary clinic where the patient is evaluated, a tentative reconstructive plan is made, and the patient is informed. Subsequently, the patient is scheduled for Mohs' surgery by the dermatologist and delayed primary reconstruction one to three days later by the plastic surgeon. Since Mohs' surgery ensures radical tumour resection in one operation, patients need no longer wait for final pathology. From a patient comfort point of view, it is now our preferred method of nasal skin cancer treatment. Despite these advantages one should bear in mind that Mohs' surgery does not necessarily result in the lowest recurrence rates. [3,10] Still, there is evidence that Mohs' micrographic surgery provides lower recurrence rates than conventional surgical excision for recurrent BCCs. [10]

In our series there was an extremely high percentage of irradical first nasal skin cancer resections as these were set up as excisional biopsies in suspect but non-biopsy proven lesions. In less critical areas these irradical excision percentages in our centre were far lower. These excisional biopsies, used prior to the current standard practice of Mohs' surgery for nasal skin cancers, are comparable to the practice of performing a punch biopsy prior to performing a scheduled Mohs' surgery.

At our centre early stage cancer of the nasal vestibule was treated with high dose interstitial radiation therapy. Since most of these patients presented with squamous cell carcinomas, conventional excision of these tumours with a margin of at least 5 mm would have led to composite defects involving columella, nasal tip, alar rim and lateral sidewall. This

group was evaluated in a separate study on tumour control, cosmesis and function, which reflected excellent results when high-dose-rate interstitial radiation therapy was used. [11] In our opinion interstitial radiation therapy should be the first treatment of choice for early stage nasal vestibule squamous cell carcinoma. All other nasal skin cancers should be treated with Mohs' surgery or with appropriate surgical excision margins.

In our series primary closure and FTSGs were often used to close small (<1.5 cm) skin-only defects. The liberal use of FTSGs can be explained by the fact that:

1. temporary closure of the defect in expectation of definite pathology was performed;
2. FTSGs are an easy, safe and fast way to cover a skin defect; and
3. some patients requested a simple and fast reconstructive solution. In comparison with other studies that proposed algorithms for nasal reconstruction it is remarkable, that primary closure and FTSGs have not even been mentioned as an option for closing small defects.

There is only one other study that compared FTSGs and local flaps for small nasal skin defects. [12] That study indicated that FTSG reconstructions had higher complication rates but local skin flap reconstructions led to more aesthetic deficiencies. Alternatively, the use of a composite dermal fat graft is a more accepted type of reconstruction. Two studies have been published with subjective results of composite skin grafts for small nasal skin defects. [13,14] Both showed excellent aesthetic results though subjectively measured. A different method to improve aesthetic outcome of FTSG reconstruction of nasal skin defects is the use of the forehead as donor-site since it has the right thickness, colour and texture. [8]

Local flaps have a good reputation for reconstruction of skin only nasal defects. A recently published algorithm for small nasal skin only defects by Guo et al. showed a complete overview of all local flaps that can be used in nasal reconstruction. [9] They arranged their algorithm in three anatomical zones: proximal, middle, and distal. They used the Miter and glabella flap in 83% for reconstruction of the proximal third zone. In our series the Miter (dorsonasal) flap was used in only 15% percent of cases. This difference can be explained by the fact that we looked at all different types of reconstruction and not only local flaps. For nasal tip or distal nasal defects the bilobed flap was often the flap of choice. This flap, originally described by Esser and later modified by McGregor and Zitelli, uses local, excellent matching skin and has ideal geometrical properties to close defects smaller than 1.5 cm, leaving a minimal donor site defect. [15,16] Although its design does not adhere to the aesthetic subunit principle, scars heal usually remarkably well. However, trapdoor deformity due to circular scar contracture can be a problem. Similar to the case series by Guo et al., the nasolabial flap was our flap of choice for skin only nasal alar defects. [9] This flap has the tendency to trapdoor, which on the one hand recreates the natural convexity of the nasal ala but on the other hand makes

the end result more unpredictable. The flap needs additional structural support to prevent excessive contraction and nostril stenosis and has fallen somewhat out of favour over time. Similar to other studies the paramedian forehead flap was the flap of choice for all skin only nasal defects that included more than one nasal subunit. [9,17,18] It is undeniably the most important flap for nasal reconstruction. [7] Proper design and execution of the paramedian forehead flap lead to good aesthetic outcome. [19] The paramedian forehead flap stays well vascularized, even after it is vigorously thinned during the second stage when the delay phenomenon has taken place. It shows excellent colour and texture match, making it an excellent flap for nasal reconstruction. [19] For reconstruction of skin and cartilage defects (when the inner lining is still intact). Forehead and nasolabial flaps are first choice if only one subunit is involved. For larger defects the forehead flap is without competition. Both flaps have a minimum of two-stages and the forehead flap yields best results when used in three stages. Restoration of the nasal skeletal framework is of great importance. Without replacing missing cartilage or enhancing existing nasal cartilages, nasal appearance will lose its typical projection, contour and definition. In addition, the nasal skeletal framework is essential for optimal nasal functioning. [8] Auricular concha and septum cartilage are most often used as grafts. Choice for a specific site is dependent on individual requirements. The auricular concha has an intrinsic curve and can be a good donor site for alar reconstruction. The reconstructed nasal cartilage framework has to be stronger than the original nasal cartilages to withstand contracting wound healing forces of the surrounding soft tissues. Functional and aesthetic outcome has been reported as good to excellent when adhering to these principles. [19]

Reconstruction of complex nasal defects includes skin, cartilage and mucosa. Reconstruction of these composite defects poses the ultimate challenge in nasal reconstruction. Multistage procedures are needed to rebuild a functional but above all an aesthetically pleasing facsimile of a nose, which satisfies patient and surgeon alike. A minimum of three and maximum of seven operations were performed in the present series to achieve an acceptable end result. This is in line with other studies. [20-23] In many cases the plastic surgeon was not fully satisfied with the result and offered additional surgery rather than surgery being requested by patients who were often very pleased with the end result. [24]

Inner lining is a vital part in order to create a pleasing end result in nasal reconstruction. Various methods have been described to reconstruct inner ling. The simplest way is to use skin grafts, but these are dry and offer no blood supply to primarily placed cartilage grafts. [25] In the present series of 56 complex nasal reconstructions no skin grafts were used to reconstruct inner lining. For selected, smaller size inner lining defects a full thickness skin graft in combination with a delayed primary cartilage graft is a good option. [26] The septal

hinge flap, first described by Wilkinson in 1978, was used in 18% of the present cases. [27] Turnover skin flaps surrounding the defect were used to provide inner lining in 27% of our cases. [18.28] These flaps however are only possible in long standing defects where the edges of the defect have been re-epithelialized. Both of the above mentioned flaps are in favour when there is a total defect of only one subunit. When two or more subunits are involved other inner lining flaps are preferred.

For bigger inner lining reconstructions, as in hemi nasal full thickness defects, ipsilateral mucoperichondrial flaps anterocaudally based on the septal branch of the superior labial artery in combination with contralateral mucoperichondrial flaps dorsally based on branches of the anterior ethmoidal vessel were often used. These flaps were first described by Burget and Menick in 1989. [29] In the present series these flaps were used in 45% of the cases. Our experience is that these flaps have a less reliable circulation, especially when combined with cartilage grafts. We have changed to the modified folded forehead flap as our inner lining reconstructive option of choice. It is a thin, supple and vascular lining and in combination with delayed primary cartilage grafts provides excellent functional and cosmetic results 30. A reliable option for major inner lining loss is a free flap to be used as vascularized inner lining. Walton et al. described 11 cases of microsurgical reconstruction of the intranasal lining31. The majority of indications were necrosis of previous inner lining reconstruction. The free flap of choice was a free radial forearm flap because of its robust vascularity, large vessels, and thin subcutaneous adipose layer. [31,32] In addition, a free flap can also be used as a last resort for skin coverage and even as a prelaminated flap. These flaps are often reserved for major defects passing the boundaries of the nasal subunits. [33,34]

Three things are important for nasal reconstruction: surgical skill, patient motivation and medical condition of the patient. Some patients benefit from just a simple solution such as a prosthesic device rather than a very complex multi stage operation. In this series nine nasal prostheses were used. Seven implant retained nasal prosthesis and two without an implant. This number is in line with another study published on facial prostheses. [35] Little is known about aesthetic outcome and patient satisfaction after nasal prosthetics and this will be a topic of future research.

CONCLUSION

Proper treatment of nasal skin cancer requires a structured multidisciplinary approach in order to achieve excellent tumour control and a satisfactory aesthetic and functional end result.

REFERENCES

1. Diepgen TL and Mahler V. The epidemiology of skin cancer. Br J Dermatol 2002; 146 Suppl 61: 1-6.
2. Greinert R. Skin cancer: new markers for better prevention. Pathobiology 2009; 76: 64-81.
3. Smeets NW, Krekels GA and Ostertag JU, et al. Surgical excision vs Mohs' micrographic surgery for basal-cell carcinoma of the face: randomised controlled trial. Lancet 2004; 364: 1766-72.
4. Smeets NW, Kuijpers DI and Nelemans P, et al. Mohs' micrographic surgery for treatment of basal cell carcinoma of the face--results of a retrospective study and review of the literature. Br J Dermatol 2004; 151: 141-7.
5. From the Sushruta Samita circa 600 BC translated from the sanskrit. Calcutta: K.K.L.Bhishagratna, 1907.
6. Burget GC and Menick FJ. The subunit principle in nasal reconstruction. Plast Reconstr Surg 1985; 76: 239-47.
7. Burget GC and Menick FJ. Aesthetic Reconstruction of the Nose. St Louis: Mosby, 1994.
8. Menick FJ. Nasal Reconstruction: Art and Practice. New York: Saunders, 2008.
9. Guo L, Pribaz JR and Pribaz JJ. Nasal reconstruction with local flaps: a simple algorithm for management of small defects. Plast Reconstr Surg 2008; 122: 130e-39e.
10. Mosterd K, Krekels GA and Nieman FH, et al. Surgical excision versus Mohs' micrographic surgery for primary and recurrent basal-cell carcinoma of the face: a prospective randomised controlled trial with 5-years' follow-up. Lancet Oncol 2008; 9: 1149-56.
11. Levendag PC, Nijdam WM and 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.
12. Rustemeyer J, Gunther L and Bremerich A. Complications after nasal skin repair with local flaps and full-thickness skin grafts and implications of patients' contentment. Oral Maxillofac Surg 2009; 13: 15-9.
13. Gurunluoglu R, Shafighi M, Gardetto A and Piza-Katzer H. Composite skin grafts for basal cell carcinoma defects of the nose. Aesthetic Plast Surg 2003; 27: 286-92.
14. Hubbard TJ. Leave the fat, skip the bolster: thinking outside the box in lower third nasal reconstruction. Plast Reconstr Surg 2004; 114: 1427-35.
15. Esser JFS. Gestielte lokale nasenplastik met zweizipligem lappen deckung des sekundaren defektes vom ersten zipfel durch den zweiten. Dtsch z Chirurgie 1918; 143: 385.
16. Zitelli JA. The bilobed flap for nasal reconstruction. Arch Dermatol 1989; 125: 957-9.
17. Klingensmith MR, Millman B and Foster WP. Analysis of methods for nasal tip reconstruction. Head Neck 1994; 16: 347-57.
18. Menick FJ. Nasal reconstruction: forehead flap. Plast Reconstr Surg 2004; 113: 100E-11E.
19. Mureau MAM, Moolenburgh SE, Levendag PC and Hofer SOP. Aesthetic and functional outcome following nasal reconstruction. Plast Reconstr Surg 2007; 120: 1217-27.
20. Arden RL, Nawroz-Danish M, Yoo GH, Meleca RJ and Burgio DL. Nasal alar reconstruction: a critical analysis using melolabial island and paramedian forehead flaps. Laryngoscope 1999; 109: 376-82.

21. Boyd CM, Baker SR, Fader DJ, Wang TS and Johnson TM. The forehead flap for nasal reconstruction. Arch Dermatol 2000; 136: 1365-70.

22. Rohrich RJ, Griffin JR, Ansari M, Beran SJ and Potter JK. Nasal reconstruction--beyond aesthetic subunits: a 15-year review of 1334 cases. Plast Reconstr Surg 2004: 114: 1405.

23. Singh DJ and Bartlett SP. Aesthetic considerations in nasal reconstruction and the role of modified nasal subunits. Plast Reconstr Surg 2003: 111: 639-48; discussion 49-51.

24. Moolenburgh SE, Mureau MAM and Hofer SOP. Aesthetic outcome after nasal reconstruction: patient versus panel perception. J Plast Reconstr Aesthet Surg 2008: 61: 1459-64.

25. Menick FJ. The use of skin grafts for nasal lining. Clin Plast Surg 2001: 28: 311-21.

26. Menick FJ. A 10-year experience in nasal reconstruction with the three-stage forehead flap. Plast Reconstr Surg 2002: 109: 1839-55.

27. Wilkinson TS. Alar hinge flap in heminasal reconstruction. Ann Plast Surg 1978: 1: 481-4.

28. Menick FJ. Nasal reconstruction with a forehead flap. Clin Plast Surg 2009: 36: 443-59.

29. Burget GC and Menick FJ. Nasal support and lining: the marriage of beauty and blood supply. Plast Reconstr Surg 1989: 84: 189-202.

30. Menick FJ. A new modified method for nasal lining: the Menick technique for folded lining. J Surg Oncol 2006: 94: 509-14.

31. Walton RL, Burget GC and Beahm EK. Microsurgical reconstruction of the nasal lining. Plast Reconstr Surg 2005: 115: 1813-29.

32. Burget GC and Walton RL. Optimal use of microvascular free flaps, cartilage grafts, and a paramedian forehead flap for aesthetic reconstruction of the nose and adjacent facial units. Plast Reconstr Surg 2007: 120: 1171-207.

33. Pribaz JJ, Weiss DD, Mulliken JB and Eriksson E. Prelaminated free flap reconstruction of complex central facial defects. Plast Reconstr Surg 1999: 104: 357-65.

34. Taghinia AH and Pribaz JJ. Complex nasal reconstruction. Plast Reconstr Surg 2008: 121: 15e-27e.

35. Visser A, Raghoebar GM, van Oort RP, Vissink A. Fate of implant-retained craniofacial prostheses: life span and aftercare. Int J Oral Maxillofac Implants 2008: 23: 89-98.

36. van der Eerden PA, Lohuis PJ, Hart AA, Mulder WC and Vuyk H. Secondary intention healing after excision of nonmelanoma skin cancer of the head and neck: statistical evaluation of prognostic values of wound characteristics and final cosmetic results. Plast Reconstr Surg 2008: 122: 1747-55.

37. Driscoll BP and Baker SR. Reconstruction of nasal alar defects. Arch Facial Plast Surg 2001: 3: 91-9.

38. Thornton JF and Weathers WM. Nasolabial flap for nasal tip reconstruction. Plast Reconstr Surg 2008: 122: 775-81.

39. Quatela VC, Sherris DA and Rounds MF. Esthetic refinements in forehead flap nasal reconstruction. Arch Otolaryngol Head Neck Surg 1995: 121: 1106-13.

40. Zhang YX, Yang J and Wang D, et al. Extended applications of vascularized preauricular and helical rim flaps in reconstruction of nasal defects. Plast Reconstr Surg 2008: 121: 1589-97.

41. Beahm EK, Walton RL and Burget GC. Free first dorsal metacarpal artery flap for nasal lining. Microsurgery 2005: 25: 551-5.

42. Flood TR and Russell K. Reconstruction of nasal defects with implant-retained nasal prostheses. Br J Oral Maxillofac Surg 1998: 36: 341-5.

Chapter 9
General discussion

GENERAL DISCUSSION

Nasal reconstruction is one of the greatest challenges for a facial reconstructive surgeon. For a patient, on the other hand, nasal amputation is one of the most mutilating facial defects. With an expansively growing incidence of nasal skin cancer, the need for optimal treatment increases for both tumour control as well as nasal reconstruction. The incidence of non-melanoma skin cancer in the United States of America is one million new cases per year. A total of 225,000 of these new skin cancers occur on the nose. [1,2] In the Netherlands the incidence of skin malignancies is expected to increase from 20.800 new cases per year in 2000 to 36.800 new patients per year in 2015. [3]

Evaluation of outcomes on a scientific level is required in order to provide optimal care and to accomplish the most favourable end result for both patient and treating surgeon. The studies presented in this thesis, aimed to improve the knowledge on psychological, functional and aesthetic outcome after nasal reconstruction. This final chapter evaluates the main findings in relation to other studies and provides suggestions for further research.

Development of a standardised tool to evaluate aesthetic and functional outcome after nasal reconstruction

A standardised tool is necessary to be able to evaluate aesthetic and functional outcome after nasal reconstruction in an objective, reliable, and reproducible manner. There is a general shortage of standardised outcome measures in plastic and reconstructive surgery. [4-7] A literature search revealed that no instruments exist to assess outcome and patient satisfaction after nasal reconstruction. Therefore, the Nasal Appearance and Function Evaluation Questionnaire (NAFEQ) was developed specifically to assess satisfaction with nasal function as well as nasal appearance in a comprehensive way (**Chapter 2**). The importance of a standardized tool is the ability to compare outcomes between different hospitals, patients and reconstruction techniques. With these data a real benefit could be derived using outcome assessment after nasal reconstruction and translated to refinements in nasal reconstruction techniques, which could lead to better aesthetic and functional results.

Clinical implementation of main findings

One of the main findings of this study was the rather high patient satisfaction with overall functional and aesthetic results after nasal reconstruction (**Chapter 3**). Although these results were comparable to other studies more critical investigation was continued as high satisfaction results would imply that no further improvements in nasal reconstruction

are possible or necessary. Since we used a standardised tool, which assessed every subunit separately, the particular items that patients favoured less could be identified. Elucidation of these items provides information for the surgeon to optimize the reconstructive techniques and results.

Alar lobule shape and nostril opening size were items that patients as well as panel members were least satisfied with. These results are in line with an earlier study in which patients reported to be least satisfied with nostril size and alar notching. [8] This indicates that these anatomical landmarks are very difficult to reconstruct. Furthermore it also became evident after analysing the complication and revision surgery data. About one third of the patients with a complex nasal defect underwent revisions, often on multiple occasions, for improving nostril stenosis and alar shape. In addition, these patients appeared to be less satisfied with their overall nasal appearance compared to patients who did not have revision surgery for nostril stenosis.

Another important finding was the significantly lower satisfaction rate with nasal reconstruction outcome assessed by professionals (five independent plastic surgeons) and laypersons compared to patients (**Chapters 4 and 5**). In the present study we selected five independent plastic surgeons to assess aesthetic outcome. The current panel outcome data are difficult to compare with previously published data, because of different panel compositions and different methods used. Only three other reports have actually used panels to assess subjective aesthetic outcome. [8-10] Drisco et al. had a panel consisting of one physician and two nurses. They did not investigate the inter-rater variability. [10] Quatela et al. used three otolaryngologists to assess aesthetic and functional results after nasal reconstruction. [9] In the present study an interclass correlation coefficient was computed. Values ranged between 0.75 and 0.94 (a value of 0 means no agreement between at least three different raters and a value of 1 means 100% agreement) indicating that there was a high level of agreement among the five different panel members.

We hypothesize that the difference in satisfaction is rooted in the professional experience of plastic surgeons, which leads to different levels of expectation. Presumably this occurs because their trained professional eye easily detects technical imperfections, which could be refined by additional surgery. In addition, professionals familiar with nasal reconstructions might focus exclusively on isolated features such as nasal alar asymmetries or nostril size instead of responding to the total face. In contrast, the patient might be more focused on the overall result that is compared to the defect before reconstruction. Most patients suffered from an extensive facial defect and they would never have imagined that they could get something back that would so closely resemble their missing nose. Another explanation for

the rather high patient satisfaction could be the patients' high mean age (64±15 years). It is known from a psychological study that patients who had congenital facial defects scored lower on facial aesthetic outcome than patients who had an acquired facial defect at an elderly age. [11,12] Finally, contrary to what might be expected, nasal reconstruction patients did not suffer from low levels of self-esteem (**Chapter 6**). This could be explained by the fact that self-esteem is developed during early puberty, and is unlikely to change discernibly after puberty. As this patient group developed a facial deformity at the mean age of 64 years, it is more plausible that their self-esteem was not affected. Since self-esteem was positively correlated with satisfaction with nasal appearance, the unaffected self-esteem could be another explanation for the high patient satisfaction. These findings are in contrast with, for example, patients with facial clefts who grow up with the belief that they are different which may induce lower levels of self-esteem. Berk et al. found that adult patients with facial clefts had significantly lower levels of self-esteem not only than their siblings, but also than a normal control group. [13]

The very critical assessment of aesthetic outcome after nasal reconstruction by laypersons is a remarkable finding. However, they became less critical when they were told that some of the shown persons had undergone a nasal reconstruction. Noticeably, the assessment of the healthy control group also became less critical. Apparently, the knowledge of a previous disease makes the observer less critical and a milder judge overall, since ratings improved significantly for both groups (patients as well as controls). Knowledge on how a layperson assesses outcome of a nasal reconstruction is extremely important as it may resemble the way an ordinary person to whom a patient may run into on the street perceives the result. There are several psychological theories which state that interaction between patient and perceiver results in a self-fulfilling prophecy whereby the patient incorporates the perceiver's expectations and behaviour into his or her self-concept. [12] If the above statement is true patients should also be less satisfied with their nasal appearance, which could for instance lead to social avoidance. Social avoidance was confirmed as a factor in one of our studies (**Chapter 6**). Significant differences in self-reported satisfaction with nasal appearance existed between patients and controls. Patients were less satisfied with their nasal appearance than healthy controls. Also patients reported significantly more social avoidance behaviour than healthy controls. No differences in other self-reported psychological outcomes were found between patients and controls. These results imply that, although in general patients are reasonably satisfied with their overall nasal appearance, a nasal reconstruction can have a profound effect on a patient's daily psychological and emotional functioning.

It is of clinical interest that nasal reconstruction patients were socially more afraid as a result of their more negative nasal appearance perception than their healthy counterparts. It is known that this could lead to social isolation, [12,14] which could also induce substantial depressive feelings and anxiety. [11-13] We were able to demonstrate increased levels of social anxiety, but not for depressive feelings. Also, problem coping styles differed significantly between patients and controls. Furthermore patients had a more passive coping style than the control group. In addition, a passive coping strategy had a strong negative correlation with satisfaction with nasal appearance. For active coping no statistical relationship with patient satisfaction was found. Moreover, passive coping had a stronger impact on the level of satisfaction with nasal appearance than active coping. Interestingly, De Boer et al. found that a passive coping style could be of even more importance than just lower satisfaction levels. [15] They found that survival in patients with a passive coping style was lower after head and neck cancer than in patients who had an active coping style. These findings indicate that coping style is a very important psychological patient characteristic to look for. If a plastic surgeon identifies a passive coping style, referral to a mental healthcare professional during the reconstructive period should be seriously considered.

Technical considerations in nasal reconstruction

The most common encountered complication was nostril stenosis (**Chapter 3**). In our opinion, inadequate inner lining frequently causes nostril stenosis and alar rim retraction. In our personal evolution of nasal reconstruction techniques we have slowly shifted away from the regular use of intranasal lining flaps. Circulation of these frail flaps is rather unreliable, especially when combined with cartilage grafts. The arc of rotation for transposition of these flaps is too often disappointing. Since reconstruction of inner lining is a vital step for successful nasal reconstruction, an adequate and reliable approach for inner lining restoration is a key element. In our opinion there is a very limited role left for intranasal lining flaps. Also Menick, who once stated that the ideal inner lining is inside the nose, [16] has moved away from this type of lining reconstruction. He has developed new concepts for inner lining restoration. [17-19]

Our current strategy for inner lining reconstruction (**Chapter 8**), is as follows. In cases with small inner lining requirements, full thickness skin grafts or turn down lining flaps with delayed primary cartilage grafting at the intermediate stage has our preference. [18] In cases with medium to larger inner lining requirements, the folded forehead flap with delayed primary cartilage grafting at the intermediate stage is our preferred technique. [17,18] For

(sub-)total nasal reconstruction with very large inner lining requirements free vascularized tissue transfer is the method of choice. [20]

Another challenging problem is alar rim thickness. In our series this improved after we changed from a two-stage to a three-stage forehead flap approach. This allowed safer and more radical thinning of the forehead flap during the second stage and needed to be combined with strategically positioned quilting sutures.

In the proposed algorithm a nasolabial flap or a forehead flap are the flaps of choice for reconstruction of an alar defect (**Chapter 8**). Two studies compared outcomes of these two flaps in reconstructing alar defects. Arden et al. preferred a nasolabial flap for defects smaller than 1.5 centimetres. For larger defects a forehead flap would be their reconstructive option. [8] Singh et al. on the other hand preferred a melolabial flap to a forehead flap for alar defects. [21] When comparing these two flaps, nasolabial flaps have more disadvantages such as unfavourable scarring, flattening of the nasolabial crease, inadequate definition of the alar base when using a one-stage nasolabial flap, the chance of tip necrosis, and long-term notching of the flap resulting in alar distortion. The forehead flap on the other hand is a safe flap, with less scarring, less obvious donor-site sequellae, and an excellent colour and texture match. Therefore, in our opinion the forehead flap is the flap of choice for reconstruction of large alar defects.

Treatment of nasal skin malignancies

With the increase of non-melanoma skin malignancies proper treatment in a multidisciplinary setting becomes increasingly important. In our centre either dermatologists or plastic surgeons perform conventional excisions. If tumour characteristics are unfavourable (e.g. aggressive subtype: sclerozing, morpheaform, micronodular, basal cell carcinoma with squamous differentiation, trabecular, infiltrative), location in the H-zone (which includes the whole nose) and tumour size of at least 1 cm in diameter), the dermatologist will perform Mohs' micrographic surgery. [2] Small and less complicated defects are reconstructed by dermatologists or plastic surgeons and large, composite, or complex defects are reconstructed by plastic surgeons.

A third option is direct radiotherapy without surgery. This has been performed in T1/T2N0 squamous cell carcinomas of the nasal vestibule (**Chapter 7**). Excellent tumour control, aesthetics and function of nasal airway passage were achieved with tumour control comparable to surgery. For T3 tumours local excision and reconstructive procedures are advised.

Another advantage of high-dose-rate brachytherapy, which is the first choice treatment of T1 or T2 vestibulum nasi squamous cell carcinomas as recommended by the Dutch Institute for Healthcare Improvement (CBO), [22,23] is an almost threefold cost reduction compared to surgical treatment followed by reconstructive surgery. From a cost perspective it would therefore seem beneficial to primarily irradiate all other nasal skin cancers as well. However, the Dutch Institute for Healthcare Improvement (CBO) recommends treating primary as well as recurrent skin cancers with conventional surgical excision or Mohs' micrographic surgery. [22] Radiotherapy is only recommended if surgical excision is not possible due to extensive tumour size or if the patient's general health precludes surgery. [22,23] Total costs for a complex nasal reconstruction could be reduced if after three operations an end result could be obtained that would satisfy both patients and treating surgeon. Although conceptually with a three-stage forehead flap reconstruction this could be achieved, our experience is that often more than three operations are necessary to achieve an optimal end result. Technically these operations could easily take place in a day care setting to further reduce costs. However, since most of these patients are rather old and often have multiple co-morbidities, they are usually admitted to hospital which increases total costs considerably.

FUTURE PERSPECTIVES

We conclude from this thesis that nasal reconstruction is a challenging procedure that can result in good aesthetic and functional outcome, when properly planned and executed. There are differences in assessment of aesthetics by patients, professionals and laypersons. The psychological impact of nasal reconstruction can be tremendous. We were able to identify personality characteristics that can predict outcome of patient satisfaction after nasal reconstruction.

Although we had the opportunity to study 788 patients in this thesis, only 56 were complex defects. Since there is a lack of statistical power with the limited group of patients with complex defects in this thesis, future research should be aimed at a prospective analysis of large groups of nasal reconstruction patients (multicentre). This is the only way to collect patient groups, which are large enough to cluster different nasal defect sizes and locations for statistical analysis. The results of this prospective multicentre study should be combined with the outcomes of personality characteristics and patient morbidity. These outcomes could be used for the development of a hypothesized prediction model, which can provide guidance

to the ideal reconstructive procedure for individual nasal defects, based on the characteristics of the nasal defect in combination with patient morbidity and personality characteristics.

The multidisciplinary treatment of nasal tumours, as previously advocated in this thesis, is successfully and satisfactory practiced in our setting. The level of evidence for this approach is still not fully available and therefore a subject for further research.

CONCLUSION

In order to achieve the highest level of satisfaction after nasal reconstruction the following considerations are vital. Local skin factors, such as previous malignancies, radiation, previous reconstructive procedures have to be assessed. Surgical skill and experience are paramount as nasal reconstruction is still very much an art, which needs to be supported with science. Patients' preference: nasal reconstruction is a time consuming procedure for the patient as well as the surgeon.

REFERENCES

1. Diepgen TL and Mahler V. The epidemiology of skin cancer. Br J Dermatol 2002; 146 Suppl 61: 1-6.
2. Smeets NW, Krekels GA and Ostertag JU, et al. Surgical excision vs Mohs' micrographic surgery for basal-cell carcinoma of the face: randomised controlled trial. Lancet 2004; 364: 1766-72.
3. de Vries E, Coebergh JW and van der Rhee H. [Trends, causes, approach and consequences related to the skin-cancer epidemic in the Netherlands and Europe]. Ned Tijdschr Geneeskd 2006; 150: 1108-15.
4. Alsarraf R. Outcomes research in facial plastic surgery: a review and new directions. Aesthetic Plast Surg 2000; 24: 192-7.
5. Stewart MG. Outcomes research: an overview. ORL J Otorhinolaryngol Relat Spec 2004; 66: 163-6.
6. Stewart MG and Porter JP. Outcomes research and facial plastic surgery. Facial Plast Surg 2002; 18: 73-6.
7. Wright JG. Outcomes research: what to measure. World J Surg 1999; 23: 1224-6.
8. Arden RL, Nawroz-Danish M, Yoo GH, Meleca RJ and Burgio DL. Nasal alar reconstruction: a critical analysis using melolabial island and paramedian forehead flaps. Laryngoscope 1999; 109: 376-82.
9. Quatela VC, Sherris DA and Rounds MF. Esthetic refinements in forehead flap nasal reconstruction. Arch Otolaryngol Head Neck Surg 1995; 121: 1106-13.
10. Drisco BP and Baker SR. Reconstruction of nasal alar defects. Arch Facial Plast Surg 2001; 3: 91-9.
11. Macgregor FC. Facial disfigurement: problems and management of social interaction and implications for mental health. Aesthetic Plast Surg 1990; 14: 249-57.
12. Bull R and Rumsey N. Social psychology of facial appearance. New York: Springer, 1988.
13. Berk NW, Cooper ME, Liu YE and Marazita ML. Social anxiety in Chinese adults with oral-facial clefts. Cleft Palate Craniofac J 2001; 38: 126-33.
14. Cochrane VM and Slade P. Appraisal and coping in adults with cleft lip: associations with well-being and social anxiety. Br J Med Psychol 1999; 72 (Pt 4): 485-503.
15. De Boer MF, McCormick LK, Pruyn JF, Ryckman RM and van den Borne BW. Physical and psychosocial correlates of head and neck cancer: a review of the literature. Otolaryngol Head Neck Surg 1999; 120: 427-36.
16. Burget GC, Menick FJ. Nasal support and lining: the marriage of beauty and blood supply. Plast Reconstr Surg 1989; 84: 189-202.
17. Menick FJ. A new modified method for nasal lining: the Menick technique for folded lining. J Surg Oncol 2006; 94: 509-14.
18. Menick FJ. A 10-year experience in nasal reconstruction with the three-stage forehead flap. Plast Reconstr Surg 2002; 109: 1839-55.
19. Menick FJ. The evolution of lining in nasal reconstruction. Clin Plast Surg 2009; 36: 421-41.

20. Walton RL, Burget GC, Beahm EK. Microsurgical reconstruction of the nasal lining. Plast Reconstr Surg 2005: 115: 1813-29.

21. Singh DJ, Bartlett SP. Nasal reconstruction: aesthetic and functional considerations for alar defects. Facial Plast Surg 2003: 19: 19-28.

22. CBO Richtlijn Evidence-based richtlijn behandeling van het basaalcelcarcinoom. 2007: 1-36.

23. Oncoline Richtlijn voor diagnostiek en behandeling van het carcinoom van de neusholte, neusbijholten en het vestibulum nasi. 2002: 571-72.

Chapter 10

Summary

Nederlandse samenvatting

SUMMARY

History and Background

Chapter 1 describes the history of nasal reconstruction. Dated approximately between 700 and 600 BC the first nasal reconstruction technique was published in the Sushruta Samhita by Sushruta in India. Since then the evolution of nasal reconstructive techniques has reached such a level that the goal is not only to restore form and function, but also to achieve excellent cosmetic appearance. In the past nasal reconstruction was mainly used to treat traumatic injuries; nowadays however, it is primarily performed following tumour resection.

The incidence of nasal skin malignancies is rapidly increasing worldwide. The incidence of non- melanoma skin cancer in the United States of America is one million new cases per year. A total of 225,000 of these new skin cancers occur on the nose. In the Netherlands the incidence of skin malignancies is expected to increase from 20.800 new cases per year in 2000 to 36.800 new patients per year in 2015. As a result of the surgical treatment of these malignancies the demand for reconstructive procedures has also increased enormously. In literature, emphasis exists on technical refinements to optimize aesthetic results following nasal reconstruction, however, little is known about the long-term aesthetic and functional outcome. There is also no standardized tool available to assess aesthetic and functional outcome after nasal reconstruction. In addition, no literature is available on the psychological impact of nasal reconstruction.

The objectives of this thesis were to develop a standardized questionnaire measuring aesthetic and functional outcome after nasal reconstruction; to study the differences in assessment by patients, professionals and laypersons; and to assess the impact of nasal reconstruction on psychological functioning. Subsequently, an algorithm for the treatment of nasal defects could be developed.

In **Chapter 2** the evaluation of the Nasal Appearance and Function Evaluation Questionnaire (NAFEQ) is described. Questions were derived from both the literature and experiences with patients. The NAFEQ was validated using 30 nasal reconstruction patients and a reference group of 175 people. Factor analysis indicated that the questionnaire was two-dimensional, so it could be divided in two subscales: functional and aesthetic outcome. High Cronbach's alpha values (>0.70) for both subscales showed that the NAFEQ is an instrument with adequate internal consistency. In conclusion, this study demonstrated that the NAFEQ can be used as a standardized questionnaire for detailed evaluation of aesthetic and functional outcome after nasal reconstruction.

Chapter 3 describes the aesthetic and functional outcome following nasal reconstruction, which was assessed in 38 consecutive patients treated for (sub)total nasal defects. Eighty-one percent were (very) satisfied with nasal function. Mucosal crusting and passage difficulties were most often identified as nasal function problems after reconstruction. Seventy-nine percent were (very) satisfied with their total nasal appearance. Patients were least satisfied with a too small ostium nasi and ala nasi shape. Although objective functional and aesthetic outcome following nasal reconstruction sometimes shows impairment compared to the normal situation, it gives high subjective patient satisfaction with function and aesthetics.

In **Chapter 4** differences in subjective aesthetic outcome after nasal reconstruction as judged by patients and an independent panel consisting of five plastic surgeons were investigated. In addition, the severity of nasal defects was correlated with patient and panel satisfaction and established landmarks of nasal anatomy were evaluated as parameters of good aesthetic outcome. The results showed discrepancies between the level of satisfaction as assessed by a professional panel and patients. The panel scored significantly lower when judging nasal appearance compared to the patients. There was no relationship between severity of nasal defects and aesthetic outcome assessed by patients or professionals.

The aim of the study in **Chapter 5** was to assess laypersons' opinions on aesthetic outcome after nasal reconstruction. This was compared with the opinion of a professional panel. Second, the effect of informing laypersons about the previous nasal reconstruction of patients on their assessment of facial attractiveness and abnormality was studied. Third, the effects of individual facial features on the assessment of facial attractiveness and abnormality were determined. No differences existed between assessment of aesthetic outcome after nasal reconstruction by laypersons and professionals (54% good to excellent). Patients were perceived significantly less attractive and more abnormal than controls. Prior knowledge had a positive effect on mean facial attractiveness and abnormality scores. High positive correlations were found between facial attractiveness and abnormality scores and the frequency of the item "nothing in particular", meaning if no particular facial feature was judged to be striking, a face was perceived more attractive and less abnormal. Therefore, the goal of nasal reconstruction would not only be to create a nose as normal as possible, but also as inconspicuous as possible.

Total or partial nasal amputation following tumour resection is one of the more severe facial disfigurements that can lead to psychosocial difficulties as experienced by patients. Successful nasal reconstruction can therefore be regarded as restoring a patient's psychosocial health. Therefore, the objective of the study in **Chapter 6** was to evaluate

different determinants of patient's psychosocial functioning and their effect on patient satisfaction after nasal reconstruction. Social anxiety and avoidance was scored significantly higher within the patient group. Patients had significantly more often a passive coping style than controls. Interestingly, self-esteem levels did not differ significantly between patients and controls. On the other hand self-esteem as well as active and passive coping strategies could be identified as predictive determinants of satisfaction with nasal reconstruction.

Chapter 7 reports on the effectiveness, aesthetic outcome and costs of interstitial high-dose-rate brachytherapy for early stage cancer of the nasal vestibule and/or columella. This was done for 64 patients treated from 1991-2005 by instructing a panel of non-medical and medical professionals to score the cosmetic result of each of these patients. Also, during an extra outpatient clinic follow-up session, all patients were seen in consultation to score the functional outcome. Finally, full hospital costs were computed. A local relapse-free survival rate of 92% at 5 years was obtained. Excellent aesthetic and functional results were observed. With 10 days admission for full treatment, hospital costs amounted to €5772. This contrasts substantially with the full hospital costs when nasal vestibule cancers are treated by reconstructive surgery, being on average threefold as expensive.

An analysis of 788 nasal reconstructions, which were performed at the Erasmus MC between 2001 and 2008, in combination with a literature review is described in **Chapter 8.** Subsequently, an algorithm for reconstruction of nasal defects after surgical excision of skin cancer was created. In our algorithm nasal defects are divided in simple, small, skin only defects or large, skin and cartilage, or full thickness defects. Small defects can be closed primarily or with local flaps. For large defects the forehead flap is the flap of choice. Creating adequate inner lining is difficult and challenging. Our current strategy for inner lining reconstruction, which is continuously evolving, is as follows. In cases with small inner lining requirements, full thickness skin grafts or turn down lining flaps with delayed primary cartilage grafting at the intermediate stage has currently our preference. In cases with medium to larger inner lining requirements, the folded forehead flap with delayed primary cartilage grafting at the intermediate stage is our preferred technique. For (sub)total nasal reconstructions with very large inner lining requirements we would now consider free vascularized tissue transfer.

Proper treatment of nasal skin cancer and nasal reconstruction require a structured multidisciplinary approach in order to achieve excellent tumour control and a satisfactory aesthetic and functional end result.

In **chapter 9** the major findings of the present thesis are discussed and recommendations for future research are given. In conclusion, patients were generally very satisfied with the aesthetic and functional outcome following nasal reconstruction. However, despite this high level of satisfaction there existed an impact on psychosocial functioning. Social avoidance and anxiety was more seen in nasal reconstruction patients. This could be the effect of negative perceptions by people in the surroundings, since we found that laypersons assessed aesthetic outcome more negatively than patients themselves.

In order to achieve the highest level of satisfaction after nasal reconstruction the following considerations are vital.

Local skin factors: previous malignancies, radiation, and previous reconstructive procedures have to be assessed.

Surgical skills and experience: nasal reconstruction is still very much an art, which needs to be supported with science.

Patients' preference: nasal reconstruction is a time consuming procedure for the patient as well as the surgeon.

SAMENVATTING

Geschiedenis en achtergrond

In **hoofdstuk 1** wordt de geschiedenis van neusreconstructie technieken beschreven. Deze begint rond 700 voor Christus met de eerste beschrijving van een neusreconstructie in de Sushruta Samhita door Sushruta in India. Sindsdien zijn neusreconstructie technieken zodanig geëvolueerd dat het doel niet alleen bestaat uit het herstel van vorm en functie van de neus, maar ook uit het verkrijgen van een esthetisch perfect resultaat. In het verleden was een neusamputatie vaak het gevolg van een trauma, maar tegenwoordig is dit voornamelijk het gevolg van de chirurgische behandeling van huidtumoren.

De incidentie van neustumoren neemt wereldwijd epidemische vormen aan. De incidentie van (niet-melanoom) huidtumoren in de Verenigde Staten is 1 miljoen nieuwe gevallen per jaar. Hiervan ontstaan 225.000 nieuwe huidtumoren op de neus. In Nederland verwacht men dat de incidentie van huidtumoren stijgt van 20.800 nieuwe gevallen per jaar in 2000 tot 36.800 nieuwe patiënten per jaar in 2015. Het gevolg van de chirurgische behandeling van deze tumoren is de wereldwijde toename in vraag naar reconstructieve behandeling. In de literatuur ligt de nadruk met name op technische verfijningen van neusreconstructie technieken om zo de esthetische uitkomsten te verbeteren. Er is echter nog zeer weinig bekend over de esthetisch en functionele uitkomsten op lange termijn. Daarnaast is er nog geen gestandaardiseerd meetinstrument om de esthetische en functionele uitkomsten te meten na neusreconstructies. Een neusamputatie en de daaropvolgende reconstructie kan een grote impact hebben op het dagelijks functioneren van een patiënt. In de literatuur zijn echter nog geen studies bekend die hier nader onderzoek naar gedaan hebben.

De doelen van het onderzoek in dit proefschrift waren het ontwikkelen van een gestandaardiseerde vragenlijst welke de functionele en esthetische uitkomsten na neusreconstructie kan meten; het analyseren van verschillen in beoordelingen door patiënten, professionals en leken; en inzicht verkrijgen in de impact van een neusreconstructie op het psychosociaal functioneren. Met behulp van alle gegevens kon uiteindelijk een neusreconstructie behandelalgoritme worden gecreëerd.

In **hoofdstuk 2** wordt de ontwikkeling van de Nasal Appearance and Function Evaluation Questionnaire (NAFEQ) beschreven. De vragen zijn ontwikkeld op basis van de literatuur en persoonlijke ervaringen met patiënten. De NAFEQ werd gevalideerd bij 30 patiënten en een controlegroep van 175 mensen. Factoranalyse bevestigde de tweedimensionale samenstelling van de vragenlijst waardoor twee subschalen konden worden gemaakt: functionele en

esthetische uitkomst. Hoge Cronbach's alpha waarden (>0.70) voor beide subschalen lieten zien dat de NAFEQ een instrument is met voldoende interne consistentie. Concluderend liet deze studie zien dat de NAFEQ gebruikt kan worden als gestandaardiseerde vragenlijst voor een gedetailleerde evaluatie van esthetische en functionele uitkomst na een neusreconstructie.

In **hoofdstuk 3** worden de esthetische en functionele resultaten van 38 patiënten na een neusreconstructie beschreven. Eenentachtig procent was erg tevreden met de functie van de gereconstrueerde neus. Slijmvlieskorsten en luchtpassage moeilijkheden werden door de patiënten het vaakst als functionele problemen gerapporteerd. Zevenennegentig procent was zeer tevreden met het uiterlijk van hun neus na reconstructie. Patiënten waren het minst tevreden over een te klein ostium nasi en de ala nasi vorm. Ondanks het feit dat de objectieve functionele en esthetische resultaten na neusreconstructies vaak nog beperkingen laten zien in vergelijking met de gezonde situatie, bestaat er toch een hoge subjectieve patiëntentevredenheid ten aanzien van functie en esthetiek.

In **hoofdstuk 4** worden de verschillen beschreven in tevredenheid met de esthetische resultaten van neusreconstructies,die werden gerapporteerd door patiënten en een onafhankelijk professioneel panel dat uit 5 plastisch chirurgen bestond. Daarnaast werd de ernst van het neusdefect gecorreleerd aan de uitkomsten van patiënt- en paneltevredenheid. De resultaten lieten discrepanties zien in de mate van tevredenheid tussen patiënten en het panel. Het panel scoorde significant lager in tevredenheid dan de patiënten. Er werd geen relatie gevonden tussen de ernst van het neusdefect en de tevredenheid met het esthetische resultaat zoals gerapporteerd door patiënten en het panel.

Het doel van de studie in **hoofdstuk 5** was het vaststellen van de mening van leken over het esthetisch resultaat na neusreconstructies. Dit werd vergeleken met de mening van een professioneel panel. Ten tweede werd bepaald of het informeren van leken over de neusreconstructie, hun mening over de aantrekkelijkheid en abnormaliteit van het gezicht zou beïnvloeden. Ten derde werd gekeken naar het effect van verschillende onderdelen van het gezicht op de bepaling van het esthetisch resultaat na neusreconstructies. Er werd geen verschil gevonden tussen beoordelingen van leken en professionals (54% goed tot zeer goed). Patiënten werden significant minder aantrekkelijk en meer afwijkend beoordeeld dan de controle groep. Voorkennis ten aanzien van de neusreconstructie had een positief effect op de gemiddelde aantrekkelijkheid en abnormaliteit scores. Er werd een hoge positieve correlatie gevonden tussen aantrekkelijkheid en abnormaliteit scores en de frequentie van de score van

het item "niets in het bijzonder." Dit betekent dat wanneer er geen afwijkende onderdelen in het gezicht werden gezien, het gezicht als meer aantrekkelijk en minder afwijkend beoordeeld werd. Daarom zou het doel van een neusreconstructie niet alleen moeten zijn het creëren van een zo normaal mogelijke neus, maar ook een zo onopvallend mogelijke neus.

Totale of partiële neusreconstructie na tumorbehandeling is een zeer ingrijpende aangezichtsverminking, hetgeen zou kunnen leiden tot psychosociale problemen bij patiënten. Een succesvolle reconstructie zou daarom gezien kunnen worden als het herstel van de psychosociale gezondheid van een patiënt. Het doel van de studie zoals beschreven in **hoofdstuk 6** was dan ook het evalueren van verschillende determinanten van het psychosociaal functioneren van een patiënt en het effect ervan op patiënt tevredenheid na een neusreconstructie. Op het gebeid van sociale angst en ontwijking werd significant hoger gescoord door patiënten dan door de controle groep. Patiënten gingen significant vaker passief om met problemen dan de controle groep. Interessant genoeg verschilde het niveau van zelfvertrouwen niet statistisch significant tussen beide groepen. Aan de andere kant werd zelfvertrouwen samen met het passief dan wel actief omgaan met problemen wel gezien als voorspellende determinanten van tevredenheid na een neusreconstructie.

Hoofdstuk 7 beschrijft de effectiviteit, de esthetische uitkomst en kosten van interstitiële hoge doses brachytherapie bij 64 patiënten die tussen 1991 en 2005 waren behandeld voor een vroeg stadium vestibulum nasi en/of columella kanker. Een panel dat bestond uit zowel medische als niet medische professionals scoorde het cosmetisch resultaat bij deze patiënten. Daarnaast werd bij deze patiënten, tijdens een extra polikliniek bezoek, de neusfunctie gescoord. Als laatste werden de totale ziekenhuiskosten berekend. Een totale ziektevrije overleving van 92% na 5 jaar werd bereikt. Uitstekende functionele en esthetische resultaten werden geobserveerd. Totale ziekenhuiskosten bedroegen per patiënt €5772, inclusief een opname van 10 dagen. Dit is gemiddeld drie maal goedkoper dan wanneer het vestibulum nasi carcinoom wordt behandeld met reconstructieve behandelmethoden.

Hoofdstuk 8 laat een analyse zien van 788 neusreconstructies die uitgevoerd zijn in het Erasmus Medisch Centrum tussen 2001 en 2008 in combinatie met een literatuur overzicht. Als resultaat werd een algoritme voor neusreconstructies na chirurgische behandeling van huidkanker opgesteld.

In ons algoritme worden neusdefecten ingedeeld in simpele, kleine huiddefecten of grote huid en kraakbeen of volledige dikte defecten. Kleine defecten kunnen primair gesloten

worden of door middel van locale huidlappen. De voorhoofdslap is de eerste keus voor grote defecten. Het creëren van een goede binnenbekleding van de neus is een lastige uitdaging. Onze huidige strategie ten aanzien van reconstructie van binnenbekleding, welke zich nog steeds ontwikkelt, is als volgt. Wanneer er een kleine binnenbekleding reconstructie nodig is, heeft een volledige dikte huidtransplantaat of een omklap bekledingslap in combinatie met uitgestelde kraakbeen transplantatie onze voorkeur. In gevallen waar middelmatige tot grote binnenbekledingsdefecten reconstructie behoeven, heeft de dubbel gevouwen voorhoofdslap met uitgestelde kraakbeen transplantatie ten tijde van de tweede etappe onze voorkeur. Voor (sub)totale neusreconstructies waar een zeer groot binnenbekledingsdefect bestaat, zouden we nu een vrij gevasculariseerde weefseltransplantatie kiezen.

Goede behandeling van neustumoren en de daarop volgende neusreconstructie behoeft een gestructureerde multidisciplinaire aanpak, om zo een optimaal mogelijke tumorbehandeling en een bevredigend esthetisch en functioneel eindresultaat te verkrijgen.

In **hoofdstuk 9** worden de belangrijkste bevindingen van dit proefschrift bediscussieerd. Daarnaast worden aanbevelingen voor toekomstig onderzoek gedaan. Concluderend kan gesteld worden dat patiënten over het algemeen zeer tevreden zijn met het functionele en esthetische resultaat na een neusreconstructie. Ondanks deze hoge mate van tevredenheid bestaat er toch een impact op het psychosociaal functioneren. Sociale angst en ontwijking worden vaker gezien bij patiënten na een neusreconstructie. Dit zou het effect kunnen zijn van negatieve beoordelingen door mensen die zij in hun omgeving tegenkomen. Immers, leken beoordeelden het uiterlijk van deze patiënten veel negatiever dan de mate waarin patiënten zelf hun uiterlijk beoordeelden. Om het hoogst mogelijke niveau van tevredenheid te behalen zijn de volgende factoren zeer belangrijk.

Locale huid factoren: er moet rekening gehouden worden met eerdere maligniteiten, radiotherapie en reconstructieve procedures.

Chirurgische vaardigheden en ervaring wegen zwaar aangezien neusreconstructie nog altijd een kunstvorm is welke meer ondersteund zou moeten worden met wetenschap.

De voorkeur van de patiënt: neusreconstructie is een tijd rovende procedure voor zowel de patiënt als de behandelende chirurg.

Appendices

Dankwoord | Curriculum Vitae | List of Publications | PhD Portofolio

Dankwoord

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Curriculum Vitae

Sanne Elsbeth Moolenburgh was born on October 16th 1976 in Rotterdam, the Netherlands. After graduating from the Montessori Lyceum in Rotterdam in 1996, she started medical school at the University of Groningen. During her study she was a student member of the liver transplantation team lead by Professor M.J.H. Slooff. After two years of internships at the Deventer Hospital in Deventer she obtained her medical degree from the University of Groningen in 2004. After having spent six months as a resident at the Department of Plastic and Reconstructive Surgery of the Erasmus Medical Centre (Prof.dr. S.E.R. Hovius) in 2004, she worked as a research fellow at this department (Prof. r. S.E.R. Hovius, Dr. S.O.P. Hofer and Dr. M.A.M. Mureau) on psychological, functional and aesthetic outcome after nasal reconstruction as presented in this thesis. In July 2009 she finished her Basic General Surgery training at the Department of General Surgery, Albert Schweitzer Hospital, Dordrecht (Dr. R.J. Oostenbroek). She is currently continuing her training as a resident at the Department of Plastic and Reconstructive Surgery, University Hospital, Erasmus Medical Centre in Rotterdam (Prof.dr. S.E.R. Hovius).

List of publications

PUBLICATIONS RELATED TO THE THESIS

Moolenburgh SE, McLennan L, Levendag PC, Munte K, Scholtemeijer M, Hofer SOP, Mureau MAM. *Nasal Reconstruction after Malignant Tumour Resection: An Algorithm for Treatment.* Submitted Plast Reconstr Surg. 2009 Aug.

Moolenburgh SE, Mureau MAM, Versnel SL, Duivenvoorden HJ, Hofer SOP. *The impact of nasal reconstruction following tumour resection on psychosocial functioning, a clinical-empirical exploration.* Psychooncology. 2009 Jul;18(7):747-52.

Moolenburgh SE, Mureau MAM, Duivenvoorden HJ, Hofer SOP. *Validation of a questionnaire assessing patient's aesthetic and functional outcome after nasal reconstruction: the patient NAFEQ-score.* J Plast Reconstr Aesthet Surg. 2009 May;62(5):656-62.

Moolenburgh SE, Mureau MAM, Hofer SOP. *Aesthetic outcome after nasal reconstruction: patient versus panel perception.* J Plast Reconstr Aesthet Surg. 2008 Dec;61(12):1459-64.

Moolenburgh SE, Mureau MAM, Hofer SOP. *Facial attractiveness and abnormality of nasal reconstruction patients and controls assessed by laypersons.* J Plast Reconstr Aesthet Surg. 2008 Jun;61(6):676-80.

Mureau MAM, **Moolenburgh SE**, Levendag PC, Hofer SOP. *Aesthetic and functional outcome following nasal reconstruction.* Plast Reconstr Surg. 2007 Oct;120(5):1217-27

Levendag PC, Nijdam WM, **Moolenburgh SE**, Tan L, Noever I, van Rooy P, Mureau MAM, Jansen PP, Munte K, Hofer SOP. *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 Sep 1;66(1):160-9.

OTHER PUBLICATIONS

Kuyvenhoven JP, Molenaar IQ, Verspaget HW, Veldman MG, Palareti G, Legnani C, **Moolenburgh SE**, Terpstra OT, Lamers CB, van Hoek B, Porte RJ. *Plasma MMP-2 and MMP-9 and their inhibitors during human orthotopic liver transplantation: The effect of aprotinin and the relation to ischemia/reperfusion in jury.* Thromb Haemost. 2004 Mar;91(3):506-13.

Moolenburgh SE, van Huizum MA, Hofer SOP.*DIEP-flap failure after pedicle division three years following transfer.*Br J Plast Surg. 2005 Oct;58(7):1000-3.

Hofer SOP, Rakhorst HA, Mureau MAM, **Moolenburgh, SE**, van Huizum MA, van Geel AN. *Pathological internal mammary lymph nodes in secondary and tertiary deep inferior epigastric perforator flap breast reconstructions.* Ann Plast Surg. 2005 Dec;55(6):583-6.

ERASMUS UNIVERSITEIT ROTTERDAM

PhD Portfolio Summary

Summary of PhD training and teaching activities

Name PhD student: *Sanne Elsbeth Moolenburgh* Erasmus MC Department: *Plastic and Reconstructive Surgery* Research School: *Plastic and Reconstructive Surgery*	PhD period: *01-08-2004 t/m 01-08-2007* Promotor(s): *Prof. S.E.R. Hovius* Supervisor: *Dr. M.A.M. Mureau and Dr. S.O.P. Hofer*

1. PhD training

	Year	Workload (Hours/ECTS)
General academic skills		
- Biomedical English Writing and Communication	*2007*	*50 hrs*
- Laboratory animal science	*2004*	*50 hrs*
Research skills Methodology		
- Introduction to clinical research	*21-01-06 t/m 25-01-06*	*20 hrs*
In-depth courses (e.g. Research school, Medical Training)		
- Micro surgery course	*2004*	24 hrs
Presentations		
- NVPC (Utrecht)	2007	40hrs
- EURAPS (Londen)	2006	40hrs
International conferences		
- EURAPS (Londen)	2006	40 hrs
Seminars and workshops		
- Wondcongres (Rotterdam)	*17-11-07*	*8 hrs*
- NVPC (Zeist)	*14-12-07*	*8 hrs*
Other		
- Diensten		*150 hrs*
- Microchirurgie		*175 hrs*

2. Teaching activities		
- Supervisie Microchirurgie cursus Skillslab	07-04-07 t/m 09-04-07	16 hrs
- Supervisie Microchirurgie cursus Skillslab	13-10-06 t/m 17-10-06	24 hrs
- Cursus Hechttechnieken (3e jaars studenten)	23-01-2006	8 hrs
- Plastische chirurgie (opleiding ok assistenten)	02-01-2006 t/m 01-07-07	120 hrs
Lecturing		
- Inleiding plastische chirurgie - (4e jaars studenten)	15-09-08 t/m 17-09-08	12 hrs