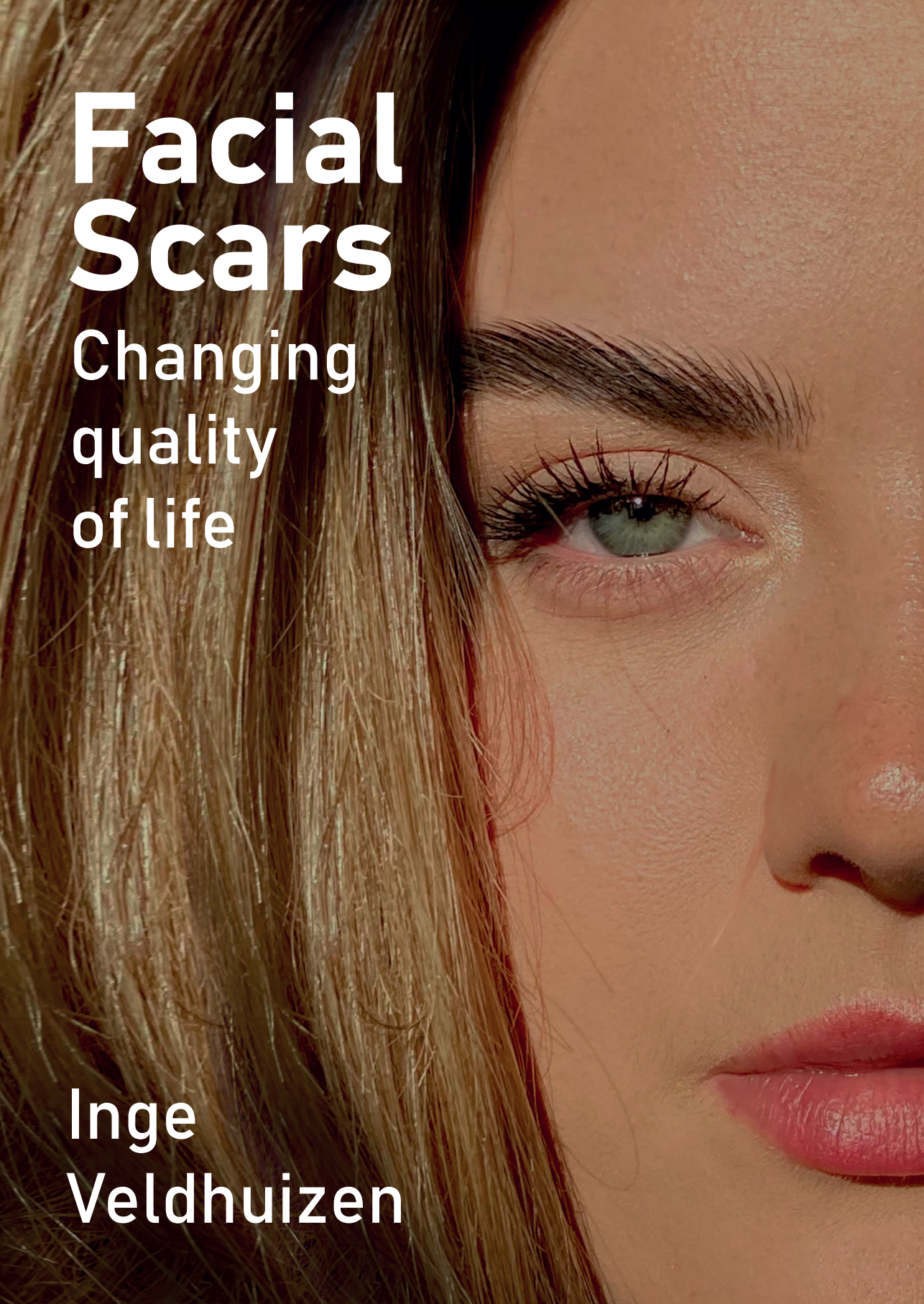
Facial scars



Facial Scars

Changing quality of life

Inge Veldhuizen

Facial Scars
Changing Quality of Life
A patient-centric approach to improve outcomes in facial skin cancer surgery

Inge Judith Veldhuizen

Colofon

Facial Scars: Changing Quality of Life

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Facial Scars
Changing Quality of Life
A patient-centric approach to improve outcomes in facial skin cancer surgery

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Voor mijn ouders.

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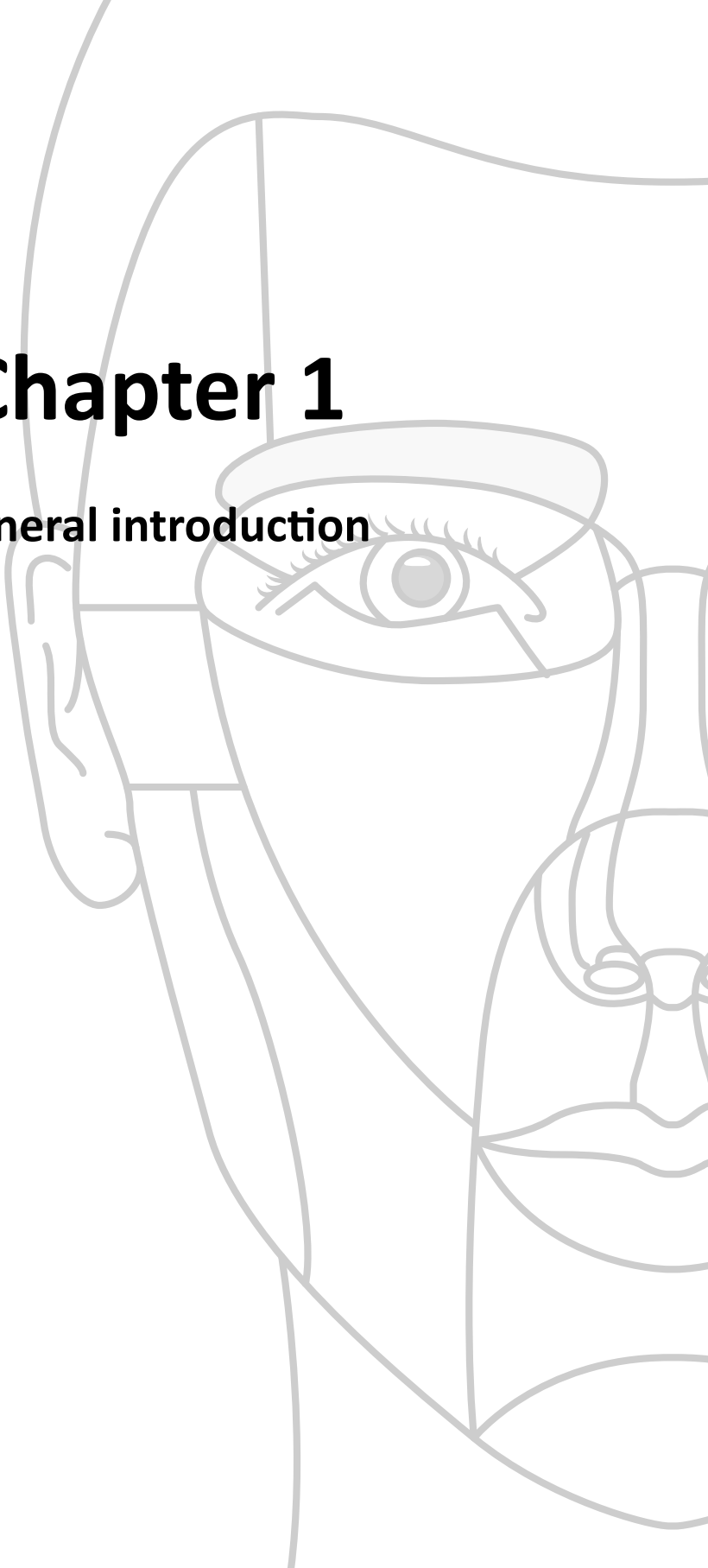
Chapter 1

General introduction



Skin Cancer

Each year worldwide, more than 14 million people are diagnosed with skin cancer.[1] Skin cancer is the most common type of cancer in the Netherlands,[2–6] with a yearly increasing incidence rate of 10%.[7] There are different types of skin cancers, frequently grouped as melanoma and nonmelanoma skin cancers (NMSC). NMSC refers to all skin cancer types except melanoma; however, 99% of these tumors are basal cell carcinoma (BCC) and squamous cell carcinoma (SCC). Therefore, NMSC is often used to represent BCC and SCC.[3,8] Another term for BCC and SCC, used more recently in the literature, is keratinocyte carcinomas since BCC and SCC have a shared lineage with epidermal keratinocytes (Fig. 1).[9,10]

Although melanoma is the most aggressive type of skin cancer, NMSC has an 18-20 times higher incidence rate.[11] NMSC occurs in the epidermis (Fig. 1). The most superficial part of the epidermis is called the stratum corneum, consisting of dead keratinocytes identified by their flat shape. The deepest part of the epidermis is called the stratum basale. Keratinocytes originate in this layer. BCC is the most common type of skin cancer and accounts for 75% of the NMSC. BCC starts in the stratum basale. Since BCC typically develops because of ultraviolet radiation (UVR),[12–14] it usually occurs in sun-exposed areas like the face.[15–17] SCC is the second most common type of skin cancer. Between the stratum corneum and stratum basale, the keratinocytes differentiate and are pushed toward the surface. In this layer, cellular changes occur, and SCC originates. They too develop because of UVR and therefore also frequently occur in sun-exposed areas, like the face. However, they can also develop in scars or chronic skin sores elsewhere on the body. In situ SCC (not involved in deeper layers) is called Bowen's disease, and pre-SCC skin conditions caused by UVR are called actinic keratoses. The lifetime risk of actinic keratoses developing into SCC is 6-10%.[18,19] Whereas death of BCC is uncommon, mortality among elderly or immunosuppressed SCC patients rises depending on the tumor stage.[20]

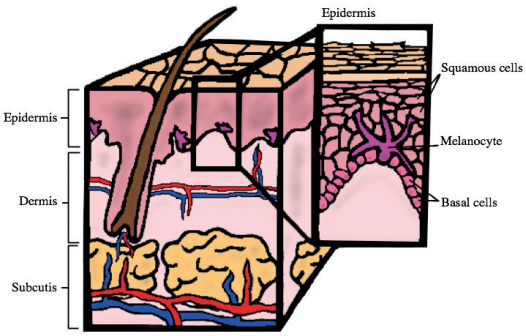


Figure 1. Location of the different types of skin cancer.

Although NMSC has a low mortality rate, the predilection for the head and neck area can cause disfigurement of facial appearance and consequently impact the quality of life. Therefore, this thesis will focus on facial NMSC.

Nonmelanoma skin cancer treatment

The treatment of NMSC consists of surgical and non-surgical methods. The non-surgical treatments are local therapies, cryotherapy, photodynamic therapy, hedgehog inhibitors, and radiotherapy. However, the first-choice treatment for facial NMSC is surgical resection,[21] since superior outcomes and higher 5-year recurrence-free survivals are observed after surgical excision compared to non-surgical treatments.[22,23]

The most used surgical treatment options are 1) wide local excision (WLE), 2) staged excision (SE), and 3) Mohs micrographic surgery (MMS). No consensus exists as to which technique is best.[24] Recently, the use of MMS increased significantly. A reason for this could be that MMS can minimize the surgical defect compared to WLE and patients can be treated and reconstructed the same day.[25–28] However, when lesions are large or if there is a significant subclinical spread, this technique can still lead to large post-surgical defects.

Reconstructions

There are different reconstructive options, such as second intention healing, primary closure, closure with a local, regional or distant flap, or a skin graft. The different reconstructive methods are individually well discussed in the literature.[29–31] However, little is known in the literature on differences in reconstructive techniques for specific defects and patients. Choosing between the reconstructive techniques can be challenging. Choices depend on different factors, such as the defect's location, skin type, age, comorbidities, and patient and/or surgical preferences. They are usually made by preserving function but also cosmesis, as post-surgical scars can be noticeable and could have a significant impact on the patient.[32–34]

Commonly, the reconstructive ladder is followed to repair surgical defects, starting with second intention healing or primary closure to a more complex reconstruction (i.e., flaps and grafts).[35] To avoid unnatural scars, the surgeon can hide the scars in the natural lines of the skin by following resting skin tension lines (RSTL's). However, the face has multiple RSTL's in close proximity to each other and when defects cross multiple subunits or RSTL directions, primary closure may distort facial contour (Fig. 2). More complex reconstructions like a flap or graft (i.g., full-thickness skin grafts or skin substitutes) could help keep the contour of the face but can result in larger, more angulated scars and/or additional scars involving unaffected skin or donor sites.

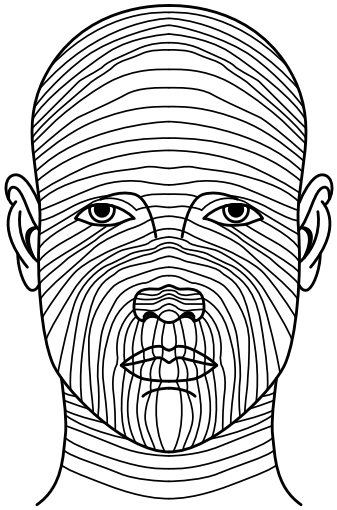


Figure 2. Resting skin tension lines (RSTL's) of the face.

Health-Related Quality of Life (HR-QoL)

HR-QoL is a broad perception that represents the physical, psychological, and social functioning of a person. For patients with facial NMSC this also includes how their disease and treatment affect their everyday functioning and disability. However, facial scars also affect patients' esthetic image, notably their body image. The Cambridge dictionary defines body image as "The idea that someone has of what their own body looks like." [36] Any significant alteration to the body may lead to psychosocial reactions.[37] Since the face is the keystone of identifying individuals and, for many, the perception of beauty and attractiveness, changing facial appearance can cause decreased HR-QoL.

The patients' quality of life depends on multiple aspects before, during, and after the treatment of NMSC. By targeting all aspects, satisfaction with the operation and doctor can increase, and HR-QoL improve. The most important way to target these aspects is to understand the patients' perspective of the healing process, operation, cancer worry, and esthetic outcome. However, these factors are highly subjective and can be influenced by individual experience and expectations, and are therefore inherently difficult to evaluate.[38]

Patient-reported outcome measures

Patient-Reported Outcome Measures (PROMs) are validated questionnaires developed to measure HR-QoL from the patient's perspective.[32,39–41] PROMs provide a way to quantify patients' experience, satisfaction, and HR-QoL.[42] Routinely measuring PROMs

pre-and post-surgery could provide physicians with a construct to measure individual and group differences, compare interventions, and consequently help to improve the shared decision-making process. In dermatologic and plastic surgery, PROMs are increasingly being utilized.[41,43,44] PROMs change subjective outcomes into quantifying outcomes by using targeted questions for the specific patient groups. By using specific PROM scales and questions, HR-QoL for defined populations can be assessed.

Multiple PROMs are developed for patients with skin cancer.[45] However, the FACE-Q Skin Cancer Module is a PROM specifically designed for patients undergoing surgical procedures for facial skin cancer.[46–49] The FACE-Q Skin Cancer Module consists of 5 scales and 2 checklists measuring appearance, quality of life, and experience of care (Table 1). Each scale consists of 6-10 items. Patient responses are rated on a Likert-type scale with four response options (e.g., definitely disagree, somewhat disagree, somewhat agree, and definitely agree); answer options are summed and then transformed to a Rasch score ranging from 0 to 100. In contrast to the scales, the checklists' responses are not summed, nor further score conversions performed, to measure each item separately. Every scale and checklist can be used independently or in conjunction with other scales and checklists of the FACE-Q Skin Cancer Module for a comprehensive assessment of patients presenting for dermatologic surgery. Since the FACE-Q Skin Cancer Module is an easy and quick way to understand the patients' experience with their scars and understand care, appearance, and quality of life, this PROM is used throughout this thesis. By incorporating the patient in the decision-making process using this PROM, patient satisfaction with the operation, the reconstruction, and the hospital care can be assessed to help increase HR-QoL.

The FACE-Q Skin Cancer Module is owned by Memorial Sloan Kettering Cancer Center; therefore, a license is needed to use this module. A license for this module for clinical care and research can be requested at www.qportfolio.org without any additional costs.

Table 1: Scales and checklists of the FACE-Q Skin Cancer Module.

Appearance	Quality of Life	Experience of Care
Satisfaction with Facial Appearance	Appearance-related Distress	Satisfaction with Information: Appearance
Appraisal of Scars	Cancer Worry Adverse Effects* Sun Protection Behavior*	

*checklists

Aim of this thesis

As NMSC is a growing global health problem, more patients will need treatment.[50] With most NMSC occurring in the head and neck area and surgical treatment being the treatment of choice, more patients will have facial scars. It is our mission to optimize patients' quality of life. Since facial scars can significantly impact HR-QoL, counseling patients to prevent future skin cancer from occurring and choosing a well-suited reconstructive option for specific defects is critical. This thesis focuses on two aims to improve healthcare in these patient groups.

1. Empowering patients to prevent skin cancer
2. Using the FACE-Q Skin Cancer PROM to improve perioperative care.

To reach these points, we should get more insight into differences in patient groups, reconstruction types, risk factors, and complications.

Outline of this thesis

Treatment starts the moment patients are diagnosed with NMSC by informing patients accordingly and counseling patients to prevent new skin cancer from occurring. The first part of this thesis focuses on prevention and targeted counseling (chapter 2-5).

Chapter 2 The Sun Protection Behavior Checklist for Targeted Counseling in Skin Cancer Patients

By counseling specific patients and patient groups on sun protection behavior, the risk of new skin cancers can be reduced. This article introduces a new checklist of the FACE-Q Skin Cancer Module; the Sun Protection Behavior checklist. This checklist can be used for patients with facial skin cancer to better target educational efforts for groups and individuals. After the development, this checklist was used in clinic with over 500 patients who completed the checklist prior to dermatologic surgery for facial skin cancer.

Chapter 3 Sun Protection Behavior Following Skin Cancer Resection and Reconstruction

The checklist introduced in chapter 2 was used at multiple time points in a one-year follow-up study with over 100 patients to measure the change in sun protection behavior over time and in different patient groups. With this information, physicians can target patient groups who show less improvement in sun protection behavior following skin cancer treatment and reduce the chance of new skin cancers in the future.

Chapter 4 Cancer Worry after Facial Non-melanoma Skin Cancer Resection and Reconstruction: A One-year Prospective Study.

Most patients experience worries about their skin cancer once diagnosed. However, even after surgical treatment, patients still experience worry. Some worry could be beneficial as it might motivate patients to take preventative measurements. However, cancer worry might impact patients' well-being and psychosocial distress, resulting in a decreased quality of life. This study focuses on cancer worry before, short- and long-term post-surgery. This study aims to assess the long-term change of cancer worry after surgical treatment in patients with NMSC to better counsel patients post-surgery.

Chapter 5 Impact of COVID-19 Delays on Skin Cancer Worry and Mohs Surgery for Keratinocytic Carcinoma

In January 2020, the first case of coronavirus disease 2019 (COVID-19) was reported in the United States, and by the end of March, all residents in the United States were urged to stay at home. Hospitals were recommended to delay the treatment of NMSC. As mentioned in chapter 4, patients with NMSC report cancer worry when diagnosed with NMSC. This study aims to evaluate the impact of the COVID-19 pandemic on surgical outcomes of MMS for NMSC as well as patients' perception of the delay in their care by using the FACE-Q Skin Cancer – Cancer Worry scale.

Once diagnosed, patients receive surgical treatment. In the next part of the thesis, intra-operative care is discussed and patient satisfaction evaluated (chapter 6-10).

Chapter 6 To see or not to see: Impact of viewing facial skin cancer defects prior to reconstruction

As patients experience psychosocial distress after their NMSC resection and reconstruction, we would like to see if simple tricks might reduce this distress and improve satisfaction with their post-operative scar. This chapter investigates if patients are more satisfied with the reconstruction when they see their defect in the mirror before the reconstruction.

Chapter 7 How to reconstruct a complex multiunit skin defect: A single-case survey study

In chapter 6, the importance of involving the patient during the operation is emphasized. After facial NMSC resection, reconstructing the defect can be challenging since multiple reconstructive options exist. Therefore, in this chapter, a survey study was conducted to evaluate the different reconstructive options for a specific patient with a surgical defect after MMS for NMSC. In addition, the patient from the survey

was asked to complete the FACE-Q Skin Cancer Module at multiple timepoints pre- and post-surgery.

Chapter 8 A Systematic Review and Overview of Flap Reconstructive Techniques for Nasal Skin Defects ects

A recent study showed that patients after nasal skin cancer resection are the least satisfied with their reconstruction compared to other parts of the face.[44] With the three-dimensional structure, lack of skin laxity, and central location, the nose is considered the most complex facial unit for reconstruction. The different reconstructive options after nasal skin cancer resection are well described; however, most are case series. This study aimed to systematically analyze the literature on reconstructions of acquired nasal deformities, investigate the complication rates, patient satisfaction, and analyze the most commonly used flap reconstructions according to the nasal subunit.

Chapter 9 Nasal Skin Reconstruction: Time to Rethink the Reconstructive Ladder?

Although there is an increasing use of PROMs in reconstructive surgery, chapter 8 showed that patient satisfaction for nasal skin reconstruction is limited in the literature. This study evaluates long-term patient satisfaction after nasal reconstruction and analyzes the reconstructive options using the FACE-Q Skin Cancer.

Chapter 10 Nasal Reconstruction with One-stage Dermal Regeneration Template and Full-thickness Skin Graft: Long-term Patient Outcomes and Complications

This chapter shows a new reconstructive option for nasal skin cancer resection: Integra dermal regeneration template. This skin substitute can be used as a single-stage method for nasal skin defect reconstructions. This study compared patient-reported outcomes and complications following single-stage Integra and FTSG after skin cancer resection.

Chapter 11 Summary and Discussion

This chapter contains a summary and general discussion providing the overall implications of this thesis and recommendations to improve healthcare in these patients.

Chapter 12 Samenvatting en Discussie

This chapter contains the Dutch translation of the summary and discussion.

Chapter 13 Impact Paragraph

In this chapter, the impact and future implementations of this thesis are discussed.

References

1. Organization, W. H. *Guide to cancer early diagnosis*. (World Health Organization, 2017).
2. Leiter, U. & Garbe, C. Epidemiology of melanoma and nonmelanoma skin cancer--the role of sunlight. *Adv. Exp. Med. Biol.* 624, 89–103 (2008).
3. Apalla, Z., Lallas, A., Sotiriou, E., Lazaridou, E. & Ioannides, D. Epidemiological trends in skin cancer. *Dermatol Pract Concept* 7, 1–6 (2017).
4. Berking, C., Hauschild, A., Kölbl, O., Mast, G. & Gutzmer, R. Basal Cell Carcinoma—Treatments for the Commonest Skin Cancer. *Dtsch Arztebl Int* 111, 389–395 (2014).
5. Vries, E. D., Poll-Franse, L. V. V. D., Louwman, W. J., Gruijl, F. R. D. & Coebergh, J. W. W. Predictions of skin cancer incidence in the Netherlands up to 2015. *British Journal of Dermatology* 152, 481–488 (2005).
6. Fontanillas, P. *et al.* Disease risk scores for skin cancers. *Nat Commun* 12, (2021).
7. de Vries, E., Nijsten, T., Louwman, M. W. J. & Coebergh, J. W. W. [Skin cancer epidemic in the Netherlands]. *Ned Tijdschr Geneeskd* 153, A768 (2009).
8. Samarasinghe, V. & Madan, V. Nonmelanoma Skin Cancer. *J Cutan Aesthet Surg* 5, 3–10 (2012).
9. Karimkhani, C., Boyers, L. N., Dellavalle, R. P. & Weinstock, M. A. It's time for 'keratinocyte carcinoma' to replace the term 'nonmelanoma skin cancer'. *J Am Acad Dermatol* 72, 186–187 (2015).
10. Nehal, K. S. & Bichakjian, C. K. Update on Keratinocyte Carcinomas. *New England Journal of Medicine* 379, 363–374 (2018).
11. Eide, M. J. *et al.* Identification of Patients With Nonmelanoma Skin Cancer Using Health Maintenance Organization Claims Data. *Am J Epidemiol* 171, 123–128 (2010).
12. Flohil, S. C., van der Leest, R. J. T., Arends, L. R., de Vries, E. & Nijsten, T. Risk of subsequent cutaneous malignancy in patients with prior keratinocyte carcinoma: a systematic review and meta-analysis. *Eur. J. Cancer* 49, 2365–2375 (2013).
13. Watson, M., Holman, D. M. & Maguire-Eisen, M. Ultraviolet Radiation Exposure and Its Impact on Skin Cancer Risk. *Semin Oncol Nurs* 32, 241–254 (2016).
14. Iannacone, M. R. *et al.* Patterns and timing of sunlight exposure and risk of basal cell and squamous cell carcinomas of the skin – a case–control study. *BMC Cancer* 12, 417 (2012).
15. de Vries, E., Louwman, M., Bastiaens, M., de Gruijl, F. & Coebergh, J. W. Rapid and Continuous Increases in Incidence Rates of Basal Cell Carcinoma in the Southeast Netherlands Since 1973. *Journal of Investigative Dermatology* 123, 634–638 (2004).

16. English, D. R., Armstrong, B. K., Kricker, A. & Fleming, C. Sunlight and Cancer. *Cancer Causes & Control* 8, 271–283 (1997).
17. Netscher, D. T. *et al.* Cutaneous Malignancies: Melanoma and Nonmelanoma Types: *Plastic and Reconstructive Surgery* 127, 37e–56e (2011).
18. Dodson, J. M., DeSpain, J., Hewett, J. E. & Clark, D. P. Malignant potential of actinic keratoses and the controversy over treatment. A patient-oriented perspective. *Arch Dermatol* 127, 1029–1031 (1991).
19. Salasche, S. J. Epidemiology of actinic keratoses and squamous cell carcinoma. *Journal of the American Academy of Dermatology* 42, S4–S7 (2000).
20. Medow, M. A., Weed, H. G. & Schuller, D. E. Simple Predictors of Survival in Head and Neck Squamous Cell Carcinoma. *Arch Otolaryngol Head Neck Surg* 128, 1282 (2002).
21. Fahradyan, A. *et al.* Updates on the Management of Non-Melanoma Skin Cancer (NMSC). *Healthcare (Basel)* 5, (2017).
22. Lv, R. & Sun, Q. A Network Meta-Analysis of Non-Melanoma Skin Cancer (NMSC) Treatments: Efficacy and Safety Assessment. *J Cell Biochem* 118, 3686–3695 (2017).
23. Guy, G. P., Machlin, S. R., Ekwueme, D. U. & Yabroff, K. R. Prevalence and costs of skin cancer treatment in the U.S., 2002-2006 and 2007-2011. *Am J Prev Med* 48, 183–187 (2015).
24. Nahhas, A. F., Scarbrough, C. A. & Trotter, S. A Review of the Global Guidelines on Surgical Margins for Nonmelanoma Skin Cancers. *J Clin Aesthet Dermatol* 10, 37–46 (2017).
25. Phan, K., Onggo, J. & Loya, A. Mohs micrographic surgery versus wide local excision for head and neck melanoma-in-situ. *J Dermatolog Treat* 31, 559–562 (2020).
26. Viola, K. V. *et al.* Mohs micrographic surgery and surgical excision for nonmelanoma skin cancer treatment in the Medicare population. *Arch Dermatol* 148, 473–477 (2012).
27. Lee, C. T. *et al.* Surgical excision, Mohs micrographic surgery, external-beam radiotherapy, or brachytherapy for indolent skin cancer: An international meta-analysis of 58 studies with 21,000 patients. *Cancer* 125, 3582–3594 (2019).
28. Wong, E., Axibal, E. & Brown, M. Mohs Micrographic Surgery. *Facial Plast Surg Clin North Am* 27, 15–34 (2019).
29. Johnson, A. R. *et al.* Facial Reconstruction After Mohs Surgery: A Critical Review of Defects Involving the Cheek, Forehead, and Perioral Region. *J Craniofac Surg* 30, 400–407 (2019).
30. Snow, S. N. Rotation flaps to reconstruct nasal tip defects following Mohs surgery. *DERMATOL SURG* 23, 916–919 (1997).

31. Sanniec, K., Harirah, M. & Thornton, J. F. Lip Reconstruction after Mohs Cancer Excision: Lessons Learned from 615 Consecutive Cases. *Plast. Reconstr. Surg.* 145, 533–542 (2020).
32. Mori, S. *et al.* Association of Quality of Life With Surgical Excision of Early-Stage Melanoma of the Head and Neck. *JAMA Dermatol* 155, 85–89 (2019).
33. Sobanko, J. F., Sarwer, D. B., Zvargulis, Z. & Miller, C. J. Importance of physical appearance in patients with skin cancer. *Dermatol Surg* 41, 183–188 (2015).
34. Zhang, J. *et al.* Patient and Physician Assessment of Surgical Scars: A Systematic Review. *JAMA Facial Plast Surg* 20, 314–323 (2018).
35. Simman, R. Wound Closure and the Reconstructive Ladder in Plastic Surgery. *J Am Col Certif Wound Spec* 1, 6–11 (2009).
36. body image. https://dictionary.cambridge.org/dictionary/english/body-image.
37. Price, P. & Tebble, N. Psychological Consequences of Facial Scarring. in *Surgery in Wounds* (eds. Téot, L., Banwell, P. E. & Ziegler, U. E.) 519–526 (Springer, 2004). doi:10.1007/978-3-642-59307-9_53.
38. Pascoe, G. C. Patient satisfaction in primary health care: a literature review and analysis. *Eval Program Plann* 6, 185–210 (1983).
39. Albornoz, C. R. *et al.* Measuring health-related quality of life outcomes in head and neck reconstruction. *Clin Plast Surg* 40, 341–349 (2013).
40. Koster, M. E. & Bergsma, J. Problems and coping behaviour of facial cancer patients. *Soc Sci Med* 30, 569–578 (1990).
41. Pusic, A. L., Lemaine, V., Klassen, A. F., Scott, A. M. & Cano, S. J. Patient-reported outcome measures in plastic surgery: use and interpretation in evidence-based medicine. *Plast. Reconstr. Surg.* 127, 1361–1367 (2011).
42. McGrail, K., Bryan, S. & Davis, J. Let's all go to the PROM: the case for routine patient-reported outcome measurement in Canadian healthcare. *Healthc Pap* 11, 8–18; discussion 55-58 (2011).
43. Vaidya, T. S. *et al.* Appearance-related psychosocial distress following facial skin cancer surgery using the FACE-Q Skin Cancer. *Arch. Dermatol. Res.* 311, 691–696 (2019).
44. Vaidya, T. S. *et al.* Patient-reported Aesthetic Satisfaction following Facial Skin Cancer Surgery Using the FACE-Q Skin Cancer Module. *Plast Reconstr Surg Glob Open* 7, e2423 (2019).
45. Dobbs, T. D., Samarendra, H., Hughes, S., Hutchings, H. A. & Whitaker, I. Patient-reported outcome measures for facial skin cancer: a systematic review and evaluation of the quality of their measurement properties. *Br J Dermatol* 180, 1018–1029 (2019).
46. Lee, E. H. *et al.* Patient experiences and outcomes following facial skin cancer surgery: A qualitative study. *Australas. J. Dermatol.* 57, e100-104 (2016).

47. Lee, E. H., Klassen, A. F., Cano, S. J., Nehal, K. S. & Pusic, A. L. FACE-Q Skin Cancer Module for measuring patient-reported outcomes following facial skin cancer surgery. *Br. J. Dermatol.* 179, 88–94 (2018).
48. Lee, E. H., Pusic, A. L., Cano, S. J. & Klassen, A. F. The FACE-Q Skin Cancer Module addresses post-resection aesthetic and quality of life outcomes. *Br. J. Dermatol.* 180, 953–954 (2019).
49. Pusic, A. L., Klassen, A. F., Scott, A. M. & Cano, S. J. Development and psychometric evaluation of the FACE-Q satisfaction with appearance scale: a new patient-reported outcome instrument for facial aesthetics patients. *Clin Plast Surg* 40, 249–260 (2013).
50. Rembielak, A. & Ajithkumar, T. Non-Melanoma Skin Cancer – An Underestimated Global Health Threat? *Clinical Oncology* 31, 735–737 (2019).

Chapter 2

The Sun Protection Behavior Checklist for Targeted Counseling in Skin Cancer Patients

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* These authors contributed equally to this work and are co-first authors.

Submitted

As ultraviolet radiation is a major risk factor for skin cancer development, patients are advised to regularly practice sun protection.[1] By counseling patients on sun protection behaviors, the risk of future skin cancers can be reduced.[2]

Questionnaires can provide clinicians with feedback on patient behaviors and quantify subjective outcomes such as quality of life and satisfaction. The FACE-Q Skin Cancer Module is a validated patient-reported outcome measure (PROM) developed for patients undergoing surgical procedures for facial skin cancer.[3,4] The module consists of rating scales and descriptive checklists.[4,5] Due to the importance of sun protection for skin cancer patients, the authors felt inclusion of a sun protection behavior checklist was clinically relevant. Although questionnaires assessing sun protection exist, some require detailed patient recall.[6,7] Our goal was to develop a simple and short checklist to assess behaviors related to sun protection of patients presenting for facial skin cancer surgery.

The development of the FACE-Q Skin Cancer scales was developed following an approach that adheres to recommended guidelines for PROM development.[3,4,8] The outdoor behavior questions were generated from patient interviews and expert input and subsequently underwent field testing (similarly to the scales) to develop a short checklist consisting of items about outdoor sun behavior. The checklist consists of 5 items asking when a patient spends time outdoors, how often they: question (Q)1=generally avoid the sun, Q2=wear sunscreen, Q3=stay in the shade, Q4=wear a hat, Q5=wear clothing in sunny weather. Answer choices range from 1-4 (1= never to 4= always). The checklist is available at *www.qportfolio.org* with a license. The checklist was then completed by patients at Memorial Sloan Kettering Cancer Center prior to dermatologic surgery for facial skin cancer between March 2017 and October 2018.

Table 1: Patient demographic and clinical factors.

Clinical/Demographics	Characteristics	N (%)
Gender	**Female**	247 (53)
	Male	284 (47)
Age (years)	**18-39**	32 (6)
	40-64	210 (39)
	≥ 64	289 (54)
Marital Status	**Married**	160 (30)
	Single	371 (70)
Smoking history	**Never**	307 (58)
	Smoked	224 (42)
Skin cancer in history (N)	**0**	233 (44)
	1-3	210 (40)
	≥4	88 (17)
Diagnosis	**Keratinocyte carcinoma**	454 (86)
	Melanoma	68 (13)
	Other cutaneous malignancies	9 (2)

A total of 833 patients with skin cancer completed the checklist. Of these, 531 (63.7%) patients had facial skin cancer and were included for further analysis. Patient responses were from one patient encounter and duplicates were not included. Patients' demographic and clinical variables are described in Table 1.

Most patients reported using sun protection "occasionally" and "often" (Fig. 1). For the items related to wearing a hat and wearing clothes in sunny weather, "never" was reported 11% and 9%, respectively. The odds ratio with Bonferroni adjustment ($p<0.01$ considered significant) was calculated for the individual questions. Women were 1.9 times more likely than men to wear sunscreen ($p=0.001$) and 0.5 times less likely to wear a hat ($p=0.001$). Although not significant, women were 1.7 times more likely than men to avoid the sun ($p=0.013$). Having a history of skin cancer was associated with a higher likelihood (OR 1.6-3.4) of reporting more sun protection behaviors (Q1 $p=0.001$, Q2 $p=0.023$, Q3-5 $p<0.001$). Patients with >3 prior skin cancers were 3.1-3.4 times more likely to seek shade ($p<0.001$), wear a hat ($p<0.001$), and cover their skin ($p<0.001$). Although smokers were less likely to avoid the sun and wear sunscreen than nonsmokers, this difference was not significant ($p=0.02$, $p=0.04$). No significant difference was seen based on age and the type of skin cancer.

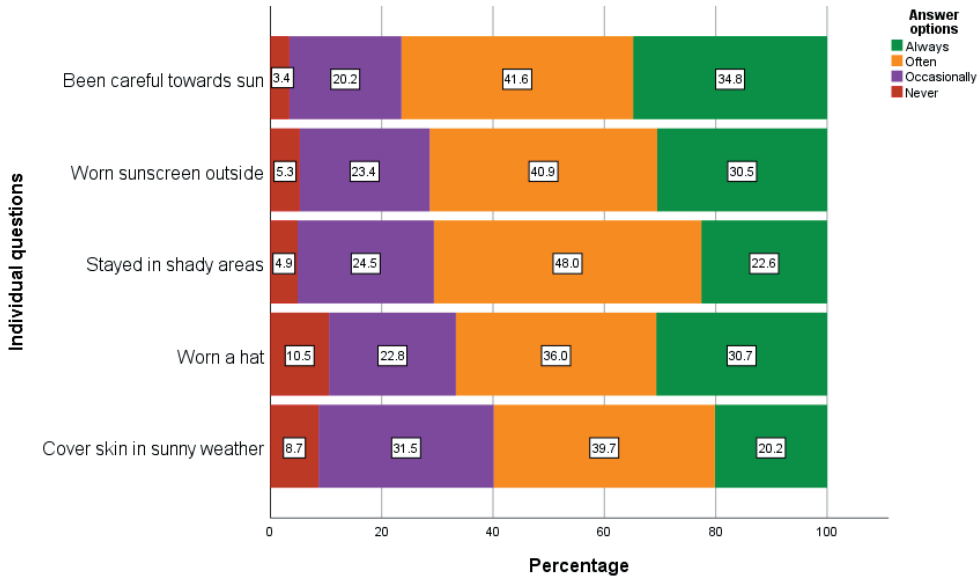

Figure 1. Percentage of patient responses for the 5-items of the Sun Protection Behavior checklist.

The Sun Protection Behavior checklist provides the clinician with a simple and quick tool to help identify areas of improvement in sun protection and can be used to identify patterns in individuals and groups. Future research applying the checklist in clinic at initial and subsequent visits may give a better insight into the patients' sun protection behavior over time. The checklist can be used independently or in conjunction with the scales and checklists of the FACE-Q Skin Cancer for a comprehensive assessment of patients presenting for dermatologic surgery.

References

1. Flohil SC, van der Leest RJT, Arends LR, de Vries E, Nijsten T. Risk of subsequent cutaneous malignancy in patients with prior keratinocyte carcinoma: a systematic review and meta-analysis. *Eur J Cancer* 2013;**49**:2365–75.
2. US Preventive Services Task Force, Grossman DC, Curry SJ, *et al.* Behavioral Counseling to Prevent Skin Cancer: US Preventive Services Task Force Recommendation Statement. *JAMA* 2018;**319**:1134–42.
3. Lee EH, Klassen AF, Lawson JL, Cano SJ, Scott AM, Pusic AL. Patient experiences and outcomes following facial skin cancer surgery: A qualitative study. *Australas J Dermatol* 2016;**57**:e100-104.
4. Lee EH, Klassen AF, Cano SJ, Nehal KS, Pusic AL. FACE-Q Skin Cancer Module for measuring patient-reported outcomes following facial skin cancer surgery. *Br J Dermatol* 2018;**179**:88–94.
5. Vaidya TS, Nehal KS, Rossi AM, Lee EH. Patient-reported adverse effects after facial skin cancer surgery: Long-term data to inform counseling and expectations. *J Am Acad Dermatol* 2019;**81**:1423–5.
6. Glanz K, Yaroch AL, Dancel M, *et al.* Measures of sun exposure and sun protection practices for behavioral and epidemiologic research. *Arch Dermatol* 2008;**144**:217–22.
7. Køster B, Søndergaard J, Nielsen JB, Allen M, Olsen A, Bentzen J. The validated sun exposure questionnaire: association of objective and subjective measures of sun exposure in a Danish population-based sample. *Br J Dermatol* 2017;**176**:446–56.
8. Lee EH, Klassen AF, Nehal KS, Cano SJ, Waters J, Pusic AL. A systematic review of patient-reported outcome instruments of nonmelanoma skin cancer in the dermatologic population. *J Am Acad Dermatol* 2013;**69**:e59-67.

Chapter 3

Sun Protection Behavior following Skin Cancer Resection and Reconstruction

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Abstract

Increased exposure to ultraviolet radiation (UVR) is associated with an increased risk of nonmelanoma skin cancer. Cutaneous surgery can be negatively influenced by UVR, causing delayed wound healing, hyperpigmentation of the scar, and an increased incidence of additional skin cancers. By changing sun protection behavior, these risks can be limited. Therefore, this study evaluates changes in patients' sun-protective behavior after Mohs micrographic surgery (MMS). Patients undergoing MMS between December 2017 and November 2019 were included. Patients were asked to complete the FACE-Q Skin Cancer - Sun Protection Behavior checklist before, three-months, and one-year post-surgery. A total of 125 patients completed the pre-operative and three-months post-operative checklists, and 89 (71.2%) completed the one-year post-operative checklist. Reported sun-protective behaviors increased post-surgery at all time points ($p < 0.001$). Patients with a prior history of facial skin cancer demonstrated a larger increase in sun protection behaviors after surgery than patients without a history of facial skin cancer ($p = 0.04$). Patients with defects located on the ear or scalp demonstrated a lesser increase in sun protection behaviors than patients with defects located in more conspicuous areas as the face ($p = 0.02$).

Our study demonstrates a change in sun protection behavior, with an increase in sun protection behavior over time in patients after MMS. However, more improvement is possible. Targeted counseling can increase sun protection behavior in patients without a history of facial skin cancer and patients with skin cancer located on the ears or scalp.

Introduction

Skin cancer is the most diagnosed form of cancer in the Netherlands.[1] Ultraviolet radiation (UVR) is a major risk factor for skin cancer.[2–4] Adherence to sun protection behaviors is a way to decrease skin cancer occurrence. Generally, over 50 percent of nonmelanoma skin cancer (NMSC) is found in the head and neck area and is most commonly treated with surgical removal.[5–7] A frequently performed procedure for NMSC is Mohs micrographic surgery (MMS).[8,9] MMS is a specialized technique that maximizes healthy tissue preservation to minimize the surgical defect compared to wide excision, which is particularly beneficial in the head and neck area.[10,11]

Studies have shown that after the first NMSC resection, there is an increased risk of a new NMSC.[12] One of the factors that negatively influence this risk and hampers the recovery after facial skin cancer resection and reconstruction is additional UVR exposure. UVR exposure to a developing scar during this period inhibits focal adhesion turnover and cytoskeletal dynamics. This cascade of events leads to delayed wound healing, hyperpigmentation, and subsequent risk of new skin cancer.[13,14] In order to prevent these complications and risks, it is essential to limit UVR exposure. Nevertheless, knowledge and use of sun protection are still limited.[15] Several studies have shown high awareness among patients regarding their sun protection behavior after skin cancer resection.[15–23] However, these studies also showed inadequate use of the sun-protective strategies in patients as well as healthy individuals.

Although there is research on the increased incidence of NMSC and enhanced skin exposure to UVR, there is scarce research on how sun protection behavior changes after skin cancer surgery. Only post-operative sun protection information could lead to misinformation on whether sun protection after surgery is adequate. Therefore, it is important to understand patient sun-protective strategies before surgery to see whether the patients change these postoperatively. We present prospective data on sun protection behavior in patients before and after MMS for NMSC.

Materials and methods

Study Population

Institutional review board approval was obtained from Catharina Hospital, Eindhoven, the Netherlands. Patients undergoing MMS for NMSC between December 2017 and November 2019 were asked to participate in this research. The MMS was performed in the Department of Dermatology and the reconstruction in the same department or the Department of Plastic, Reconstructive, and Hand

Surgery. Patients' inclusion criteria included age 18 years or older, fluent in Dutch, and accessible by phone and/or email. Patients were excluded if they had comorbidities causing a disrupted view of reality, e.g., dementia or depression. All patients received verbal information about sun protection, including the risk of UVR for future skin cancer and scar healing after surgery. Additional written information was given to patients discussing the MMS procedure and follow-up appointments. Relevant demographic and clinical information, defect size, defect location, and wound closure were recorded from electronic medical records. The location of the defect was categorized into facial defects and ear or scalp defects.

Questionnaire

All patients undergoing MMS for NMSC were asked to complete the Dutch version of the FACE-Q Skin Cancer - Sun Protection Behavior checklist before, three months after, and one year after the surgery. This Dutch FACE-Q Skin Cancer version was a linguistically translated version of the validated psychometric questionnaires.[24,25] The checklist consisted of five questions regarding how often patients engaged in specific sun-protective behavior. The items assessed in the FACE-Q Skin Cancer – Sun Protection Behavior checklist are: "Been careful towards sun," "Worn sunscreen outside," "Stayed in shady areas," "Worn a hat," and "Cover skin in sunny weather." Answer choices ranged from 1 to 4, 1 being 'Never,' 2 'Occasionally,' 3 'Often,' and 4 'Always.' Responses were summed with a total score ranging from 5 to 20. In this study, higher sun protection behavior scores indicate greater adherence to sun protective strategies. The Sun Protection Behavior checklist is available at *www.Qportfolio.org*.[26]

Statistical analysis

Descriptive statistics and graphical methods were used to analyze patient and clinical characteristics. Baseline sun protection data were compared across clinical and demographic characteristics. The normality of the distribution for the outcome variables was assessed with Shapiro-Wilk test and the assumption of homogeneity of variances assessed using Levene's test. Non-normal data were compared with the Mann-Whitney U test or Kruskal Wallis H test. A $p < 0.05$ was considered significant. Because of outliners with boxplot visualization, a Friedman test was run to determine if there were differences in sun protection behavior change per patient based on the overall score and for each individual question over time. To compare each time point, pairwise comparisons were performed with a Bonferroni correction for multiple comparisons. Statistical significance for this pairwise comparison was accepted at $p < 0.017$ level. Linear mixed models were used to

analyze the improvement in sun protection score from baseline with clinical and demographic characteristics, incorporating a random intercept for each patient and adjusting for factors that were significant on univariable analysis. $P < 0.05$ was considered statistically significant. The linear mixed model approach and Friedman test do not require patients to be measured at each time point; thus, no patients were excluded due to loss of follow-up. IBM SPSS Statistics 25.0 (IBM, USA) was used for all analyses.

Results

In this study, 370 patients were invited to participate. A total of 125 patients completed the pre-operative (baseline) and three-months post-operative sun protection behavior checklist. Of these, 89 (71.2%) completed the one-year post-operative sun protection checklist. The mean age at the time of MMS was 66.9±12.1 years and most participants were female (53.6%). Demographics and clinical characteristics of the patients are presented in Table 1.

Table 1: Demographics and Clinical Characteristics by baseline sun protection scores.

Variables	N (%)
Gender	
Male	58 (46.4)
Female	67 (53.6)
Age	
<60	31 (24.8)
60-70	36 (28.8)
>70	58 (46.4)
Smoking history	
Former/current	75 (60.0)
Never	50 (40.0)
History of facial skin cancer	
Yes	49 (39.2)
No	76 (60.8)
Area of facial surgery	
Scalp/ear	12 (9.7)
Face	113 (90.4)
Defect size (cm)	
<1.0	28 (22.4)
1.0-2.0	72 (57.6)
>2.0	25 (20.0)
Wound closure	
Primary closure	59 (47.2)
Flaps	48 (38.4)
Full-thickness skin graft	18 (14.4)

The mean sun protection behavior score at baseline was 12.6±3.2 on a scale from 5 to 20. There were no significant differences between baseline sun protection scores and gender (p = 0.28), age (p = 0.83), smoking history (p = 0.65), previous facial skin cancer (p = 0.87) and area of facial skin cancer (p = 0.74). After three months, the mean sun protection behavior score increased to 13.6±3.4 and after one year, the score increased to 14.5±3.1. While using the Friedman test, sun protection behavior scores were significantly different over time ($p < 0.001$), with higher scores observed at the three-month (p = 0.01) and one-year ($p < 0.001$) time point when compared to baseline scores. No significant difference was observed from the three-month to one-year time point (p = 0.04) while using the Bonferroni correction for multiple comparisons (Fig. 1).

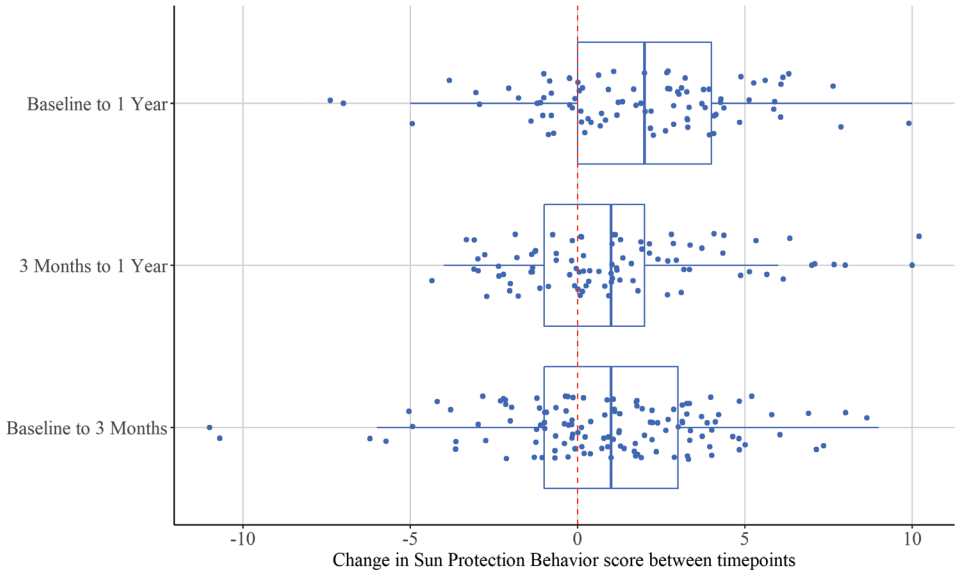

Figure 1. Change in sun protection behavior scores at different timepoints.

When comparing the individual questions of the checklist, the three-month and one-year postoperative scores also increased from baseline with patients being more careful in the sun ($p < 0.001$), wearing more sunscreen ($p < 0.001$), staying in shady areas (p = 0.03), wearing hats outside ($p < 0.001$) and covering their skin ($p < 0.001$) after skin cancer surgery. Of the 125 patients, 6 patients (4.8%) had a complication including dehiscence, hypertrophic scarring, infection, and post-operative ectropion. Having a complication did not affect patients' sun protection behavior scores.

Linear mixed model analysis demonstrated more improvement in sun protection behavior in patients who had a history of facial skin cancer compared to no prior history of facial skin cancer (p = 0.04) (Table 2). The biggest difference, calculated with a separate linear regression model, occurred between baseline and three-months post-operative (p = 0.02) (Fig. 2A). Patients demonstrated a larger increase in sun protection behavior when the defect was in conspicuous areas such as the face, compared to less conspicuous areas such as the scalp or ears (p = 0.02) (Fig. 2B). No difference was seen in the change in sun protection behavior score and the other patient characteristics (Table 2).

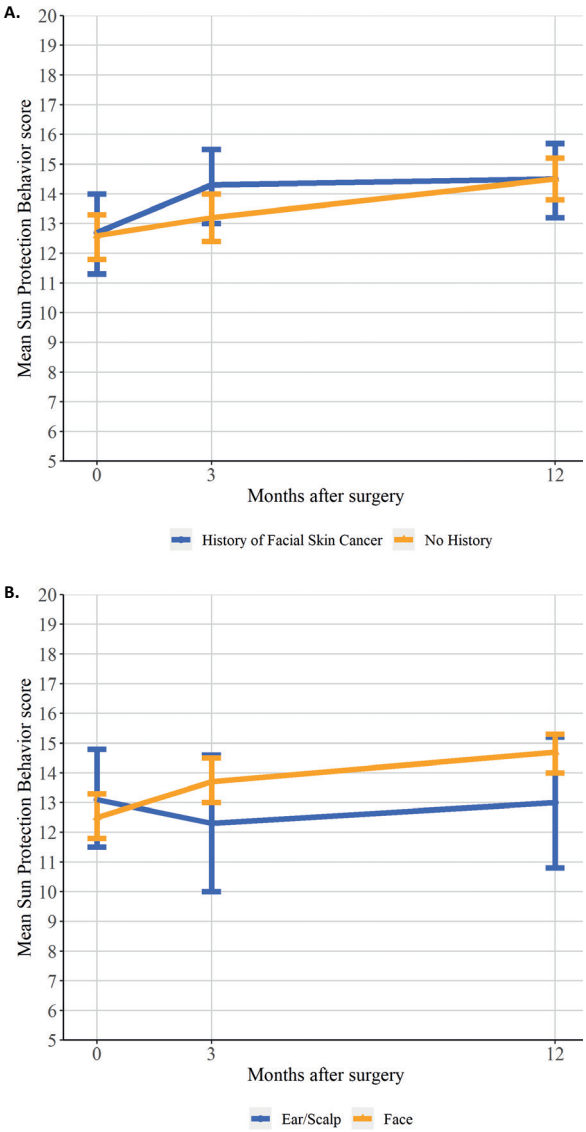

Figure 2. Sun protection over time by patient characteristics. Vertical lines indicate 95% confidence intervals.

A. Sun protection behavior at each time point by history of facial skin cancer.

B. Sun protection behavior at each time point by location of skin cancer

Table 2: Summary of multivariate mixed effect models of Sun Protection Behavior checklist.

	Estimate	Standard error	p-value
Gender:			
Female (Reference)	0	-	-
Male	-0.53	0.43	0.221
Timepoints			
Three-months (Reference)	0	-	-
One-year	0.90	0.28	0.001
Baseline*	-0.42	0.07	<0.001
Age:			
>70 years (Reference)	0	-	-
60 – 70 years	0.84	0.50	0.096
<60 year	0.39	0.53	0.463
Timepoints			
Thee-months (Reference)	0	-	-
One-year	0.90	0.43	0.002
Baseline*	-0.42	0.28	<0.001
Previous facial skin cancer:			
Yes (Reference)	0	-	-
No	0.89	0.07	0.044
Timepoints			
Three-months (Reference)	0	-	-
One-year	0.92	0.28	0.001
Baseline*	-0.42	0.07	<0.001
Defect size:			
>2.0 cm (Reference)	0	-	-
1.0-2.0 cm	-0.31	0.55	0.571
<1.0 cm	0.29	0.66	0.668
Timepoints			
Three-months (Reference)	0	-	-
One-year	0.91	0.28	0.001
Baseline*	-0.42	0.07	<0.001
Wound closure:			
Flaps (Reference)	0	-	-
Full-thickness skin graft	-0.61	0.66	0.358
Primary	-0.62	0.46	0.183
Timepoints			
Three-months (Reference)	0		
One-year	0.91	0.28	0.001
Baseline*	-0.42	0.07	<0.001
Smoking:			
Yes (Reference)	0	-	-
No	0.33	0.43	0.451
Timepoints			
Three-months (Reference)	0	-	-
One-year	0.89	0.30	0.002
Baseline*	-0.42	0.07	<0.001
Location:			
Face (Reference)	0	-	-
Ear/Scalp	-1.62	0.67	0.018
Timepoints			
Three-months (Reference)	0	-	-
One-year	0.92	0.30	0.001
Baseline*	-0.42	0.06	<0.001

* Sun protection behavior scores prior to surgery.

Discussion

After NMSC surgery, UVR exposure remains a risk factor for additional skin cancers and can lead to delayed wound healing and scar hyperpigmentation. Therefore, it is important to understand whether patients practice more sun protective strategies after NMSC surgery.[17] We observed a significant increase in sun protection behavior, especially in the first three-months after NMSC resection. There is still a small increase three-months to one-year after surgery, suggesting patients continue to be aware of sun protection in the long-term post-operative period.

In patients with a history of prior facial skin cancer, a greater increase in sun protection behavior was seen in the first three months compared to patients without a history of facial skin cancer. This could be due to the group being more aware of wound healing after the reconstruction and the increased risk of additional skin cancer with UVR. In patients with a defect on the ear or scalp, a decrease in sun protection behavior was seen the first three months after surgery, supporting a previous study showing that the ears are more likely to be forgotten when applying sunscreen.[27] Since the ears and scalp can be more hidden by hair and are less noticeable in the mirror, the scars can also be less prominent. This could lead to patients being less reminded of their skin cancer and, therefore, more likely to forget the use of sun protection.

Although sun protection behavior changes over time, the mean sun protection score after one year is 14.5 on a scale from 5 to 20, suggesting further improvement is possible. A study in 2014 showed that patients know the risk of not using sun protection behavior after skin cancer surgery, but only a small percentage uses sun protection behavior.[15] Furthermore, even a decrease after three years is seen in some patients compared to before skin cancer resection.[21] A systematic review in 2016 also reports some patients do not change their sun protection behavior after surviving malignant melanoma.[28]

One essential step to changing sun protection behavior is counseling. In this study, patients received verbal counseling about sun protection behavior for scar healing and the risk of skin cancer after reconstruction. No written consultation was given to patients after the MMS. However, studies have shown that verbal consultations are as effective as written consultations.[29,30] Targeted counseling may help improve sun protection behavior for specific patient groups, such as patients with skin cancer located at the ear or scalp.

There are limitations to this study. Since this research was located in the Netherlands, this could impact reliability. In southern countries with more sun exposure, different patterns of sun protection behavior could be seen. Not all invited patients participated in the study; therefore, it is possible that patients who did not complete the checklist were less compliant. Larger multicenter studies

with a follow-up of more than one year may better reflect sun protection behavior changes in the NMSC population. However, this study shows the Dutch perspective of NMSC and their awareness and use of sun-protective strategies before and after facial reconstructions.

Conclusions

Patients undergoing MMS for NMSC are more aware of sun-protective behavior one-year after surgery compared to before surgery. However, counseling is still necessary to increase awareness of sun protection behavior for scar healing and skin cancer risk in the future. Targeted counseling may improve sun protection behavior in patients with ear or scalp defects and patients without a prior history of facial skin cancer.

References

1. Huidkanker meest voorkomende vorm van kanker in Nederland - IKNL. https://www.iknl.nl/nieuws/2015/huidkanker-meest-voorkomende-vorm-van-kanker-in-ne.
2. Flohil, S. C., van der Leest, R. J. T., Arends, L. R., de Vries, E. & Nijsten, T. Risk of subsequent cutaneous malignancy in patients with prior keratinocyte carcinoma: a systematic review and meta-analysis. *Eur. J. Cancer Oxf. Engl. 1990* **49**, 2365–2375 (2013).
3. Watson, M., Holman, D. M. & Maguire-Eisen, M. Ultraviolet Radiation Exposure and Its Impact on Skin Cancer Risk. *Semin. Oncol. Nurs.* **32**, 241–254 (2016).
4. Iannacone, M. R. *et al.* Patterns and timing of sunlight exposure and risk of basal cell and squamous cell carcinomas of the skin – a case–control study. *BMC Cancer* **12**, 417 (2012).
5. Potenza, C. *et al.* A Review of the Literature of Surgical and Nonsurgical Treatments of Invasive Squamous Cells Carcinoma. *BioMed Res. Int.* **2018**, (2018).
6. Mohs Surgery. *The Skin Cancer Foundation* https://www.skincancer.org/treatment-resources/mohs-surgery/.
7. Staples, M. P. *et al.* Non-melanoma skin cancer in Australia: the 2002 national survey and trends since 1985. *Med. J. Aust.* **184**, 6–10 (2006).
8. Lee, C. T. *et al.* Surgical excision, Mohs micrographic surgery, external-beam radiotherapy, or brachytherapy for indolent skin cancer: An international meta-analysis of 58 studies with 21,000 patients. *Cancer* **125**, 3582–3594 (2019).
9. Wong, E., Axibal, E. & Brown, M. Mohs Micrographic Surgery. *Facial Plast. Surg. Clin. N. Am.* **27**, 15–34 (2019).
10. Nehal, K. S. & Bichakjian, C. K. Update on Keratinocyte Carcinomas. *N. Engl. J. Med.* **379**, 363–374 (2018).
11. van Loo, E. *et al.* Surgical excision versus Mohs' micrographic surgery for basal cell carcinoma of the face: A randomised clinical trial with 10 year follow-up. *Eur. J. Cancer Oxf. Engl. 1990* **50**, 3011–3020 (2014).
12. Marcil, I. & Stern, R. S. Risk of Developing a Subsequent Nonmelanoma Skin Cancer in Patients With a History of Nonmelanoma Skin Cancer: A Critical Review of the Literature and Meta-analysis. *Arch. Dermatol.* **136**, 1524–1530 (2000).
13. Liu, H. *et al.* Ultraviolet B (UVB) Inhibits Skin Wound Healing by Affecting Focal Adhesion Dynamics. *Photochem. Photobiol.* **91**, 909–916 (2015).
14. Chadwick, S., Heath, R. & Shah, M. Abnormal pigmentation within cutaneous scars: A complication of wound healing. *Indian J. Plast. Surg. Off. Publ. Assoc. Plast. Surg. India* **45**, 403–411 (2012).

15. Goldenberg, A., Nguyen, B. T. & Jiang, S. I. B. Knowledge, understanding, and use of preventive strategies against nonmelanoma skin cancer in healthy and immunosuppressed individuals undergoing Mohs surgery. *Dermatol. Surg. Off. Publ. Am. Soc. Dermatol. Surg. Al* **40**, 93–100 (2014).
16. Harth, Y., Ulman, Y., Peled, I. & Friedman-Birnbaum, R. Sun protection and sunscreen use after surgical treatment of basal cell carcinoma. *Photodermatol. Photoimmunol. Photomed.* **11**, 140–142 (1995).
17. Lee, E. H. *et al.* Patient experiences and outcomes following facial skin cancer surgery: A qualitative study. *Australas. J. Dermatol.* **57**, e100-104 (2016).
18. Levy-Shraga, Y. *et al.* Sun Exposure and Protection Habits in Pediatric Patients with a History of Malignancy. *PloS One* **10**, e0137453 (2015).
19. Leung, V. K. Y., Dobbinson, S. J., Goodman, D. J., Kanellis, J. & Chong, A. H. Skin cancer history, sun-related attitudes, behaviour and sunburn among renal transplant recipients versus general population. *Australas. J. Dermatol.* **59**, e106–e113 (2018).
20. Warren, M., McMeniman, E., Adams, A. & De'Ambrosis, B. Skin protection behaviour and sex differences in melanoma location in patients with multiple primary melanomas. *Australas. J. Dermatol.* **58**, 25–29 (2017).
21. Idorn, L. W., Datta, P., Heydenreich, J., Philipsen, P. A. & Wulf, H. C. A 3-Year Follow-up of Sun Behavior in Patients With Cutaneous Malignant Melanoma. *JAMA Dermatol.* **150**, 163–168 (2014).
22. Rhee, J. S. *et al.* Quality of Life and Sun-Protective Behavior in Patients With Skin Cancer. *Arch. Otolaryngol. Neck Surg.* **130**, 141–146 (2004).
23. von Schuckmann, L. A. *et al.* Sun protection behavior after diagnosis of high-risk primary melanoma and risk of a subsequent primary. *J. Am. Acad. Dermatol.* **80**, 139-148.e4 (2019).
24. Lee, E. H., Klassen, A. F., Cano, S. J., Nehal, K. S. & Pusic, A. L. FACE-Q Skin Cancer Module for measuring patient-reported outcomes following facial skin cancer surgery. *Br. J. Dermatol.* **179**, 88–94 (2018).
25. Ottenhof, M. J. *et al.* Patient-reported Outcome Measures: The FACE-Q Skin Cancer Module: The Dutch Translation and Linguistic Validation. *Plast. Reconstr. Surg. Glob. Open* **7**, (2019).
26. admqportfolio. FACE-Q | Skin Cancer - Q-Portfolio ADAPTABLE TO YOUR NEEDS. http://qportfolio.org/face-q/skin-cancer/ (2018).
27. Azurdia, R. M., Pagliaro, J. A., Diffey, B. L. & Rhodes, L. E. Sunscreen application by photosensitive patients is inadequate for protection. *Br. J. Dermatol.* **140**, 255–258 (1999).
28. Nahar, V. K. *et al.* Skin cancer prevention practices among malignant melanoma survivors: a systematic review. *J. Cancer Res. Clin. Oncol.* **142**, 1273–1283 (2016).

29. Armstrong, A. W. *et al.* Online Care Versus In-Person Care for Improving Quality of Life in Psoriasis: A Randomized Controlled Equivalency Trial. *J. Invest. Dermatol.* **139**, 1037–1044 (2019).
30. Tates, K., Antheunis, M. L., Kanters, S., Nieboer, T. E. & Gerritse, M. B. The Effect of Screen-to-Screen Versus Face-to-Face Consultation on Doctor-Patient Communication: An Experimental Study with Simulated Patients. *J. Med. Internet Res.* **19**, (2017).

Chapter 4

Cancer worry after Facial Non-melanoma skin cancer resection and reconstruction: A one-year prospective study

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Abstract

Objective: Non-melanoma skin cancer (NMSC) is one of the most diagnosed cancers in the world, with the number of new occurrences rising every year. Most patients with facial skin cancer experience cancer-related worry. Yet, little is known about their worry during the period after cancer treatment. This study aimed to assess the long-term change of cancer worry after surgical treatment in patients with NMSC.

Methods: Patients undergoing surgery for facial NMSC between December 2017 and March 2020 were asked to complete the FACE-Q Skin Cancer - Cancer Worry scale before (baseline), three-months, and one-year post-surgery.

Results: A total of 151 patients completed the baseline and three-month, and 99 (65.6%) the one-year post-operative survey. A significant decrease in cancer worry score was seen between baseline and three-months post-surgery ($p < .001$). No difference was found between the three-months and one-year post-surgery scores ($p = .78$). Less improvement in cancer worry was seen for patients who had one facial skin cancer in their medical history ($p = .001$) and patients who had a history of facial surgery ($p < .001$).

Conclusion: Post-surgery patients still experience cancer worry. Therefore, targeted counseling might be of value when coping with cancer-related concerns. Patients with a history of facial NMSC and patients with a history of facial surgery might benefit from additional counseling.

Background

Worldwide, non-melanoma skin cancer (NMSC) is known as one of the most common cancers.[1] Between 2 to 3 million cases of NMSC occur each year and the incident rates keep rising.[2] Most NMSCs are located on the head and neck due to the high sun exposure in these areas.[3,4] There are different treatment approaches for NMSC (e.g., excision, radiotherapy, anti-cancer creams), of which Mohs micrographic surgery (MMS) is increasingly being used for facial NMSC.[5–7]

Once diagnosed with NMSC, most patients experience cancer-related worry (e.g., worry about skin cancer progression).[8] At first, removal of the skin cancer seems to result in lower levels of cancer worry.[9] However, some cancer worry may persist due to factors that stay present after surgery; such as surgery-induced scarring.[10,11] This may be a constant physical reminder of the skin cancer, resulting in an increased level of worry about their NMSC and the risk of new skin cancers. Patients with a history of skin cancer will have a lifelong risk of subsequent NMSC development.[12] The estimated 3-year risk of new NMSCs lies between 18-44% and is shown to rise according to the number of prior occurrences in the medical history.[13–16] This constant risk may ultimately worsen patients' cancer worry as a fear of recurrence often develops once diagnosed with NMSC.[17–19] Therefore, it is crucial for healthcare professionals to recognize patients' cancer-related concerns and respond adequately to their need for supportive care.[18]

Although studies discussing skin cancer worry exist,[8,9,17,18] there is little known on the long-term change of the cancer worry after facial NMSC treatment. More knowledge on cancer worry scores following surgery and cancer worry scores in different patient groups may help identify patients at risk for high cancer worry and those who may benefit from supportive care interventions. This study aimed to prospectively analyze cancer worry in patients before and after facial MMS for NMSC, with the use of the FACE-Q Skin Cancer Module, a validated patient-reported outcome measure specifically designed for patients undergoing facial skin cancer resection.[20–22]

Methods

Institutional review board approval was obtained from Catharina Hospital, Eindhoven. A single-center prospective study design was used. Patients were enrolled at the Department of Dermatology between April 2017 and March 2020 and were asked to participate before undergoing MMS for NMSC. Informed consent was given prior to answering the survey. The reconstruction following MMS was performed either at the same department or the Department of Plastic, Reconstructive, and Hand Surgery in the same hospital. Patients were included if

they were 18 years or older, adequately fluent in the Dutch language, and available by email or phone. Information was given both verbally and through leaflets discussing the preparations, procedure, possible complications, and the follow-up period.

Electronic medical records were used to obtain relevant demographics and clinical information, such as the number of prior- facial and/or non-facial NMSC in the medical history, lesion size, lesion location, wound closure, any prior facial surgery (e.g., skin cancer, benign lesion removal, surgery because of trauma) and cancer history other than NMSC (e.g., prostate cancer, lung cancer, melanoma). The location of the lesion was categorized as i) central: the eye, nose, and lips ii) peripheral: forehead, scalp, cheek, chin, and ears. Wound closure techniques were divided into primary closure, flaps, and others (e.g., second intention healing and full-thickness skin graft (FTSG)). The longest diameter of the lesion after resection and before the reconstruction, in any axis, was termed "lesion diameter" and divided into two groups: <1.5 cm and ≥ 1.5 cm. Complications were recorded if surgical (e.g., ectropion repair) or non-surgical (e.g., administration of antibiotics) intervention by a medical healthcare professional was necessary.

Questionnaire

The FACE-Q Skin Cancer consists of five scales and two checklists. Each scale and checklist can be used independently or in conjunction with other scales and checklists. For this study the FACE-Q Skin Cancer – Cancer Worry scale was used. All patients received the validated Dutch translation of the questionnaire via mail prior to (baseline), three-months, and one-year after MMS.[20–23] Questionnaires were considered complete when all items of the Cancer Worry scale were answered. Patients were included in the study if they completed the Cancer Worry scale at baseline and three-months post-operative. The Cancer Worry scale consists of ten questions on a Likert-type scale covering subjects such as general worry about skin cancer, worry cancer might spread, daily cancer worry, and anxiousness. Answer options were: strongly disagree, disagree, agree, or strongly agree. The sum of the score was converted into a Rasch score ranging from 0 to 100.[24] Higher scores indicate more cancer worry.

Statistical analysis

The differences between the cancer worry scores at baseline were calculated for the demographic and clinical variables. Non-normal distributed data, measured with the Shapiro Wilk test and Levene's test, were tested with the Mann-Whitney U or Kruskal Wallis H test; otherwise, the unpaired t-test or ANOVA was applied. The Friedman test for non-normal distributed data was used to present differences in cancer worry scores per patient over time. Pairwise comparisons were performed

with a Bonferroni correction for multiple comparisons. Statistical significance for this test was accepted at $p < .017$ level. The course of the mean cancer worry score was analyzed for associations with clinical and demographic characteristics by using a mixed linear regression model. A random intercept and slope were incorporated for every patient to measure improvement in cancer worry compared to baseline, with an adjustment for the baseline cancer worry score. Further analysis was done on the difference in cancer worry score between two timepoints by executing separate linear regression models for characteristics that showed significant associations with the cancer worry score. A $p < .05$ was considered statistically significant. Data management and analysis were performed using IBM SPSS statistics 26.0 (IBM, USA).

Results

A total of 239 patients completed the Cancer Worry scale before MMS. Of these patients, 151 completed the three-month post-operative questionnaire and were therefore included in this study. The one-year post-operative survey was completed by 99 (65.6%) patients. No significant difference was found between the included patients and the patients that only completed the baseline Cancer Worry scale (p=0.48). In addition, no clinical or demographic differences were found between the lost to follow-up patients at three-months versus baseline (n = 151 vs. n = 88) and one-year versus three-months (n = 99 vs. n = 52). The mean age at the time of surgery was 67.1 ± 11.7 years (mean ± standard deviation). Ninety-three patients (61.6%) had a central lesion and 58 (38.4%) a peripheral lesion. The mean size of the lesion was 1.6 ± 0.8cm. Most patients were reconstructed with a primary closure (n = 74, 49.0%), followed by flap reconstruction (n = 58, 38.4%). Ten patients (6.6%) experienced a complication (flap reconstruction n = 4, primary closure n = 3, FTSG n = 3). All complications were minor, requiring surgical or non-surgical intervention (e.g., correction of ectropion, administration of antibiotics).

Most patients (92.7%, RASCH score range from 6 to 92) expressed some degree of cancer worry at baseline. Of the 151 patients, 27 patients (17.9%) had at least one other cancer diagnosis in their medical history (either current, in remission, or history of cancer, e.g., prostate cancer, lung cancer, melanoma). No significant difference in cancer worry was found between the 27 patients with a cancer diagnosis other than NMSC in their medical history and the 124 patients without a cancer diagnosis other than NMSC (n = 27, mean 34.0 ± 19.2 vs. n = 124, mean 37.1 ± 19.1, p = .34). Patients who had a history of prior facial surgery showed a higher cancer worry score compared to patients who did not (p = .03). From the patients with a history of prior facial surgery, 51 patients (80.9%) had undergone surgery for NMSC (mean cancer worry score 37.5 ± 17.9) and twelve patients (19.1%) had

undergone a cosmetic (e.g., eyelid correction) or traumatic facial surgery (mean cancer worry score 50.3 ± 16.7). Baseline cancer worry scores, patient demographic and clinical variables are shown in Table I.

Table 1: Demographic and clinical characteristics by baseline cancer worry scores.

Variables	N (%)	Baseline cancer worry score, Mean (SD)	p-value
Age, y			
< 70	77 (51.0)	36.5 (19.7)	.93 ‡
≥ 70	74 (49.0)	36.6 (18.5)	
Gender			
Male	68 (45.0)	33.9 (19.0)	.18 ‡
Female	83 (55.0)	38.7 (18.9)	
Smoking			
Yes/Former	88 (58.3)	36.5 (19.0)	.94 ‡
No	63 (41.7)	36.6 (19.4)	
Location defect			
Central	93 (61.6)	37.5 (19.3)	.37 ‡
Peripheral	58 (38.4)	35.1 (18.9)	
Defect diameter, cm			
< 1.5	78 (51.7)	37.3 (19.4)	.64
≥ 1.5	73 (48.3)	35.8 (18.8)	
Wound closure			
Primary closure	74 (49.0)	35.4 (20.1)	.58 ‡
Flap	58 (38.4)	37.2 (18.6)	
Others†	19 (12.6)	39.2 (17.0)	
Number of prior facial NMSC			
0	92 (60.9)	35.9 (20.0)	.67 ‡
1	39 (25.8)	37.3 (18.2)	
≥2	20 (13.3)	38.4 (17.1)	
Number of prior non-facial NMSC			
0	105 (69.5)	35.9 (20.2)	.54 ‡
1-2	20 (13,3)	36.6 (16.4)	
≥3	26(17.2)	39.4 (16.5)	
History of facial surgery			
Yes	63 (41.7)	40.0 (18.3)	.03 ‡
No	88 (58.3)	34.1 (19.4)	

SD, standard deviation; y, year; cm, centimeter; NMSC, Non-melanoma skin cancer.
† Second intention healing, n = 6; Full-thickness skin graft, n = 13
‡ P-value calculated with the Mann-Whitney U or Kruskall-Wallis H test

During the one-year follow-up period, the difference in cancer worry scores was statistically significant over time ($p < .001$). A significant decrease in cancer worry score was seen between baseline (mean 36.6 ± 19.1) and three-months post-surgery (mean 27.3 ± 21.4, $p < .001$), and between baseline and one-year post-surgery (mean 24.5 ± 19.5, $p < .001$). No significant difference in cancer worry score was found between three-months and one-year post-surgery ($p = .78$) (Fig. 1). At the three-month time point, the cancer worry score of the 52 patients who did not complete the one-year post-operative survey did not significantly differ from the 99

patients that did complete the one-year post-operative survey (n = 99 mean 25.3 ±19.2 vs. n = 52 mean 31.1 ± 24.7, p = 0.19).

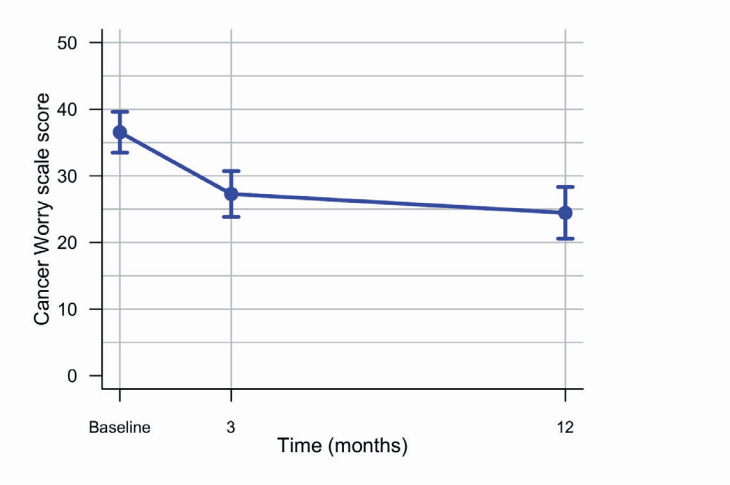

Figure 1. The mean cancer worry score at each timepoint. Vertical lines indicate 95% confidence intervals.

Results of the mixed linear regression model can be found in Table II. This analysis revealed less improvement in cancer worry scores for patients who had a history of one prior NMSC compared to no history (p = .001, Fig. 2). A history of two or more prior facial NMSC did not have an effect on change in cancer worry over time (p = .12). The change in cancer worry scores after treatment was greater in patients who did not have a history of facial surgery compared to patients who had a history of facial surgery (p < .001). No significant difference in cancer worry scores and the other patient characteristics were seen (see Table II). A separate linear regression model demonstrated a significant difference in cancer worry score between baseline and three-months post-operative for patients with one prior facial NMSC (p = .01, Fig. 2) and patients with prior history of facial surgery (p = .01, Fig. 2).

Table 2: Summary of the mixed linear regression models on the cancer worry scores.

	Estimate	Standard error	p-value
Age, y			
≥ 70 (Reference)	0	0	-
< 70	0.32	2.66	.91
Timepoints			
Three-months (Reference)	0	0	-
One-year	-0.91	1.38	.51
Baseline †	0.65	0.07	< .001
Gender			
Female (Reference)	0	0	-
Male	4.04	2.66	.13

Table 2: Continued

	Estimate	Standard error	p-value
Timepoints			
Three-months (Reference)	0	0	-
One-year	-0.89	1.38	.52
Baseline †	0.66	0.07	< .001
Smoking			
Yes/Former (Reference)	0	0	-
No	-1.27	2.69	.64
Timepoints			
Three-months (Reference)	0	0	-
One-year	-0.90	1.38	.51
Baseline †	0.65	0.07	< .001
Location defect			
Peripheral (Reference)	0	0	-
Central	1.05	2.73	.70
Timepoints			
Three-months (Reference)	0	0	-
One-year	-0.90	1.38	.52
Baseline †	0.65	0.07	< .001
Defect diameter, cm			
≥ 1.5 (Reference)	0	0	-
< 1.5	0.28	2.66	.92
Timepoints			
Three-months (Reference)	0	0	-
One-year	-0.91	1.38	.51
Baseline †	0.65	0.07	< .001
Wound closure			
Others (Reference)	0	0	-
Primary closure	0.89	4.24	.84
Flap	-0.14	4.35	.97
Timepoints			
Three-months (Reference)	0	0	-
One-year	-0.92	1.38	.51
Baseline †	0.65	0.07	< .001
Number of prior facial NMSC			
No (Reference)	0	0	-
1	10.32	3.02	.001
≥ 2	6.12	3.86	.12
Timepoints			
Three-months (Reference)	0	0	-
One-year	-0.78	1.38	.57
Baseline †	0.64	0.07	< .001
History of facial surgery			
Yes (Reference)	0	0	-
No	-9.98	2.60	< .001
Timepoints			
Three-months (Reference)	0	0	-
One-year	-0.77	1.38	.58
Baseline †	0.61	0.07	< .001

y, year; cm, centimeter; NMSC, non-melanoma skin cancer.
† Cancer worry scores prior to surgery

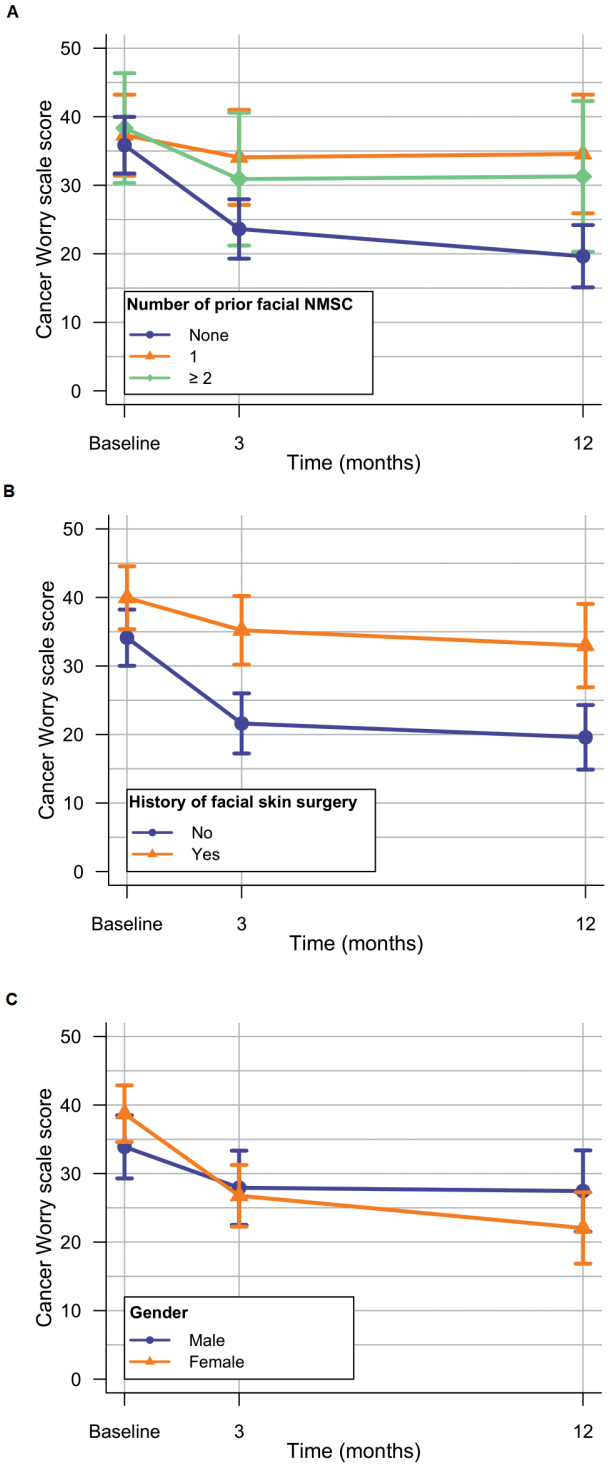

Figure 2. The mean cancer worry score at each timepoint by patient characteristics

Vertical lines indicate 95% confidence intervals.

A. The average cancer worry score at each point in time by number of prior facial non-melanoma skin cancer

B. The average cancer worry score at each point in time by history of facial surgery

C. The average cancer worry score at each point in time by gender

Discussion

Cancer worry can significantly impact patients' well-being and increase their psychosocial distress, resulting in a decreased quality of life.[17] This study showed that most patients experience varying levels of cancer worry when diagnosed with NMSC. These cancer worry levels decrease after treatment, which is consistent with previous study findings.[9] A further decrease was observed until one year after MMS. However, post-surgery patients still experienced cancer worry. Some level of cancer worry could be beneficial as it might motivate patients to take preventative measurements for skin cancer (e.g., sunscreen). Nonetheless, fear might cause psychosocial complaints.[17] Therefore, it is important to understand the patients' concerns following diagnosis and treatment to prevent unnecessary fears, such as fear of dying from NMSC skin cancer as NMSC is known for having a low morbidity and mortality rate.[12] As such, targeted counseling would help patients cope with their fears and thereby contribute to a successful recovery.[18,25]

In this study, patients without a history of facial skin cancer showed a larger decrease in cancer worry post-surgery compared to patients with a history of facial NMSC. The difference in cancer worry levels after surgery may be due to the prior skin cancer contributing to concerns about recurrence or the potential for new lesions, which is a common cause for concern among patients with NMSC.[11,17] In this context, informing patients that the five-year recurrence rates are considerably lower after MMS treatment compared to other treatment modalities could help decrease patients' concerns.[7,26] However, it is important to inform patients that the risk of new NMSC will continue to persist and that it may be useful to lower this risk with preventative measurements, e.g., regular skin examination, sun protection, or more innovative methods such as smartphone applications and teledermoscopy.[16,27–32] Therefore, this group of patients might benefit from receiving additional counseling and information on recurrence rates, future skin cancer risk, and skin cancer prevention.

Furthermore, patients that did not undergo facial surgery prior to treatment demonstrated a larger decrease in cancer worry after MMS than patients with a history of facial surgery. Visible facial scarring might result in worry about additional alterations and may thereby increase the fear of undergoing skin cancer treatment.[25] Counseling and guidance could help these patients to go through the process of adapting to visible alterations;[25] such as showing the lesion before reconstruction, which may result in lower appearance-related distress.[33]

Study limitations

There are some limitations to this study. The study did not report on social support (e.g., relationship status, loneliness, and work environment) and did not register

new facial NMSC diagnoses during the follow-up period. These factors may contribute to the cancer worry scores post-surgery. In addition, only patients who completed the baseline and three-month post-operative time points were included, of which 65.5% of the patients completed all three time points; it is possible that those who refused to participate or did not complete the study had more or less cancer worry after one year. However, no significant difference was found between patient characteristics and cancer worry scores of the patients who were lost to follow-up and those who completed the study. Larger multicenter studies, including different skin cancer types, treatment types and patients' social support, may bring a better understanding on cancer worry levels for patients diagnosed with NMSC. Furthermore, larger studies could also give more insight into the differentiation between any worry and clinical worry and the nature of the patients' concerns.

Clinical implications

The outcome of this study could offer physicians a better understanding of cancer worry after treatment and may help specific patient groups better cope with their skin cancer. By incorporating the FACE-Q Skin Cancer – Cancer Worry scale in clinic, unchanged or increased levels of cancer worry can be detected over time. In addition, the physician could look at the individual items of the scale to differentiate between the cause of the cancer worry. This way, the Cancer Worry scale might identify patients who may benefit from targeted counseling or specialized psychological care. It may also result in fewer post-surgery visits for patients that do not need additional support. Consequently, incorporating the FACE-Q Skin Cancer – Cancer Worry scale in clinic might improve the quality and the efficiency of patient care.

Conclusion

After MMS treatment for facial NMSC, patients experience less cancer worry compared to baseline. However, for most patients, cancer worry was still present at one-year post-surgery. Counseling may help patients cope with their cancer-related worry. Additionally, patients with a history of facial NMSC and a history of facial surgery might benefit from targeted counseling.

Reference

1. Khazaei Z, Ghorat F, Jarrahi AM, Adineh HA, Sohrabivafa M, Goodarzi E. Global incidence and mortality of skin cancer by histological subtype and its relationship with the human development index (HDI); an ecology study in 2018. *World Cancer Res J*. 2019;**6**(April 2019). doi:10.32113/wcrj_20194_1265
2. Ultraviolet (UV) radiation and skin cancer. Accessed June 11, 2020. https://www.who.int/news-room/q-a-detail/ultraviolet-(uv)-radiation-and-skin-cancer
3. de Vries E, Louwman M, Bastiaens M, de Gruijl F, Coebergh JW. Rapid and Continuous Increases in Incidence Rates of Basal Cell Carcinoma in the Southeast Netherlands Since 1973. *J Invest Dermatol*. 2004;**123**(4):634-638. doi:10.1111/j.0022-202X.2004.23306.x
4. Netscher DT, Leong M, Orengo I, Yang D, Berg C, Krishnan B. Cutaneous Malignancies: Melanoma and Nonmelanoma Types: *Plast Reconstr Surg*. 2011;**127**(3):37e-56e. doi:10.1097/PRS.0b013e318206352b
5. Lv R, Sun Q. A Network Meta-Analysis of Non-Melanoma Skin Cancer (NMSC) Treatments: Efficacy and Safety Assessment. *J Cell Biochem*. 2017;**118**(11):3686-3695. doi:10.1002/jcb.26015
6. Mansouri B, Bicknell LM, Hill D, Walker GD, Fiala K, Housewright C. Mohs Micrographic Surgery for the Management of Cutaneous Malignancies. *Facial Plast Surg Clin N Am*. 2017;**25**(3):291-301. doi:10.1016/j.fsc.2017.03.002
7. van Loo E, Mosterd K, Krekels GAM, et al. Surgical excision versus Mohs' micrographic surgery for basal cell carcinoma of the face: A randomised clinical trial with 10 year follow-up. *Eur J Cancer Oxf Engl 1990*. 2014;**50**(17):3011-3020. doi:10.1016/j.ejca.2014.08.018
8. Zhang J, Miller CJ, O'Malley V, Etzkorn JR, Shin TM, Sobanko JF. Patient quality of life fluctuates before and after Mohs micrographic surgery: A longitudinal assessment of the patient experience. *J Am Acad Dermatol*. 2018;**78**(6):1060-1067. doi:10.1016/j.jaad.2018.02.065
9. Khoshab N, Vaidya TS, Dusza S, Nehal KS, Lee EH. Factors contributing to cancer worry in the skin cancer population. *J Am Acad Dermatol*. Published online October 1, 2019. doi:10.1016/j.jaad.2019.09.068
10. Sobanko JF, Sarwer DB, Zvargulis Z, Miller CJ. Importance of physical appearance in patients with skin cancer. *Dermatol Surg Off Publ Am Soc Dermatol Surg Al*. 2015;**41**(2):183-188. doi:10.1097/DSS.0000000000000253
11. Burdon-Jones D, Thomas P, Baker R. Quality of life issues in nonmetastatic skin cancer. *Br J Dermatol*. 2010;**162**(1):147-151. doi:10.1111/j.1365-2133.2009.09469.x

12. Leiter U, Keim U, Eigentler T, et al. Incidence, Mortality, and Trends of Nonmelanoma Skin Cancer in Germany. *J Invest Dermatol*. 2017;**137**(9):1860-1867. doi:10.1016/j.jid.2017.04.020
13. Sedaghat AR. Understanding the Minimal Clinically Important Difference (MCID) of Patient-Reported Outcome Measures. *Otolaryngol--Head Neck Surg Off J Am Acad Otolaryngol-Head Neck Surg*. 2019;**161**(4):551-560. doi:10.1177/0194599819852604
14. Ousmen A, Touraine C, Deliu N, et al. Distribution- and anchor-based methods to determine the minimally important difference on patient-reported outcome questionnaires in oncology: a structured review. *Health Qual Life Outcomes*. 2018;**16**(1):228. doi:10.1186/s12955-018-1055-z
15. Voineskos SH, Klassen AF, Cano SJ, Pusic AL, Gibbons CJ. Giving Meaning to Differences in BREAST-Q Scores: Minimal Important Difference for Breast Reconstruction Patients. *Plast Reconstr Surg*. 2020;**145**(1):11e-20e. doi:10.1097/PRS.0000000000006317
16. Marcil I, Stern RS. Risk of Developing a Subsequent Nonmelanoma Skin Cancer in Patients With a History of Nonmelanoma Skin Cancer: A Critical Review of the Literature and Meta-analysis. *Arch Dermatol*. 2000;**136**(12):1524-1530. doi:10.1001/archderm.136.12.1524
17. Radiotis G, Roberts N, Czajkowska Z, Khanna M, Körner A. Nonmelanoma skin cancer: disease-specific quality-of-life concerns and distress. *Oncol Nurs Forum*. 2014;**41**(1):57-65. doi:10.1188/14.ONF.57-65
18. Körner A, Garland R, Czajkowska Z, Coroiu A, Khanna M. Supportive care needs and distress in patients with non-melanoma skin cancer: Nothing to worry about? *Eur J Oncol Nurs Off J Eur Oncol Nurs Soc*. 2016;**20**:150-155. doi:10.1016/j.ejon.2015.07.006
19. Mellon S, Kershaw TS, Northouse LL, Freeman-Gibb L. A family-based model to predict fear of recurrence for cancer survivors and their caregivers. *Psychooncology*. 2007;**16**(3):214-223. doi:10.1002/pon.1074
20. Lee EH, Klassen AF, Lawson JL, Cano SJ, Scott AM, Pusic AL. Patient experiences and outcomes following facial skin cancer surgery: A qualitative study. *Australas J Dermatol*. 2016;**57**(3):e100-e104. doi:10.1111/ajd.12323
21. Lee EH, Klassen AF, Nehal KS, Cano SJ, Waters J, Pusic AL. A systematic review of patient-reported outcome instruments of nonmelanoma skin cancer in the dermatologic population. *J Am Acad Dermatol*. 2013;**69**(2):e59-67. doi:10.1016/j.jaad.2012.09.017
22. Lee EH, Klassen AF, Cano SJ, Nehal KS, Pusic AL. FACE-Q Skin Cancer Module for Measuring Patient-Reported Outcomes Following Facial Skin Cancer Surgery. *Br J Dermatol*. 2018;**179**(1):88-94. doi:10.1111/bjd.16671

23. Ottenhof MJ, Lardinois AJPM, Brouwer P, et al. Patient-reported Outcome Measures: The FACE-Q Skin Cancer Module: The Dutch Translation and Linguistic Validation. *Plast Reconstr Surg Glob Open*. 2019;**7**(10). doi:10.1097/GOX.0000000000002325
24. Andrich D. Controversy and the Rasch model: a characteristic of incompatible paradigms? *Med Care*. 2004;**42**(1 Suppl):I7-16. doi:10.1097/01.mlr.0000103528.48582.7c
25. Koster ME, Bergsma J. Problems and coping behaviour of facial cancer patients. *Soc Sci Med 1982*. 1990;**30**(5):569-578. doi:10.1016/0277-9536(90)90155-l
26. Paoli J, Daryoni S, Wennberg A-M, et al. 5-year recurrence rates of Mohs micrographic surgery for aggressive and recurrent facial basal cell carcinoma. *Acta Derm Venereol*. 2011;**91**(6):689-693. doi:10.2340/00015555-1134
27. Green A, Williams G, Neale R, et al. Daily sunscreen application and betacarotene supplementation in prevention of basal-cell and squamous-cell carcinomas of the skin: a randomised controlled trial. *Lancet Lond Engl*. 1999;**354**(9180):723-729. doi:10.1016/S0140-6736(98)12168-2
28. Gordon L, Olsen C, Whiteman DC, Elliott TM, Janda M, Green A. Prevention versus early detection for long-term control of melanoma and keratinocyte carcinomas: a cost-effectiveness modelling study. *BMJ Open*. 2020;**10**(2):e034388. doi:10.1136/bmjopen-2019-034388
29. Horsham C, Snoswell C, Vagenas D, et al. Is Teledermoscopy Ready to Replace Face-to-Face Examinations for the Early Detection of Skin Cancer? Consumer Views, Technology Acceptance, and Satisfaction with Care. *Dermatol Basel Switz*. 2020;**236**(2):90-96. doi:10.1159/000506154
30. Kong FW, Horsham C, Ngoo A, Soyer HP, Janda M. Review of smartphone mobile applications for skin cancer detection: what are the changes in availability, functionality, and costs to users over time? *Int J Dermatol*. 2021;**60**(3):289-308. doi:10.1111/ijd.15132
31. Heckman CJ, Liang K, Riley M. Awareness, understanding, use, and impact of the UV index: A systematic review of over two decades of international research. *Prev Med*. 2019;**123**:71-83. doi:10.1016/j.ypmed.2019.03.004
32. Manne S, Buller D, Devine K, et al. Sun Safe Partners Online: Pilot Randomized Controlled Clinical Trial. *J Med Internet Res*. 2020;**22**(9):e18037. doi:10.2196/18037
33. Veldhuizen IJ, Lee EH, Kurtansky NR, et al. To see or not to see: Impact of viewing facial skin cancer defects prior to reconstruction. *Arch Dermatol Res*. Published online January 30, 2021. doi:10.1007/s00403-021-02187-1

Chapter 5

Impact of COVID-19 Delays on Skin Cancer Worry and Mohs Surgery for Keratinocytic Carcinoma

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Submitted

Abstract

Background: Given extraordinary public health risk from the COVID-19 pandemic, many organizations recommended delaying management of keratinocyte carcinoma (KC). However, the impact of COVID-19 delays on patient and KC management is not known.

Objective: To evaluate the impact of COVID-19 treatment delays on patients' perception, skin cancer worry, and Mohs micrographic surgery (MMS) outcomes for KC.

Methods: Patients with KCs whose MMS was delayed due to the COVID-19 pandemic versus a control group in the prior year. Patients were asked to complete the FACE-Q Skin Cancer - Cancer Worry scale and COVID-specific questions.

Results: Delay time (from biopsy to treatment) was longer for the COVID-delay patients (COVID-delay n=143: 129.0 days vs. controls n=381: 41.0 days, p=<.0001). Although the overall cancer worry was similar in COVID-delay and control patients (p=.9), 22% of COVID-delay patients were more worried about their skin cancer than COVID-19. No difference in tumor characteristics and MMS surgical outcomes was seen.

Limitations: Prospective cohort study of two academic tertiary care centers in Boston, MA (BWH) and New York, NY (MSK)

Conclusion: Almost a quarter of patients worried more about their skin cancer than COVID-19, MMS surgical outcomes were not be impacted by delays in treatment

Introduction

The first case of coronavirus disease 2019 (COVID-19) was reported on January 20, 2020 in the United States (U.S.) and by the end of March 2020, 34 states urged residents to stay at home in order to reduce COVID-19 transmission.[1] This led to a significant decrease in patient volume as many medical centers and practices delayed elective and nonurgent surgeries. As a result, the medical community had to adjust diseases disease management.[2] In March 2020, the National Comprehensive Cancer Network (NCCN) published an advisory statement for basal cell carcinoma (BCC) and cutaneous squamous cell carcinoma (CSCC) collectively termed keratinocyte carcinoma (KC) care during the COVID-19 pandemic.[3] This statement recommended delaying of KCs during the COVID-19 pandemic with the exception of tumors determined by the physician to pose a risk of "metastasis or debilitating progression within 3 months."[3] These guidelines are based on recommendations from experts in KCs rather than published data as an unprecedented situation similar to this had not arisen in the last 100 years.

As COVID-19 continues to ravage the world, it is important to understand whether skin cancer management delays are associated with negative outcomes, such as larger tumors requiring more extensive surgery or increased patient anxiety. Both New York, NY and Boston, MA were among the hardest hit cities in the first wave of the pandemic, which led to either a temporary closure or severe reduction in skin cancer treatment. Evaluating patients with skin cancers from these regions who had delays in care can help inform management guidelines and the dermatology community on how to best counsel patients during the remainder of the pandemic.

The purpose of this study is to evaluate the impact of the COVID-19 pandemic on patient perception of their skin cancer and surgical outcomes of Mohs micrographic surgery (MMS) for cutaneous squamous cell carcinoma (CSCC) and basal cell carcinoma (BCC).

Methods

The study was approved by the Partners and Memorial Sloan Kettering Cancer Center (MSK) Institutional Review Board. The following patients with BCC and CSCCs treated with MMS at the Brigham and Women's Micrographic Surgery Center (herein "BWH") and Memorial Sloan Kettering Mohs and Dermatologic Surgery Unit (herein "MSK") were included in the study if: 1. MMS was cancelled due to the stay at home recommendations in Massachusetts and New York and rescheduled from the end of April through August 2020 (herein "COVID-delay patients") and 2. MMS performed in the same months in 2019 (herein "control patients").

Electronic medical records of all patients were reviewed for patient demographics (COVID-19 related medical comorbidities, smoking status, and history of skin cancers), tumor characteristics (tumor location, pre-operative tumor size, histologic type, and tumor risk factors) and MMS outcomes (post-operative tumor size, number of MMS stages, and reconstruction type).

To assess how the COVID-19 pandemic impacts patients' perspective on their skin cancer, the Cancer Worry scale from the FACE-Q Skin Cancer Module was distributed to the COVID-delay and control patients. Patients received the cancer worry scale prior to their MMS treatment by e-mail or in clinic while waiting for their MMS treatment. The FACE-Q Skin Cancer is a validated patient-reported outcome measure specifically developed for patients undergoing surgical procedures for facial skin cancers.[4–6] The Cancer Worry scale contains 10 items that assess a patient's cancer worry on a Likert-type scale.[7] The responses are summed and then transformed to a Rasch score from 1-100 with higher scores representing greater worry. As the Cancer Worry scale was developed pre-pandemic, COVID-delay patients were asked 4 additional COVID-19 related questions (table 2). Only COVID-delay and control patients who completed the FACE-Q Skin Cancer - Cancer Worry scale were included in the final analysis.

Patient and tumor characteristics and MMS outcomes were analyzed using descriptive statistics and frequency tabulation. Analysis of variance (ANOVA) was used to evaluate whether certain factors (high-risk COVID-19 comorbidity, prior melanoma, prior CSCC, tumor diameter ≥ 20 mm, 65 years of age or older, gender, and tumors located in the H zone) influenced the Cancer Worry scores and any risk factors found to be statistically significant were analyzed using multivariate ANOVA (MANOVA). Univariate and multivariate logistic regression models were used to analyze which tumors were more likely to require complex reconstructions. In addition, logistic regression models were used to determine which factors were associated with COVID-delay patients being more worried about their skin cancer than COVID-19 as well as individuals who were upset about the delay in surgery. All reported *p*-values are two-sided with type I error (α) of <0.05 considered to be statistically significant. Statistical analyses were performed using Stata version 14.0 (StataCorp, College Station, TX).

Results

A total of 191 patients at both BWH and MSK cancelled or had their MMS surgery rescheduled due to the COVID-19 stay at home advisory, of which 143 (64 from BWH and 79 from MSK) completed the FACE-Q Cancer Worry scale and COVID-19 specific questions (75% response rate) and were included in the final analysis. The control group consists of 381 patients who underwent MMS for KCs from May-August 2019

and completed the FACE-Q Skin Cancer - Cancer Worry scale. Table 1 details the patient and tumor characteristics. There was no difference in patient demographics (e.g. age, gender, and prior skin cancer) and tumor characteristics (e.g. tumor type and location) in the combined cohort. The COVID-delay cohort had more COVID-19 related medical comorbidities (COVID-delay: 117/143 (82%) vs. controls: 243/381 (64%), p=<.0001). Few patients overall were current smokers (COVID-delay: 6/143 (4%) vs. controls: 17/381 (5%), p=.9).

The mean time from biopsy to treatment was approximately 3 months longer for the COVID-delay group compared to controls (COVID-delay: 129.0 days (SD 97.9 days) vs. controls: 41.0 days (SD 44.3 days), p=<.0001). The mean score for the Cancer Worry scale was similar in COVID-delay and control patients (COVID-delay: 45.0 (SD 17.9) vs. controls: 44.7 (SD 44.7), p=.9) (Figure 1). Interestingly, the score was approximately 5 points higher in MSK patients (COVID-delay: 47.7 (SD 18.2) vs. controls: 47.0 (SD 20.3), p=.8) compared to BWH patients (COVID-delay: 42.0 (SD 16.9) vs. controls: 42.9 (SD 19.4), p=.7), indicating that MSK patients are slightly more worried about their skin cancer compared to the BWH cohort. MANOVA found higher equivalent cancer worry scores in tumors ≥ 20mm (+7.9), patients less than 65 years of age (+7.1), and female patients (+4.4).

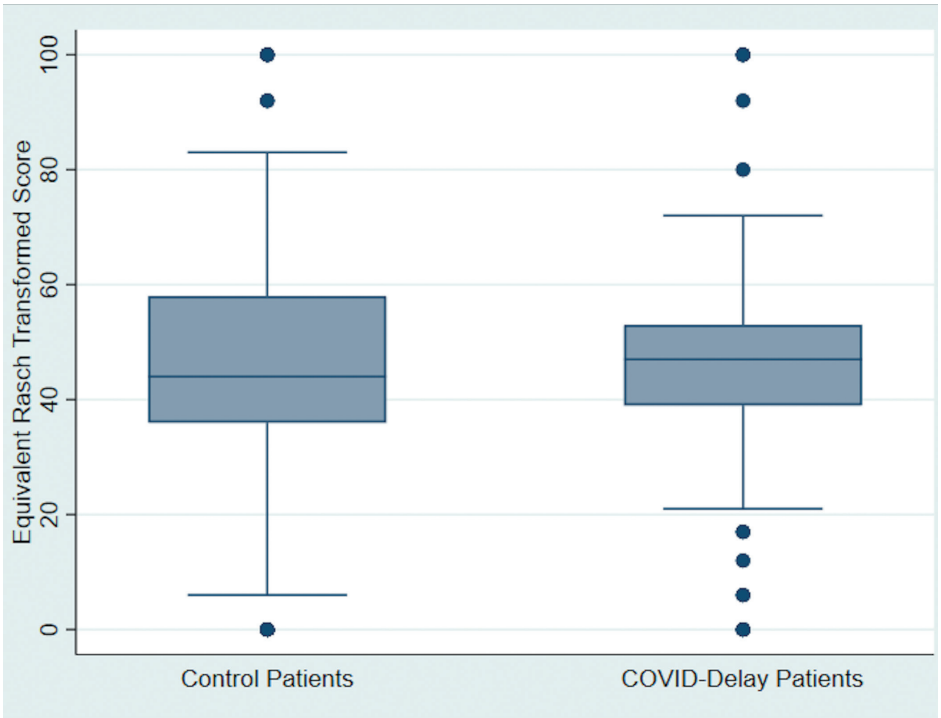

Figure 1. FACE-Q Skin Cancer - Cancer Worry Scores in the COVID-delay and Control Patient.

Table 1: Patient and tumor characteristics of the combined, BWH, and MSKCC cohorts.

	Combined			BWH			MSKCC		
	COVID-Delay (n=143)	Controls (n=381)	p*	COVID-Delay (n=64)	Controls (n=210)	p*	COVID-Delay (n=79)	Controls (n=171)	p*
Age at diagnosis, years (SD)[‡]	68.5 (12.5)	68.6 (12.6)	.9	71.6	69.6	.2	66.0 (13.1)	67.4 (13.1)	.4
Sex, n (%)			.6			.2			.04
Male	76 (54)	193 (51)		28 (44)	112 (53)		49 (62)	82 (48)	
Female	66 (46)	186 (49)		36 (56)	98 (47)		30 (38)	89 (52)	
Comorbidities, n (%)			<.0001[×]			.06[×]			.2[×]
Active cancer	19 (13)	20 (5)		12 (19)	6 (3)		7 (9)	14 (8)	
Chronic kidney disease	8 (5)	7 (2)		7 (9)	6 (3)		1 (1)	1 (<1)	
Heart conditions	10 (7)	86 (23)		5 (8)	59 (28)		5 (6)	27 (16)	
Hypertension	60 (39)	149 (39)		36 (56)	86 (41)		24 (30)	64 (37)	
Immunocompromised[†]	10 (7)	32 (8)		1 (2)	19 (9)		7 (9)	10 (6)	
Obesity	0 (0)	8 (2)		0 (0)	7 (3)		0	1 (<1)	
Diabetes	11(8)	39 (10)		5 (8)	20 (10)		6 (8)	19 (11)	
Asthma	2 (1)	18 (5)		0 (0)	11 (5)		2 (3)	7 (4)	
None	26 (18)	138 (34)		5 (8)	80 (33)		21 (27)	58 (34)	
Smoking history, n (%)			.01			.08			0.2
Never	89 (65)	188 (51)		40 (63)	97 (46)		49 (67)	92 (57)	
Former	41 (30)	164 (44)		21 (33)	100 (48)		21 (29)	65 (40)	
Current	6 (4)	17 (5)		3 (5)	12 (6)		3 (4)	5 (3)	
Prior skin cancer history, n (%)			.2			.1			.8
CSCC	54 (38)	140 (37)		24 (38)	71 (34)		31 (39)	70 (41)	
BCC	82 (58)	186 (49)		34 (53)	93 (45)		49 (62)	95 (56)	
MM	18 (13)	60 (16)		2 (3)	23 (11)		16 (20)	37 (22)	
Time from biopsy to treatment, days (SD)	129.0 (97.9)	41.0 (44.3)	<.0001	138.1 (124.4)	36.3 (47.2)	<.0001	121.1 (69.3)	46.9 (39.6)	<.0001
Tumor Location Zone, n (%)			.4			.3			.3
H[§]	60 (42)	137 (36)		29 (45)	83 (40)		31 (39)	56 (33)	
M[’]	62 (44)	186 (49)		26 (41)	107 (51)		37 (47)	79 (46)	
L[^]	20 (14)	55 (15)		9 (14)	19 (9)		11 (14)	36 (21)	
Tumor Type, n (%)			.6			.4			.1
BCC	96 (68)	246 (65)		41 (64)	145 (69)		56 (71)	103 (60)	
SCC	46 (32)	132 (35)		23 (36)	64 (31)		23 (29)	68 (40)	

BCC Subtype, n (%)			.01			.2			.02
Aggressive	12 (13)	58 (26)		4 (11)	26 (20)		8 (15)	32 (32)	
Non-aggressive	80 (87)	166 (74)		37 (89)	119 (82)		48 (86)	70 (68)	
CSCC, n (%)			.7			.2			.8
Well-differentiated	41 (89)	122 (92)		23 (100)	59 (92)		21 (91)	64 (94)	
Moderately-differentiated	2 (4)	9 (7)		0 (0)	5 (8)		2 (9)	4 (6)	
Poorly-differentiated	0	1 (<1)		0	0		0 (0)	1 (<1)	
1+ High-Risk Factor	4 (3)	14 (4)		2 (3)	10 (5)		2 (7)	4 (6)	
Tumor Diameter mm, mean (SD)									
Pre-operative	9.0 (6.2)	8.7 (6.3)	.7	8.7 (6.7)	8.9 (7.1)	.8	9.1 (5.8)	8.4 (5.2)	.4
Post-operative	15.6 (9.0)	14.2 (8.0)	.07	13.6 (8.3)	13.7 (7.9)	1.0	17.1 (9.3)	14.6 (8.2)	.04
Number of MMS stages, mean (SD)	1.5 (.7)	1.5 (.7)	1.0	1.3 (0.5)	1.3 (0.5)	.6	1.7 (.7)	1.8 (.7)	.4
Reconstruction Type			.007			.1			.02
Secondary intention	26 (19)	66 (18)		14 (23)	34 (16)		12 (15)	33 (20)	
Linear repair	78 (56)	239 (64)		40 (65)	136 (65)		39 (50)	104 (62)	
Flap	18 (13)	45 (12)		2 (3)	25 (12)		17 (22)	20 (12)	
Graft	5 (4)	19 (5)		2 (3)	10 (5)		3 (4)	9 (5)	
Other«	12 (9)	7 (2)		4 (6)	4 (2)		7 (8)	3 (2)	

Abbreviations: BWH, Brigham and Women's Hospital; MSKCC, Memorial Sloan Kettering Cancer Center; CSCC, cutaneous squamous cell carcinoma; BCC, basal cell carcinoma; MM, malignant melanoma; PNI, perineural invasion; MMS, Mohs micrographic surgery

* p-values based on Chi-square unless otherwise specified

‡ p-value based on Student's T test

† Immunocompromised includes immune deficiency, organ transplant recipient, immunosuppressive medication, prolonged steroid use, HIV, bone marrow transplant

× P value represents any comorbidity vs. none

« Includes cerclage, xenograft, and Integra dermal regeneration template

§ H zone includes central face, eyelids/canthi, eyebrows, nose, lips, chin, ear, periauricular area, genitalia, hands, feet, ankles, nail units, and nipples/areola.

› M zone includes cheeks, forehead, scalp, neck, jawline, and pretibial surface.

ˆ L zone includes trunk and extremities (excluding pretibial surface, hands, feet, nail units, and ankles.

Table 2: Results of the COVID-19 related questions.

	Combined (n=143)	BWH (n=64)	MSKCC (n=79)
Would you say your skin cancer worry compared to COVID-19 worry is: n (%)			
Less	64 (45)	35 (54)	29 (37)
The same	40 (28)	14 (22)	28 (35)
More	31 (22)	10 (15)	21 (27)
How did you feel when your treatment was delayed (select all): n (%)			
Understood the reason (COVID-19)	119 (84)	49 (75)	72 (91)
Understood the rationale (skin cancer treatment was not urgent)	38 (27)	18 (28)	20 (25)
Was upset about the delay	14 (10)	4 (6)	10 (13)
Did you develop any of the following symptoms after March 1, 2020? n (%)			
Cough	5 (4)	3 (3)	2 (3)
Fever	0 (0)	0 (0)	0 (0)
Sore throat	0 (0)	0 (0)	0 (0)
Nasal congestion/runny nose	1 (1)	2 (2)	0 (0)
Shortness of breath	1 (1)	0 (0)	1 (1)
Muscle aches	0 (0)	1 (1)	0 (0)
Anosmia	1 (1)	0 (0)	1 (1)
History of COVID-19, n (%)	3 (2)	0 (0)	3 (4)

Abbreviations: BWH, Brigham and Women's Hospital; MSKCC, Memorial Sloan Kettering Cancer Center.

The majority (104/143, 73%) of COVID-delay patients felt their skin cancer worry was either less or the same as their COVID-19 worry. However, about one-quarter of COVID-19 patients were more worried about their skin cancer (combined cohort: 31/143 (22%); BWH: 10/64 (15%); MSKCC: 21/79 (27%)). Similarly, the majority of patients in the COVID-delay group understood the reason for the delay in MMS (119/143, 84%). While only 27% (38/143) of COVID-delay patients understood the rationale for deferring treatment, only 10% (14/143) were upset about the delay. Prior history of CSCC and tumor diameter ≥ 20 mm were significantly associated with being more worried about skin cancer on univariate analysis, but neither were statistically significant on multivariate analysis (Prior CSCC: OR 1.9 (95% CI 0.82-4.2); Tumor diameter ≥ 20 mm: OR 2.5 (95% CI 0.73-8.7)). Patients with tumors 20 mm or larger were 6 times more likely to be upset with the delay in surgery compared to patients with tumors <20 mm (OR 6.3 (95% CI 1.9-21.2)) (table 3).

Table 3: Multivariate logistic regression models.

Variable	Complex Reconstruction		Skin cancer worry greater than COVID-19 worry		Upset about MMS delay	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
History of CSCC						
None	1 [reference]				--	--
Prior CSCC	.5 (.3-1.0)	.04	1.9 (.8-4.2)	.1		
Tumor diameter						
< 20mm	1 [reference]					
≥ 20mm	4.2 (1.7-10.5)	.002	2.5 (.7-8.7)	.1	6.3 (1.9-21.1)	.003
Tumor Zone‡						
M or L Zone	1 [reference]		--	--	--	--
H Zone	6.6 (3.7-11.7)	<.0001				
Histology†						
Non-aggressive	1 [reference]		--	--	--	--
Aggressive	2.0 (1.1-3.7)	.02				

Abbreviations: CSCC, cutaneous squamous cell carcinoma; MMS, Mohs micrographic surgery; OR, odds ratio; CI, confidence interval

‡ H zone includes central face, eyelids/canthi, eyebrows, nose, lips, chin, ear, periauricular area, genitalia, hands, feet, ankles, nail units, and nipples/areola; M zone includes cheeks, forehead, scalp, neck, jawline, and pretibial surface; L zone includes trunk and extremities (excluding pretibial surface, hands, feet, nail units, and ankles.

† Aggressive includes micronodular, morpheaform, or infiltrative BCCs; poorly-differentiated SCCs; tumors with PNI; SCCs with 1 or more high-risk features.

For MMS variables, no significant difference in pre- or post-operative defect size, mean number of Mohs stages, or complexity of reconstruction was seen between the control and the COVID-delay group. More BCCs with aggressive histology (i.e. infiltrative, morpheaform, or micronodular) were treated in the control group (COVID-delay: 12/96 (13%) vs. controls: 58/246 (26%), p=.01), but the majority of CSCCs in both cohorts were well differentiated (COVID-delay: 41/46 (89%) vs. controls: 122/132 (92%), p=.7). On multivariable models of the COVID-delay cohort, patients with a history of a CSCC were half as likely to require a complex reconstruction (OR 0.5 (95% CI 0.3-0.9)) whereas tumors with a diameter ≥ 20 mm were 4 times (OR 4.2 (95% CI 1.7-10.5)), those in the H zone were 6.5 times (6.6 (95% CI 3.7-11.7)), and tumors with aggressive histologic features (i.e. infiltrative, morpheaform, or micronodular BCCs or poorly-differentiated or PNI CSCCs) were twice (OR 2.0 (95% CI 1.1-3.7)) as likely to require a complex reconstruction (table III).

Discussion

This is the first study to evaluate the impact of MMS delays for KCs due to the COVID-19 pandemic on patient perception and surgical outcomes. Despite substantial reductions in MMS surgery at both institutions and a 3-month delay in care, the combined cohort had no difference in pre-operative tumor diameter, post-operative defect size, or reconstruction type. However, while the majority of both COVID-delay and control patients had low cancer worry scores, about a quarter reported being more worried about their skin cancer than COVID-19. This analysis includes patients treated in two cities most heavily hit by the first wave of the COVID-19 pandemic when COVID-19 fear was high and little known about how to treat this new disease. Although the number of COVID-19 cases in the U.S. far exceeds that of the first wave at the present time, there have been significant medical advances in COVID-19 management and therapeutics and so it is unlikely that medical procedures, including MMS, will be delayed as they were in New York City and Boston in Spring 2020. Yet, patients may still prefer to delay medical care; therefore, data such as this is useful when counseling patients about their risks of COVID-19 compared to delaying their skin cancer care.

The psychological impact of delaying MMS compounded with COVID-19 anxiety are important considerations to address during the ongoing pandemic. Although the majority of patients at both institutions worried less or the same about their skin cancer compared to the COVID-19 pandemic, about one-quarter of patients worried more. In the analysis presented herein, there were no clear indicators of which patients worried more about their skin cancer. In addition, 10% were upset about the delay in surgery. Interestingly, the overall skin cancer worry was relatively low and similar in both the COVID-delay and control cohorts, which speaks to the cancer worry not impeding significantly on quality of life; however, younger patients, females, and those with larger tumors were more worried about their skin cancers. Evaluating for cancer worry and whether it is being influenced by the pandemic is critical to ensure ongoing medical care. Targeting such patients with information on staff COVID-19 testing and vaccinations, adequate personal protective equipment (PPE), and updated protocols to ensure patient safety can help ease COVID-19 related worry. Telemedicine has also enabled physicians to communicate with patients and provide pre-operative counseling without additional COVID-19 exposure.[8]

Although the overall surgical outcomes were not impacted in this analysis, it may be prudent to offer surgery to larger tumors (≥ 20mm), tumors located in the H zone, and those with aggressive histology, all of which were associated with a greater odds of requiring a complex reconstruction. Although hospitals and other medical societies have highlighted the risks of delaying medical care, many patients

are still opting to postpone appointments due to concerns over COVID-19. A survey of approximately 5,000 adults in the U.S in June 2020 found that 40% delayed or avoided any medical care.[9] In the author's experience, some patients have reached out for guidance on whether MMS can be postponed for a few months, whereas others felt strongly about delaying their surgery. The results of this study can help provide data so patients can make informed decisions; however, this study reflects surgical delays at the beginning of the pandemic. With COVID-19 continuing to escalate, MMS outcomes may be impacted if patients do not feel comfortable pursuing medical care.

During this unprecedented time in history and medical care, patient decisions to treat medical conditions are even more complex, with individual, social, and financial factors weighing more heavily. While only 2 (3%) of the COVID-delay patients developed COVID-19 at some point during the pandemic, this may be related to the stay-at-home advisories in the spring 2020 and lower COVID-19 transmission rates in NY and MA in the summer 2020. However, it is possible that the elderly MMS population (median age of cohort is 68 years) are more COVID-19 cautious. Nevertheless, some centers have adopted pre-operative COVID-19 testing prior to MMS. Pre-operative testing is more useful when COVID-19 transmission rates are higher; however, few studies have directly evaluated how many COVID-19 patients are identified on pre-operative testing. One study in Brazil found that almost 8% of 540 patients tested positive for COVID-19 prior to surgery during the peak of the pandemic in May 2020.[10] One limitation to pre-operative testing is that it is often performed 48-72 hours prior to the surgery, which can lead to false-negative results. Futures studies evaluating the utility of COVID-19 testing prior to MMS are needed.

This study is subject to limitations. Although it does capture patients treated at two distinct practices, both surgery centers are located at large academic centers in the Northeast and so the results of the study may not be generalizable to private practices or other geographic regions. Importantly, although both MMS centers re-opened in April and May 2020 for routine cases, some patients may have opted to further delay their care due to COVID-19 fears or re-located temporarily to a different geographic region since New York City and Boston were two of the most heavily hit cities with the initial COVID-19 wave. Thus, the cohort may not include patients who opted to delay their care even longer. In addition, since the results reflect delays at the beginning of the pandemic, it may underestimate patient anxiety that may increase as the pandemic continues and the impact of longer treatment delays on MMS outcomes. Finally, only patients who completed the FACE-Q Cancer - Worry Scale were included in the final analysis and there may have been a bias for which patients did not complete the survey. However, the overall response rate was high (75%) and so the study likely represents the patients treated at the two institutions.

The COVID-19 pandemic continues to impact healthcare delivery across the U.S. Although many hospitals are trying to provide ambulatory services while managing COVID-19 surges, delays in MMS may occur. It is important to understand the repercussions of delayed surgical treatment including the patients' preferences and concerns as the pandemic evolves. In this analysis, nearly a quarter of patients were more worried about their skin cancer, although pre- and post-operative sizes as well as complexity of reconstructions were unchanged in the COVID-delay cohort compared to tumors treated in the prior year despite a 3-month delay in MMS. The data presented herein can be used to augment identifying patients' needs and help inform timing of MMS. While it would be useful to have other studies, given the pace of the pandemic it may not be feasible to generate more data that can directly inform clinical decision making during the present surge.

References

1. Moreland, A. Timing of State and Territorial COVID-19 Stay-at-Home Orders and Changes in Population Movement — United States, March 1–May 31, 2020. *MMWR Morb. Mortal. Wkly. Rep.* **69**, (2020).
2. Litchman, G. H. & Rigel, D. S. The immediate impact of COVID-19 on US dermatology practices. *J. Am. Acad. Dermatol.* **83**, 685–686 (2020).
3. National Comprehensive Cancer Network Covid-19 Resources: Advisory Statement for Non-Melanoma Skin Cancer Care During the Covid-19 Pandemic. Available at: *https://www.nccn.org/covid-19/pdf/NCCN-NMSC.pdf*. Accessed April 1, 2020
4. Lee, E. H., Klassen, A. F., Cano, S. J., Nehal, K. S. & Pusic, A. L. FACE-Q Skin Cancer Module for measuring patient-reported outcomes following facial skin cancer surgery. *Br. J. Dermatol.* **179**, 88–94 (2018).
5. Lee, E. H. *et al.* Patient experiences and outcomes following facial skin cancer surgery: A qualitative study. *Australas. J. Dermatol.* **57**, e100-104 (2016).
6. Lee, E. H. *et al.* A systematic review of patient-reported outcome instruments of nonmelanoma skin cancer in the dermatologic population. *J. Am. Acad. Dermatol.* **69**, e59-67 (2013).
7. Khoshab, N., Vaidya, T. S., Dusza, S., Nehal, K. S. & Lee, E. H. Factors contributing to cancer worry in the skin cancer population. *J. Am. Acad. Dermatol.* **83**, 626–628 (2020).
8. Perkins, S., Cohen, J. M., Nelson, C. A. & Bunick, C. G. Teledermatology in the era of COVID-19: Experience of an academic department of dermatology. *J. Am. Acad. Dermatol.* **83**, e43–e44 (2020).
9. Czeisler, M. É. *et al.* Delay or Avoidance of Medical Care Because of COVID-19-Related Concerns - United States, June 2020. *MMWR Morb. Mortal. Wkly. Rep.* **69**, 1250–1257 (2020).
10. Aguiar, S. *et al.* Value of preoperative testing for SARS-CoV-2 for elective surgeries in a cancer center during the peak of pandemic in Brazil. *J. Surg. Oncol.* **122**, 1293–1295 (2020).

Chapter 6

To see or not to see: Impact of viewing facial skin cancer defects prior to reconstruction

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Abstract

Background: Patient expectations of the scar after Mohs micrographic surgery (MMS) are often not realistic, leading to subsequent psychosocial sequelae such as anxiety, depression, and avoidance of social situations. When patient expectations are not met, this may also contribute to a decrease in patient satisfaction after surgery. Therefore, altering expectation levels may change patient satisfaction and psychosocial distress levels after surgery.

Objective: To assess whether patient satisfaction improves in patients after MMS when patients view the surgical defect prior to reconstruction.

Method: Patients undergoing facial MMS between December 2017 and September 2019 were included. Patients received or did not receive a mirror after MMS to view the surgical defect before closing the defect. Patients were asked to complete the Dutch FACE-Q Skin Cancer before, one-week, three-months, and one-year after MMS.

Results: A total of 113 patients where included. One-hundred-eight (95.6%), 113 (100%), and 93 (82.3%) questionnaires were completed, one-week, three-months, and one-year follow-up, respectively. Satisfaction with facial appearance and appraisal of scars significantly improved over time for all patients, no such improvement was seen for appearance-related distress. Female patients who looked in the mirror had higher satisfaction with facial appearance than female patients who did not look in the mirror. Also, lower appearance-related distress scores were seen in patients who looked in the mirror prior to a flap reconstruction.

Conclusion: Showing the defect in the mirror prior to the reconstruction may result in higher patient satisfaction in female patients and patients before undergoing a flap reconstruction.

Introduction

Non-melanoma skin cancer (NMSC) is the most common type of cancer worldwide.[1] In the Netherlands, the occurrence of NMSC almost quadrupled over the last 20 years.[2] The majority of NMSC occurs in the head and neck area and is often treated with excision.[3] A commonly performed surgical technique that maximizes the preservation of healthy tissue is Mohs micrographic surgery (MMS).[4,5] MMS can minimize the surgical defect compared to wide excision; however, for large tumors, or if there is significant subclinical spread, this will lead to large post-surgical defects.

The choice of reconstruction for a MMS defect is made by preserving function but also cosmesis, as post-surgical scars can be noticeable and have a significant impact on the patient.[6–8] If the patient's facial appearance is altered or perceived to be so, psychosocial implications include anxiety, depression, and avoidance of social situations.[7,9,10] Patient satisfaction and psychosocial distress can be influenced by individual experience as well as expectations.[11] Patient-Reported Outcome Measures (PROMs) provide a way to quantify patients' experience and satisfaction.[12] Since satisfaction is subjective and inherently difficult to evaluate, routinely measuring PROMs pre and post-operatively could provide a basis for comparison between interventions.[13] An increase in the development and use of PROMs in MMS for measuring facial appearance and scar outcomes is seen.[14–16] The FACE-Q Skin Cancer is a PROM specifically designed for patients undergoing surgical procedures for facial skin cancer.[17–20]

In a recent study where patients were asked to draw the anticipated scar length prior to their facial MMS, an unrealistic expectation regarding scar length was seen.[21] When the scar length after reconstruction is larger than expected, the patient's distress about their appearance rose significantly.[22] Patients tend to evaluate their post-operative appearance by comparing it to the appearance of their face last seen.[23] Since individuals judge their appearance by looking in the mirror,[24] the authors believe that by looking at the defect in the mirror, expectations of the scar will decrease as they will better appreciate the value of reconstruction to restore their appearance. A study in 2015 showed no significant difference in satisfaction in 20 patients who looked at their defect in the mirror compared to 16 patients who did not, using the the Patient Scar Assessment Questionnaire (PSAQ). However, this study was limited by the small number of patients, short follow-up time, and was notable for several wounds that healed secondarily.[25] This study's objective is to prospectively evaluate short and long-term satisfaction in over 100 patients that view their defect in the mirror prior to reconstruction compared to those that do not. Patient-reported satisfaction of the scar, facial appearance, and appearance-related psychosocial distress was assessed using the FACE-Q Skin Cancer.[18]

Materials and Methods

Institutional review board approval was obtained from Catharina Hospital, Eindhoven, the Netherlands. Patients were included if they were ≥18 years old, natively proficient in Dutch, and underwent facial MMS between December 2017 and September 2019. Patients were excluded if they received second intention healing as reconstructive option. MMS was performed by the Department of Dermatology and the reconstruction by the same department or the Department of Plastic, Reconstructive, and Hand Surgery. One week after the reconstruction, patients were asked if they viewed the defect in the mirror. Viewing occurred immediately after MMS when the margins were clear and prior to the reconstruction. The dermatologic surgeon or plastic surgeon performing the reconstruction presented the mirror to the patient. The MMS and reconstruction were performed the same day and in the same procedure room.

Study data were collected in Castor EDC,[26] and relevant demographic and surgical data were retrieved from electronic medical records. Complications were collected and included: bleeding, dehiscence, infection, hypertrophic scarring, a post-surgical facial paralysis, and an ectropion. They were categorized into non-surgically treated complications (e.g. laser, secondary intention healing), and surgically treated complications (e.g. revision). The longest diameter of the lesion after resection and before the reconstruction, in any axis, was termed 'surgical defect diameter'.

FACE-Q Skin Cancer

All patients were asked to complete the Dutch version of the FACE-Q Skin Cancer Module.[27] The questionnaires were sent by email or post before (baseline), one week, three months, and one year after surgery. If patients did not respond, automatic reminders were send up to 3 times. After receiving the reminders, if patients still did not respond, patients were called. During the call, they could fill in the questionnaire via phone or receive a new email with the FACE-Q Skin Cancer. The scales used for this study with the time points are shown in Table 1. Each scale consists of 8-10 questions on a Likert-type scale. Scales are converted into Rasch scores ranging from 0 to 100.[28] Higher scores indicate greater satisfaction with facial appearance, higher psychosocial distress, and greater satisfaction with post-surgical scar for the satisfaction with facial appearance scale, appearance-related distress scale, and appraisal of scars scale, respectively.

Table 1: Clinical and Demographics characteristics of patients by Mirror.

Demographics		Mirror	No Mirror	*P*-Value
Age (years)	Mean (SD)	64.4 (12.6)	70.4 (10.8)	0.009
Gender	Male (%)	29 (42.6)	23 (51.1)	0.377
	Female (%)	39 (57.4)	22 (48.9)	
History Facial Skin Cancer	No (%)	41 (60.3)	26 (57.8)	0.790
	Yes (%)	27 (39.7)	19 (42.2)	
Location	Nose (%)	38 (55.9)	12 (26.7)	0.951
	Forehead/Scalp (%)	8 (11.8)	13 (28.9)	
	Cheek/Chin (%)	12 (17.6)	4 (8.9)	
	Eye (%)	6 (8.8)	7 (15.6)	
	Ear (%)	2 (2.9)	7 (15.6)	
	Upper lip/Lower lip (%)	2 (2.9)	2 (4.4)	
Wound closure	Primary closure (%)	28 (41.2)	27 (60.0)	0.121
	Flap (%)	32 (47.1)	12 (26.7)	
	Full-thickness skin graft (%)	8 (11.8)	6 (13.3)	
Surgical defect diameter (cm)	Mean (SD)	1.6 (0.7)	1.8 (0.9)	0.117
Complication	No complication (%)	60 (87)	41 (87.2)	0.954
	Non-surgically treated (%)	7 (10.1)	5 (10.6)	
	Surgically treated (%)	2 (2.9)	1 (2.1)	

Statistical analysis

Descriptive statistics were used to analyze patient and clinical characteristics and carried out using IBM SPS Statistics 25.0 (IBM, USA). Looking in the mirror was compared with clinical and demographic characteristics. Continuous variables were compared depending on the assumption of normality with Shapiro-Wilk test and assumption of homogeneity of variances using Levene's test. The Chi-Square test or the Fisher's exact test for small sample sizes was used for dichotomous variables. The Mann-Whitney U test compared continuous variables when unpaired t-tests were precluded by violations of parametric assumptions. A $p < 0.05$ was considered significant. For all three scales of the FACE-Q Skin Cancer, a linear mixed effects model was used to analyze associations with longitudinal FACE-Q Skin Cancer scores of patients who looked in the mirror or did not look in the mirror prior to reconstruction. Linear mixed-effects models were fit in R using the lme4 package.[29] In each model a random intercept was fit for every individual to account for within-patient correlation of FACE-Q Skin Cancer scores. Age, gender, and pre-operative scores (when applicable) were adjusted for in each model. Additional factors were accounted for as covariate if they were suggested to be significant on bivariate analysis with both the outcome and the primary research variable, respectively. Age, gender, wound closure method, defect size, and prior history of facial skin cancer were considered possible effect modifiers on the relationship between the mirror and FACE-Q scores.

Results

A total of 113 patients completed the FACE-Q Skin Cancer prior to the MMS. Of these 113 patients, 108 (95.6%) completed the one-week, 113 (100%) completed the three-months and 93 (82.3%) patients completed the one-year post-operative questionnaires. Patients were categorized into two groups: *Mirror*, which indicates that the patient looked in the mirror and *No Mirror*, which indicates that the patient did not look in the mirror after MMS and prior to the reconstruction. Sixty-eight patients (60.2%) looked in the mirror, 45 patients (36.8%) did not look in the mirror. The mean age at the time of reconstruction was 64.4±12.6 years for the *Mirror* and 70.4±10.8 years for the *No Mirror* (p = 0.009) group. There was no significant difference in surgical defect diameter between the 2 groups (p = 0.117). The most commonly involved facial unit was the nose, with primary closure being the most frequently used reconstructive technique. Patient and clinical characteristics categorized by mirror groups are shown in table 2.

FACE-Q Skin Cancer Scales

The satisfaction with facial appearance scale and appearance-related distress scale were given at all time points, whereas the appraisal of scars scale was only given at post-operative time points. Overall, a significant improvement in the satisfaction with facial appearance (p = 0.047) and appraisal of scars scales was seen over time (p < 0.001) (Figure 1). The appearance-related distress scale did not show a difference over time (p = 0.089).

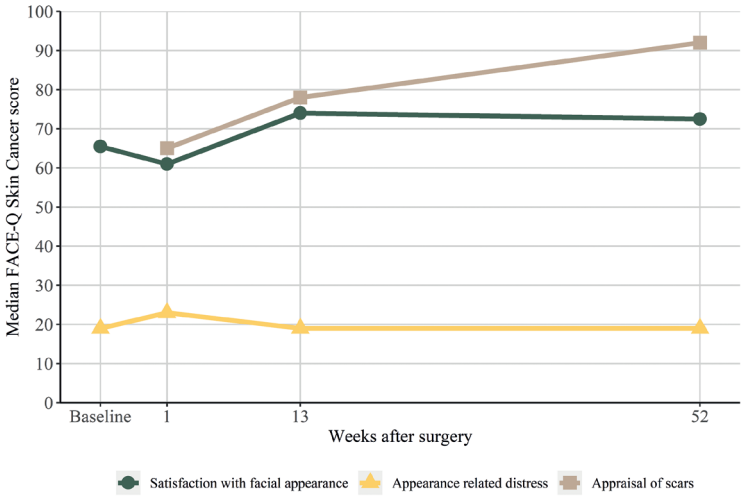

Figure 1. FACE-Q Skin Cancer scale scores over time. High scores for the facial appearance and appraisal of scars scale indicate higher patient satisfaction, whereas high scores for the Appearance-related Distress scale indicate lower patient satisfaction.

Table 2: Multivariate analysis with interaction terms of FACE-Q Skin Cancer scales by Mirror.

	Estimate	Standard Error	*p*-value
Satisfaction with Facial Appearance scale			
Looked in Mirror	8.66	4.12	0.038
Time after surgery			
1 week (reference)	0	-	-
3 months	7.86	1.97	< 0.001
12 months	5.99	2.13	0.005
Age	0.24	0.12	0.046
Gender			
Female (reference)	0	-	-
Male	13.40	4.46	0.003
Baseline Facial Appearance scale	0.39	0.08	< 0.001
Mirror * Male	-12.44	5.73	0.032
Appearance-Related Distress scale			
Looked in Mirror	-12.19	4.56	0.009
Time after surgery			
1 week (reference)	0	-	-
3 months	-4.14	1.79	0.022
12 months	-3.82	1.94	0.050
Age	-0.11	0.11	0.329
Gender			
Female (reference)	0	-	-
Male	-3.36	2.53	0.187
Baseline Distress scale	0.48	0.10	< 0.001
Wound closure			
Flap (reference)	0	-	-
Primary closure	-15.76	4.63	< 0.001
Skin graft + others	-11.49	6.15	0.064
Mirror * Wound closure			
Mirror * Primary closure	16.20	5.86	0.007
Mirror * Full-thickness skin graft	11.24	8.02	0.164
Appraisal of Scars scale			
Looked in Mirror	2.53	3.22	0.434
Time after surgery			
1 week (reference)	0	-	-
3 months	9.40	1.98	< 0.001
12 months	15.10	2.14	< 0.001
Age	0.52	0.13	< 0.001
Gender			
Female (reference)	0	-	-
Male	10.92	3.01	< 0.001
Wound closure			
Flap (reference)	0	-	-
Primary closure	6.57	3.31	0.050
Full-thickness skin graft	-2.57	4.61	0.578

* Interaction term.

On multivariate analysis, patients that looked at their defect in the mirror had higher scores for the satisfaction with facial appearance scale compared to those that did not look at the defect (p = 0.038), with women who looked in the mirror being more satisfied with their appearance (p = 0.032). No such difference was seen in men (Figure 2). Increasing age was associated with higher satisfaction with facial appearance scores (p = 0.046). Of patients who did not look in the mirror, men scored higher than women (p = 0.003).

The appearance-related distress scale scores showed significantly lower distress in patients that looked at their defect in the mirror (p = 0.009). This was notable for patients who underwent a flap closure, where lower scores were seen in those that saw their defect prior to the reconstruction. There were no differences in patients who had primary or FTSG reconstruction and saw their defect in the mirror compared to those that did not (Figure 2). There were no associations seen with the mirror and the appraisal of scars scale (p = 0.434). However, male patients (p < 0.001) and increasing age (p < 0.001) in both the *Mirror* and *no Mirror* groups were more likely to score higher for scar satisfaction than females and younger aged patients.

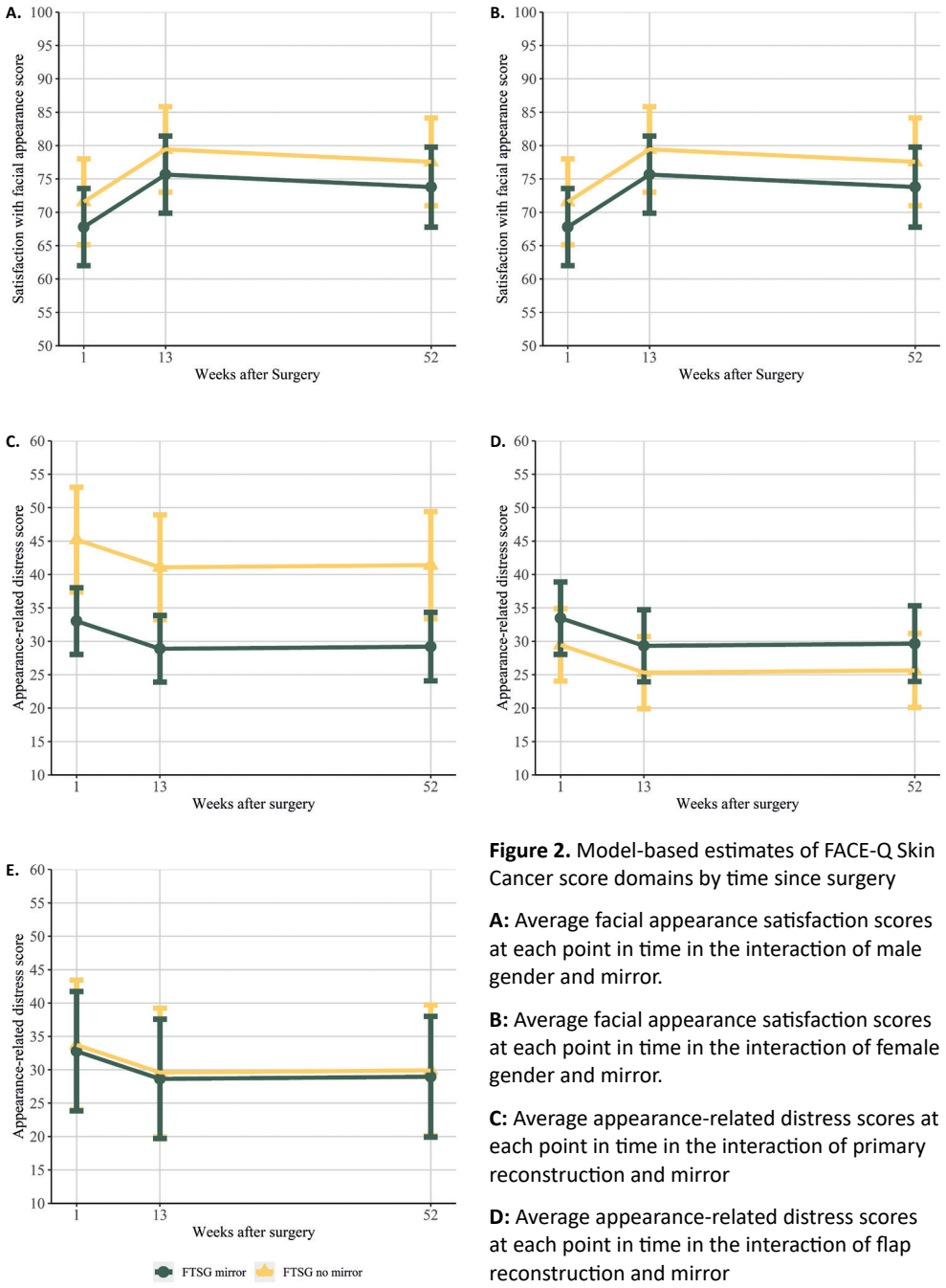

Figure 2. Model-based estimates of FACE-Q Skin Cancer score domains by time since surgery

A: Average facial appearance satisfaction scores at each point in time in the interaction of male gender and mirror.

B: Average facial appearance satisfaction scores at each point in time in the interaction of female gender and mirror.

C: Average appearance-related distress scores at each point in time in the interaction of primary reconstruction and mirror

D: Average appearance-related distress scores at each point in time in the interaction of flap reconstruction and mirror

E: Average appearance-related distress scores at each point in time in the interaction of full thickness skin graft (FTSG) reconstruction and mirror

Discussion

In this study, patient-reported satisfaction was assessed at multiple time points for patients who looked or did not look in the mirror at the surgical defect after MMS and before reconstruction. This study shows that female patients benefitted from looking at their defect, with higher facial appearance satisfaction. Patients before a flap reconstruction also benefitted from looking at the defect, which lowers their appearance-related distress levels after surgery. The appearance-related distress scores do not change significantly over time for both the *Mirror* and the *No Mirror* group, which means that no significant change in psychosocial distress was seen over time after MMS. However, the significant increase in appearance-related distress score in patients who did not look in the mirror prior to a flap reconstruction could be due to the patient not knowing the initial defect size after MMS and therefore expecting a smaller defect and smaller reconstruction. Patients' expectation levels after MMS are higher than realistically possible, with patients expecting smaller scar sizes after skin cancer resection.[21] Since expectations can define patient satisfaction, this could lead to higher distress after surgery.[11,21] Another reason could be that flap reconstructions can result in multiple, complex scars while patients expect a linear scar, which could also lead to more distress after surgery. Flap reconstructions also require greater tissue movement, resulting in more swelling and bruising than other repair types. When the patient looks at the defect, the patient can be more understanding that closing it with a simpler reconstruction could lead to distortion of facial contour.

Patient satisfaction with facial appearance, for both the *Mirror* and the *No Mirror* group, decreases one week after surgery. However, it increases back to baseline results or even slightly higher satisfaction three months after surgery. From three months to one year satisfaction with facial appearance does not change, suggesting that patient satisfaction with facial appearance peaks three months post-operatively. The female patients in both groups show a lower satisfaction with facial appearance compared to the male patients, similar to previous research.[16] Male patients were also not significantly impacted by looking at the defect, whereas female patients who look at the defect show higher satisfaction with facial appearance. This suggests that female patients are more impacted by looking at the defect compared to male patients. Women are known for experiencing greater difficulty adapting to facial skin cancer and value facial aesthetics more than men.[30,31]

Patient appraisal of scars increases significantly at all time points for both the *Mirror* and the *No Mirror* group. The highest score in scar satisfaction is seen one year after surgery, with still a significant increase three months to one year after surgery, supporting the hypothesis that healing continues long-term post-operative and improves over time, with scar maturation being a process of 12- to

18-months.[32] Looking in the mirror did not change patients' appraisal of scars. Since the mirror image of the defect is not representative for the scar, this might explain the lack of difference between the appraisal of the scar in the two groups. After the reconstruction, the scar length for both groups is still the same, meaning the patients feeling about the scar's appearance does not change when looking at the defect.

Limitations of the study include asking the patient one week later if they looked in the mirror, which could lead to recall bias. Also, there was no record of why the patients did not look in the mirror. The doctor may not have given the mirror to the patient, or the patient refused to look in the mirror due to fear or underlying anxiety. Future studies with randomization may better describe the difference in patient satisfaction when looking in the mirror prior to the reconstruction.

Conclusion

Satisfaction with facial appearance increases in female patients that look at their defect in the mirror prior to reconstruction. Appearance-related distress scores decrease in patients who look in the mirror before a flap reconstruction, suggesting providing patients the opportunity to view their defect in the mirror before flap reconstructions and for females will increase both short-term as well as long-term patient satisfaction.

References

1. Cameron, M. C. *et al.* Basal cell carcinoma: Epidemiology; pathophysiology; clinical and histological subtypes; and disease associations. *Journal of the American Academy of Dermatology* (2019) doi:10.1016/j.jaad.2018.03.060.
2. Nederlandse Kankerregistratie (NKR), I. Nederlandse kankerregistratie (NKR). *2018* (2019).
3. Ouyang, Y.-H. Skin cancer of the head and neck. *Semin. Plast. Surg.* **24**, 117–126 (2010).
4. Lee, C. T. *et al.* Surgical excision, Mohs micrographic surgery, external-beam radiotherapy, or brachytherapy for indolent skin cancer: An international meta-analysis of 58 studies with 21,000 patients. *Cancer* **125**, 3582–3594 (2019).
5. Wong, E., Axibal, E. & Brown, M. Mohs Micrographic Surgery. *Facial Plast. Surg. Clin. N. Am.* **27**, 15–34 (2019).
6. Mori, S. *et al.* Association of Quality of Life With Surgical Excision of Early-Stage Melanoma of the Head and Neck. *JAMA Dermatol.* **155**, 85–89 (2019).
7. Sobanko, J. F., Sarwer, D. B., Zvargulis, Z. & Miller, C. J. Importance of physical appearance in patients with skin cancer. *Dermatol. Surg. Off. Publ. Am. Soc. Dermatol. Surg. Al* **41**, 183–188 (2015).
8. Zhang, J. *et al.* Patient and Physician Assessment of Surgical Scars: A Systematic Review. *JAMA Facial Plast. Surg.* **20**, 314–323 (2018).
9. Rumsey, N. Psychosocial adjustment to skin conditions resulting in visible difference (disfigurement): What do we know? Why don't we know more? How shall we move forward? *Int. J. Womens Dermatol.* **4**, 2–7 (2018).
10. Zhang, J. *et al.* Patient quality of life fluctuates before and after Mohs micrographic surgery: A longitudinal assessment of the patient experience. *J. Am. Acad. Dermatol.* **78**, 1060–1067 (2018).
11. Pascoe, G. C. Patient satisfaction in primary health care: a literature review and analysis. *Eval. Program Plann.* **6**, 185–210 (1983).
12. McGrail, K., Bryan, S. & Davis, J. Let's all go to the PROM: the case for routine patient-reported outcome measurement in Canadian healthcare. *Healthc. Pap.* **11**, 8–18; discussion 55-58 (2011).
13. Philpot, L. M. *et al.* Barriers and Benefits to the Use of Patient-Reported Outcome Measures in Routine Clinical Care: A Qualitative Study. *Am. J. Med. Qual. Off. J. Am. Coll. Med. Qual.* **33**, 359–364 (2018).
14. Pusic, A. L., Lemaine, V., Klassen, A. F., Scott, A. M. & Cano, S. J. Patient-reported outcome measures in plastic surgery: use and interpretation in evidence-based medicine. *Plast. Reconstr. Surg.* **127**, 1361–1367 (2011).

15. Vaidya, T. S. *et al.* Appearance-related psychosocial distress following facial skin cancer surgery using the FACE-Q Skin Cancer. *Arch. Dermatol. Res.* **311**, 691–696 (2019).
16. Vaidya, T. S. *et al.* Patient-reported Aesthetic Satisfaction following Facial Skin Cancer Surgery Using the FACE-Q Skin Cancer Module. *Plast. Reconstr. Surg. Glob. Open* **7**, e2423 (2019).
17. Lee, E. H. *et al.* Patient experiences and outcomes following facial skin cancer surgery: A qualitative study. *Australas. J. Dermatol.* **57**, e100-104 (2016).
18. Lee, E. H., Klassen, A. F., Cano, S. J., Nehal, K. S. & Pusic, A. L. FACE-Q Skin Cancer Module for measuring patient-reported outcomes following facial skin cancer surgery. *Br. J. Dermatol.* **179**, 88–94 (2018).
19. Lee, E. H., Pusic, A. L., Cano, S. J. & Klassen, A. F. The FACE-Q Skin Cancer Module addresses post-resection aesthetic and quality of life outcomes. *Br. J. Dermatol.* **180**, 953–954 (2019).
20. Pusic, A. L., Klassen, A. F., Scott, A. M. & Cano, S. J. Development and psychometric evaluation of the FACE-Q satisfaction with appearance scale: a new patient-reported outcome instrument for facial aesthetics patients. *Clin. Plast. Surg.* **40**, 249–260 (2013).
21. Fix, W. C. *et al.* Comparison of Accuracy of Patient and Physician Scar Length Estimates Before Mohs Micrographic Surgery for Facial Skin Cancers. *JAMA Netw. Open* **3**, e200725–e200725 (2020).
22. Cassileth, B. R., Lusk, E. J. & Tenaglia, A. N. Patients' perceptions of the cosmetic impact of melanoma resection. *Plast. Reconstr. Surg.* **71**, 73–75 (1983).
23. Przylipiak, M. *et al.* Improvements in the perception of facial attractiveness following surgical aesthetic treatment; study based on online before and after photos. *J. Cosmet. Dermatol.* **18**, 296–300 (2019).
24. Sezgin, B., Findikcioglu, K., Kaya, B., Sibar, S. & Yavuzer, R. Mirror on the wall: a study of women's perception of facial features as they age. *Aesthet. Surg. J.* **32**, 421–425 (2012).
25. Dabiri, G., Tiger, J., Anderson, H. & Iwamoto, S. Patient Satisfaction After Mohs Surgery is not Dependent on Seeing Post-Mohs Defect Prior to Repair. *J. Clin. Aesthetic Dermatol.* **8**, 33–37 (2015).
26. Castor EDC. Castor Electronic Data Capture. https://castoredc.com (2019).
27. Brouwer, P., Westra, I., Ottenhof, M. J., Hoogbergen, M. M. & Mouës-Vink, C. M. De implementatie van de FACE-Q huidkankermodule in Nederland. *Ned. Tijdschr. Voor Plast. Chir.* **1**, 39–41 (2018).
28. Andrich, D. Controversy and the Rasch model: a characteristic of incompatible paradigms? *Medical care* (2004) doi:10.1097/01.mlr.0000103528.48582.7c.
29. Bates, D., Mächler, M., Bolker, B. & Walker, S. Fitting Linear Mixed-Effects Models Using lme4. *J. Stat. Softw.* **67**, 1–48 (2015).

30. Katz, M. R., Irish, J. C., Devins, G. M., Rodin, G. M. & Gullane, P. J. Psychosocial adjustment in head and neck cancer: The impact of disfigurement, gender and social support. *Head Neck* **25**, 103–112 (2003).
31. Koster, M. E. & Bergsma, J. Problems and coping behaviour of facial cancer patients. *Soc. Sci. Med. 1982* **30**, 569–578 (1990).
32. Commander, S. J., Chamata, E., Cox, J., Dickey, R. M. & Lee, E. I. Update on Postsurgical Scar Management. *Semin. Plast. Surg.* **30**, 122–128 (2016).

Chapter 7

How to reconstruct a complex multiunit skin defect: A single-case survey study

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Reconstructing a defect after surgical excision of nonmelanoma skin cancer (NMSC) can be challenging as many different reconstructive options exist.[1,2] When choosing a reconstruction method, it is important to understand the patient's perspective of the scar, operation, and healing process.[3] A recent study showed that some patients benefit from receiving a mirror and looking at their defect after NMSC resection and before reconstruction, as this led to higher patient satisfaction.[4] A possible reason for this is that patients can adjust their expectations and better understand the origin of the post-operative scar. This emphasizes that involving the patient in the decision-making and considering the patient's final scar, impacts patient satisfaction after surgery. To capture patient's experiences and treatment satisfaction, patient-reported outcome measurements (PROMs) are developed. A validated PROM to assess patient satisfaction after facial skin cancer resection and reconstruction is the FACE-Q Skin Cancer Module.[5–7] This survey study examines the different reconstructive options of a patient with a surgical defect after Mohs micrographic surgery (MMS) for NMSC and evaluates patient's satisfaction following reconstruction using the FACE-Q Skin Cancer.

Institutional review board approval was obtained from Catharina Hospital Eindhoven. In August 2019, a 65-year-old woman with a 1.5x1.5cm defect at the right alar crease after MMS was asked to complete the Appearance-related Distress and Appraisal of Scar scales, and the Adverse Effects checklist of the FACE-Q Skin Cancer Module translated to Dutch.[8] The questionnaires were sent by email before, one-week, three-months, and one-year after surgery. Higher scores indicated higher psychosocial distress and greater satisfaction with post-surgical scar formation. The Adverse Effects checklist comprises 10 symptoms (e.g., pain, numbness, tingling). Each symptom was scored separately (1-not at all bothered, 2-a little, 3-moderately, 4-extremely bothered).

Figure 1. Patient case: 65-year-old ♀ with a 1.5x1.5cm defect at the right alar crease.

A national survey was conducted in November 2019. An anonymized picture (Figure 1) of the 65-year-old woman was sent to all plastic surgeons and residents in plastic surgery practicing in the Netherlands (n=453) via the Dutch Society of Plastic Surgery (NVPC). The plastic surgeon or resident in plastic surgery had to choose one reconstructive option. Answer options for reconstruction were primary closure, a full-thickness skin graft (FTSG), a flap reconstruction, a free flap, or other. The survey participants were divided into plastic surgeons and residents in plastic surgery.

A total of 132 members of the NVPC completed the survey (29.1%). Most of the responders were plastic surgeons (69.7%). The most chosen option was a flap (97.0%), notable a nasolabial flap. However, a wide range of reconstructive options was selected with 9 different flaps (Table 1). The results show a significant difference between the plastic surgeons and the residents regarding their choice of reconstruction (p=0.01) and years of experience as a resident (p=0.01). No significant difference was seen between the reconstructive method and years of experience as a plastic surgeon (p=0.22).

Table 1: Survey reconstructive techniques.

Reconstructive method	N (%)
Primary closure	0 (0.0)
FTSG	3 (2.3)
Flap	128 (97.0)
Nasolabial flap	65 (50.8)
VY-plasty	11 (8.6)
Bilobed flap	8 (6.3)
Cheek advancement flap	7 (5.5)
Rhomboid flap	6 (4.7)
Mesolabial flap	2 (1.6)
Banner flap	1 (0.8)
Hatched flap	1 (0.8)
Forehead flap	1 (0.8)
Combined procedures[a]	26 (20.3)
Free flap	0 (0.0)
Other	1 (0.8)
Secondary granulation	1 (100)

a Combination of two reconstructive methods (e.g., VY-plasty and bilobed flap, cheek advancement and bilobed flap).

The 65-year-old woman was reconstructed in August 2019 with a FTSG by a resident in plastic surgery with 3-5 years of experience. Three residents (0-3 years: 2, >5 years: 1) chose FTSG as an adequate reconstructive technique (7.5%), compared to none of the plastic surgeons (0.0%). After reconstruction, the patient was very satisfied with her facial scar, with a perfect scar score three-months (score 100)

and one-year post-operative (score 100). The appearance-related distress score slightly increased after surgery; however, the score remained low (before 14, one-week 23, three-months 23, one-year 28). The patient experienced none to minimal adverse effects during the whole period after reconstruction, with the mean for each symptom being less than 2 (a little) on a scale of 1-4 (Table 2).

Table 2: Adverse Effects checklist .

Adverse Effects checklist	1-week score	3-months score	1-year score
Pain	1	1	1
Discomfort	2	2	1
Sensitivity	2	1	1
Numberness	2	2	2
Tingling	1	1	1
Tightness	1	2	2
Itchiness	1	2	1
Swelling	2	2	1
Bruising	2	1	1
Difficulty facial movements	2	1	1

Although the participants received a limited survey in order to achieve a high response rate, our data showed that a wide range of reconstructive techniques is considered in Dutch plastic surgery practice. Since many different reconstructive options exist, it is often difficult to choose the best technique for specific patients. FTSG is a fast and simple reconstruction with minimal scarring. Flaps may avoid contour defects and can lead to high aesthetic outcomes.[9] By keeping both the differences in skin characteristics (e.g., skin color, texture, and thickness) and contouring of facial subunits in mind, the scar can be strategically positioned and therefore camouflaged.[10,11] However, it may lead to a larger operation and larger post-surgery scars. Even though 97.0% of the participants chose a flap reconstruction as an adequate reconstructive technique, a simple reconstruction with a FTSG showed maximum satisfaction with the post-surgical scar and low appearance-related distress. Although this survey is limited by one patient case and not every defect may be suitable for a simple reconstruction, this study shows that the patient's perspective on satisfying outcomes often differs from that of the surgeon. It is not always necessary to choose the most challenging or extensive reconstructive technique to obtain a satisfactory outcome.

Keeping it simple while managing patient expectations can often yield the best overall outcome. By involving the patient in the decision process and explaining the different simple and complex reconstructive options higher satisfaction can be obtained.

Literature

1. Veldhuizen, I. J. *et al.* A Systematic Review and Overview of Flap Reconstructive Techniques for Nasal Skin Defects. *Facial Plast Surg Aesthet Med* (2021) doi:10.1089/fpsam.2020.0533.
2. Johnson, A. R. *et al.* Facial Reconstruction After Mohs Surgery: A Critical Review of Defects Involving the Cheek, Forehead, and Perioral Region. *J Craniofac Surg* **30**, 400–407 (2019).
3. Mori, S. & Lee, E. H. Beyond the physician's perspective: A review of patient-reported outcomes in dermatologic surgery and cosmetic dermatology. *Int J Womens Dermatol* **5**, 21–26 (2019).
4. Veldhuizen, I. J. *et al.* To see or not to see: Impact of viewing facial skin cancer defects prior to reconstruction. *Arch Dermatol Res* (2021) doi:10.1007/s00403-021-02187-1.
5. Lee, E. H. *et al.* A systematic review of patient-reported outcome instruments of nonmelanoma skin cancer in the dermatologic population. *Journal of the American Academy of Dermatology* **69**, e59–e67 (2013).
6. Lee, E. H., Klassen, A. F., Cano, S. J., Nehal, K. S. & Pusic, A. L. FACE-Q Skin Cancer Module for measuring patient-reported outcomes following facial skin cancer surgery. *British Journal of Dermatology* **179**, 88–94 (2018).
7. Lee, E. H. *et al.* Patient experiences and outcomes following facial skin cancer surgery: A qualitative study. *Australas. J. Dermatol.* **57**, e100-104 (2016).
8. Ottenhof, M. J. *et al.* Patient-reported Outcome Measures: The FACE-Q Skin Cancer Module: The Dutch Translation and Linguistic Validation. *Plast Reconstr Surg Glob Open* **7**, e2325 (2019).
9. Lindsay, K. J. & Morton, J. D. Flap or graft: The best of both in nasal ala reconstruction. *J Plast Reconstr Aesthet Surg* **68**, 1352–1357 (2015).
10. Burget, G. C. & Menick, F. J. The subunit principle in nasal reconstruction. *Plast Reconstr Surg* **76**, 239–247 (1985).
11. Menick, F. J. Facial reconstruction with local and distant tissue: the interface of aesthetic and reconstructive surgery. *Plast Reconstr Surg* **102**, 1424–1433 (1998).

Chapter 8

A systematic review and overview of flap reconstructive techniques for nasal skin defects

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Abstract

Background: Reconstruction of nasal skin defects can be challenging due to limited skin laxity and underlying cartilage, and therefore often require a complex reconstruction. The aim of this review is to systematically analyze the literature on nasal skin reconstructions with specific detail to flap reconstructions.

Methods: A systematic literature review of nasal skin reconstruction was performed and focused on flap reconstructions. Flap reconstructions were stratified based on defect size, nasal subunit and reconstruction type. Complication rates and patient outcomes were also assessed.

Results: A total of 176 articles (11,370 patients) met the inclusion criteria. Of these, 59 articles showed various flap techniques. For defects ≤1.5cm, every subunit had 4-6 options except the alar rim, which showed 1 option. Rotation-advancement flaps were mostly used for the nasal tip and sidewall, whereas bilobed flaps were used more for the ala and dorsum. Defects >1.5cm were most commonly reconstructed with the forehead flap. The mean complication rate of flap reconstructions was 13.8%. Only 8 of the 176 articles (4.5%) reported patient satisfaction using a standardized questionnaire.

Conclusion: This review shows various flap reconstruction options with their corresponding complication rate that will help guide the surgeon in choosing reconstructive options for different nasal skin defects.

Key Points

Question: What are the most commonly reported flap reconstructive options for nasal skin defects and their complications?

Findings: Defects >1.5cm were mostly reconstructed with a forehead flap and defects ≤1.5cm with a rotation-advancement or bilobed flap. There are multiple other flap options available with varying degrees of complications.

Meaning: The flap options for reconstructing nasal skin defects primarily depend on the size of the defect and main subunit involved.

Introduction

The nose functions as a conduit for respiration and olfaction. In addition, it plays a significant role in facial identity and aesthetic appearance.[1,2] Therefore, deformities of the nose can impair both function and aesthetics. Nasal deformities are either congenital or acquired; the latter being caused by trauma, chronic inflammation, or malignancies. Congenital nasal deformities are rare, whereas acquired nasal deformities are common and involve nasal skin. Surgical management is often the treatment of choice to correct and improve deformities and maintain airflow.[3–7]

The nose is unique in its framework of cartilage and bone, symmetry, and limited skin laxity. Therefore, when reconstructing nasal skin, the surgeon will consider various options in the reconstructive ladder to recreate the anatomy, ensure symmetry, and maintain airway patency. However, the reconstructive ladder is not straightforward for nasal skin reconstructions and there exist numerous approaches, notably flap reconstructions, for defects of various sizes.[8] To help reconstruct nasal defects, Burget and Menick described a subunit principle, dividing the nose into specific areas (subunits).[9] By maintaining incision lines between subunits, the nose preserves natural shadows and contour for an aesthetically pleasing outcome. However, even with this principle, visible scarring of the nose can impact individuals' self-perception and social interactions, diminishing quality of life.[10,11] If scars do not heal favorably, even a small defect of the nose can carry a large social impediment.[1] Therefore, in addition to sound surgical techniques, the patients' perspective of the healing process and aesthetic outcome can better inform surgeons and patients in choosing an optimal reconstruction. To incorporate the patients' point of view, this is best captured using a validated patient-reported outcome measure (PROM) in clinical care and research.[12–15]

In the literature, most articles about nasal skin reconstruction are case series of flap reconstructions. There are some algorithms about nasal skin reconstructions based on single-center studies describing the reconstructive options used in their clinic;[16–20] but to the authors' knowledge, no systematic review examining nasal skin reconstructions exists. The goal of this study was to systematically analyze the literature on reconstructions of acquired nasal deformities and analyze the most commonly used flap reconstruction according to nasal subunit and assess for outcomes and complications.

Materials and methods

A systematic literature review of studies on nose reconstructions was conducted by an experienced medical librarian in MEDLINE ALL via Ovid (1946-present), Embase via embase.com (1974-present), and Cochrane CENTRAL registry of Trials via Wiley (1992-present). The search terms include facial defects with surgical interventions

(Supp. 1). The first search was completed on November 16, 2018. A more recent search was completed on June 22, 2020 for any additional articles that may have arisen since the first search.

Articles were imported in Rayyan and deduplicated using the method described by Bramer et al.[21] PRISMA 2009 checklist (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) was used for article selection and analysis.[22] Five independent reviewers screened titles and abstracts of the retrieved articles in a blinded fashion, and at least two reviewers assessed each paper. A discussion with a third reviewer solved any discrepancies.

Inclusion and exclusion criteria were established prior to the search (Fig. 1). All articles of patients with nose defects who underwent reconstruction of the skin were included.

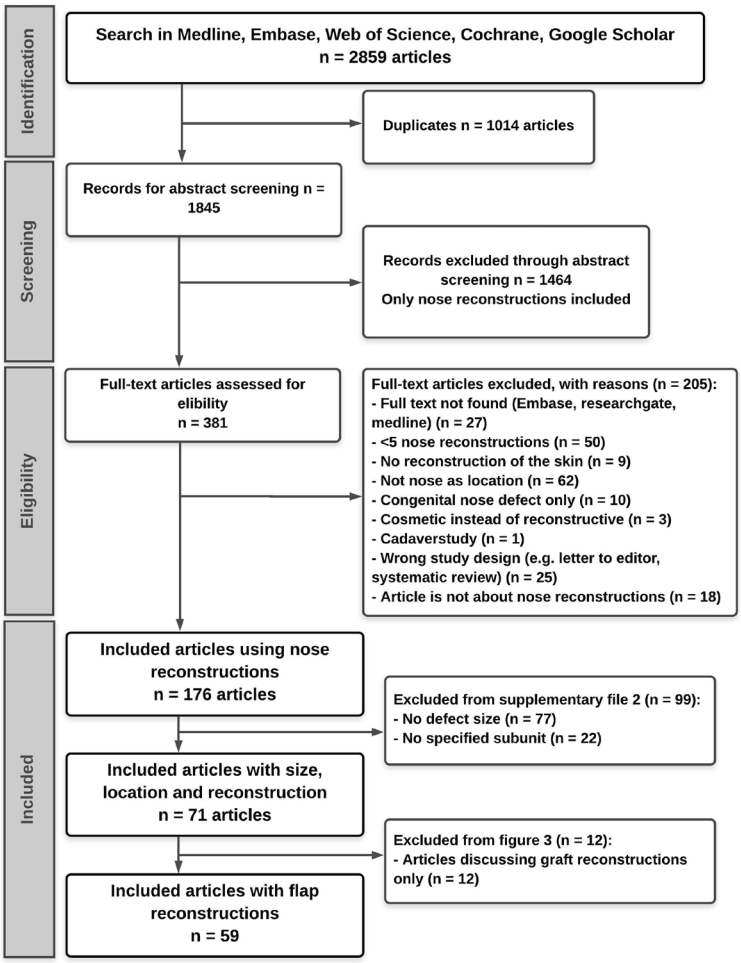

Figure 1. Flowchart of article selection.

Articles that included less than five patients, used prothesis reconstructions, cadaver studies, or did not reconstruct the skin of the nose (e.g. cartilage reconstruction only) were excluded. In addition, conference abstracts, letters to the editor, thesis, commentaries, literature review, animal studies, and articles not written in English were excluded.

Data were extracted from full-text articles in a predesigned standardized table. Variables collected were mean patient age, study size, comorbidities (smoking, anticoagulation, diabetes), defect size, type of reconstruction, complications, and if aesthetic satisfaction was included. Aesthetic satisfaction was categorized as surgeon or patient-reported, and assessed if a validated questionnaire was used. Articles that reported defect size, nasal subunit, and reconstruction were then further analyzed to categorize flap reconstructions based on size and nasal subunit. Reconstructions were summed according to defect size and subunit. If a reconstruction type had less than 10 patients it was excluded from further analysis. The complications from these articles were collected and summed. A complication rate per flap reconstruction was calculated by summing all complications reported for a specific reconstruction divided by the total sum.

The Level of Evidence was measured using the Oxford Centre for Evidence-Based Medicine guidelines. The Level of Evidence ranged from I to V, with I representing adequately powered and conducted randomized clinical trials and V representing case reports.[23]

Results

A total of 2859 articles were identified. After duplicate removal and abstract review, 381 articles were selected for full-text analysis (Fig. 1). After further exclusion, 176 articles from 27 different countries published between January 1971 and January 2020 were included in the final database. The Level of Evidence for most of the studies were level IV studies (Table 1).

Table 1: Level of evidence based on Oxford Centre for Evidence-Based Medicine.

Level of evidence	Description	Articles
I	Randomized controlled trials Systematic reviews	0
II	Controlled trial without randomization	0
III	Case-control Retrospective cohort studies	5
IV	Case series Cross-sectional studies	171
V	Case reports Expert opinion	0

The 176 articles included a total of 11,370 patients and 11,442 nose reconstructions. The patients' mean age was 59.6 ± 13.9 years. The nasal skin defects were secondary to resection of cutaneous malignancy in 10,109 patients (88.9%), trauma in 489 (4.3%), congenital abnormality in 64 (0.6%), or other causes (e.g., infection, scar revision, iatrogenic) in 23 (0.2%) In 685 patients (6.0%) the cause of the nose defect was not specified. The defect size ranged from 0.4cm to 7.0cm.

In 10,669 patients (93.8%), the location of the reconstruction was specified to a nasal subunit. When defects involve more than one subunit, the defect was designated to the most involved subunit. The most involved subunit was the nasal ala (29.7%) followed by the tip (24.3%) (Fig. 2).

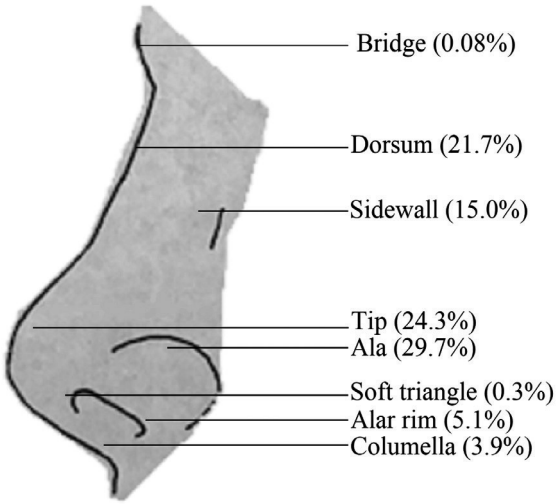

Figure 2. Location of the nose by subunit.

Of the 176 articles, 72 articles reported aesthetic satisfaction (37.1%). Thirteen of 72 articles only reported physician satisfaction. Of the remaining 59 articles, patient satisfaction with reconstruction was assessed. However, 51 articles did not use a validated satisfaction questionnaire. The remaining 8 articles used the following validated questionnaires: Patient Satisfaction Questionnaire (PSQ-18),[24] Modified Hollander Wound Evaluation scale,[25] Manchester scar scale,[26] DAS24 questionnaire,[27] Vancouver scar scale, [28] Patient scar assessment scale,[29] and the Visual Analogue Scale (VAS).[28,30,31] The VAS scale was used the most (3 of the 8 articles), including 254 patients. All 8 articles reported patient satisfaction at only one post-operative timepoint.

Articles that specified defect size, nasal subunit location, and reconstruction were included to develop an overview of flap reconstructive options. Of the 176 articles, 77 did not report a defect size and 28 articles did not specify the subunit and were excluded. Seventy-one articles remained; these articles are shown in supplementary file 2. Of these articles 59 report on flap reconstructions and 12 report only on graft reconstructive techniques. The flap reconstruction data from the 59 articles were then combined. If a specific flap reconstructive technique or subunit involved less than 10 patients in total, it was excluded. In total, there were 1833 patients. The reconstructions were grouped based on whether the defect size was ≤1.5cm or >1.5cm and further categorized per subunit (Fig. 3). Among defects ≤1.5cm, five or more flap types were described for the tip, nasal ala, and dorsum. Only the nasolabial flap was described as a flap reconstructive option for the alar rim. For defects >1.5cm, the nasal tip had a wide variety of eight flap types, whereas the ala and dorsum had four flap types, and the sidewall had only three flap types. Details about the flap reconstructions can be found in Supplementary file 2. All complications mentioned in the articles were combined, with a corresponding complication rate. The complications in Figure 3 are reported in Table 2. The mean complication rate for flap reconstructions was 13.8% (n = 253).

Size	Location	Reconstruction	N	CR*
≤1.5cm	Tip	Rotation-advancement flap	143	11.9
		Bilobed flap	121	18.2
		Trilobed/Quadrilobed flap	71	18.3
		Advancement flap	59	0
		Nasolabial flap	36	13.9
		Pedicled island flap	25	4.0
	Ala	Bilobed flap	136	29.4
		Nasolabial flap	95	0.2
		Pedicled island flap	89	0.7
		Croissant/Pincer/Spiral flap	39	20.5
		Advancement flap	22	9.1
		Trilobed/Quadrilobed flap	14	35.7
	Sidewall	Rotation-advancement flap	46	15.2
		Bilobed flap	40	12.5
		Pedicled island flap	26	30.8
		Forehead flap	12	8.3
	Dorsum	Bilobed flap	71	0
		Advacement flap	28	0
		Pedicled island flap	21	14.3
		Rotation-advancement flap	16	0
		Proximal Peng flap	14	14.3
	Alar rim	Nasolabial flap	18	0

CR*	N	Reconstruction	Location	Size
17.2	134	Forehead flap	Tip	>1.5cm
6.2	65	Frontonasal flap		
11.1	27	Nasolabial flap		
0	20	Trilobed/Quadrilobed flap		
20.0	15	Pedicled island flap		
20.0	15	Bilobed flap		
14.3	14	Advancement flap		
16.7	12	Croissant/Pincer/Spiral flap		
17.3	110	Forehead flap	Ala	
16.3	80	Nasolabial flap		
18.5	27	Rotation-advancement flap		
11.8	17	Advancement flap		
0	51	Forehead flap	Sidewall	
0	25	Perialar crescentic flap		
7.8	13	Propellar flap		
12.5	48	Forehead flap	Dorsum	
0	38	Birhombic flap		
30.8	13	Propellar flap		
20	10	Advancement flap		

Figure 3. Review of nasal flap reconstructions based on 1833 patients.
* See Supp 2. for detail about the articles and flap reconstructions used in this overview.
Abbreviation: CR, complication rate.

Table 2: Complications based on 1833 patients.

Complications	Frequency	%
Total	253	100
Pin cushioning	80	31.6
Hematoma/congestion of the flap	46	18.2
Partial necrosis	33	13.0
Infection	18	7.1
Dehiscence	11	4.3
Nasal obstruction	11	4.3
Alar rim retraction	10	4.0
Edema	9	3.7
Hypertrophic scar	2	0.8
Not specified.	34	13.4

Discussion

This systematic review describes flap reconstructions for nasal skin defects based on anatomic subunit, defect size, and associated complications. Many options can be considered for nasal skin reconstructions. For defects larger than 1.5cm, the forehead flap is most reported among the 4 subunits. Even though the forehead flap gives in most cases a good cosmetic result, it is a longer procedure that requires at least two operations and subsequent revisions to achieve the desired cosmetic result.[32,33] Not all patients are willing to endure multiple operations and therefore will prefer a single-staged procedure. In addition, for patients with blood thinners, a history of multiple skin cancers, or comorbidities, a less complex reconstructive option may be beneficial. This review shows multiple other techniques to consider for patients that do not wish to endure multiple-stage operations. For defects of 1.5cm or smaller, the most reported reconstructive options per nasal subunit were more diverse. The nasal tip showed 6 published options and was often reconstructed with a rotation-advancement flap. For the nasal sidewall the bilobed flap and the rotation-advancement flap were almost equally reported. However, the bilobed flap showed a lower complication rate, which may be due to the better distribution of skin tension.[34] For the ala, the bilobed flap was also the most published reconstruction. However, the cumulative complication rate was higher, likely due to the greater risk of alar rim notching and pin cushioning.[35] Therefore, when reconstructing the ala, consideration for the nasolabial flap or pedicled island flap is preferred. This review also highlights less reported reconstructive options such as the proximal Peng flap and propeller flap that may be considered. However, graft reconstructions, linear closures and secondary intention healing were not reported in this overview. As seen in Supplementary File 2, when reconstructing the alar rim, columella and soft triangle a composite graft can be a good option. In addition, a full-thickness skin

graft, biologic and synthetic skin substitutes are options to consider when a more complex reconstruction is less favored.

Complications were included when the article designated the adverse outcome as a complication; however, the definition varied across studies. This heterogeneity and lack of differentiation between short- and long-term complications highlight the difficulty of knowing whether the complication was transient or persistent. Since no distinction was made, this could result in high complication rates. The mean complication rate for flap reconstructions was 13.8%, with pin cushioning being the most commonly reported at 31.6%. The bilobed flap, for example, had a high risk of pin cushioning due to the increased risk of contraction beneath the flap. Therefore, to minimize this, it is important to insert a flap without tension. A smaller arc has also been shown to reduce the tension of the flap.[36] Whereas pin cushioning may be considered more of an adverse event it was included as a complication as the articles described it as such. Infection was rare among complications, whereas a previous study suggested higher infection rates following nasal skin reconstructions.[37] Furthermore, 14.2% of the complications were not specified, which could lead to a misrepresentation of these complications. However, the inclusion of complications informs surgeons, helping them strategize to minimize these complication risks.

Understanding the patients' perspective of the healing process and their aesthetic outcome is important to facilitate clinical decision-making for surgeons and patients. Unfortunately, most articles in this review did not report on patient satisfaction or were limited in the tool used. From the articles that reported on aesthetic satisfaction, almost half of the articles did not use a questionnaire to validate aesthetic outcomes. Rather, the patient was simply asked if they were satisfied with the reconstruction, which may also be influenced by other factors related to the office or hospital, surgeon, and staff. Only a small number of articles used a standardized questionnaire - with the VAS scale being the most common. The VAS scale is a single question scoring system ranging from 0 to 10. Patients were asked to rate their satisfaction with 0 being very dissatisfied and 10 very satisfied. There were no additional questions about symptoms, scarring, or psychosocial distress in the VAS scale. The articles that used a standardized questionnaire for patient satisfaction reported only on long-term post-operative satisfaction. Since the patients' facial satisfaction is very subjective, pre-operative and post-operative satisfaction using a PROM designed for facial surgery could provide a better view of the scar from the reconstruction. PROMs are increasingly being used in dermatologic and plastic surgery to measure these outcomes.[15,38,39] Since cutaneous malignancy are accountable for most (88.9%) acquired nasal skin defects; the FACE-Q Skin Cancer PROM was developed specifically designed for patients undergoing surgical procedures on the face for cutaneous malignancy.[40–43]

There are limitations to this review. Articles that did not include defect size, nasal subunit, or reconstruction were excluded in the flap overview. Therefore, some flap reconstructions and nasal subunits may have been missed. In this review, the repairs focused on the main subunit involved, whereas in the clinical setting, surgical defects may involve multiple subunits. In those scenarios, more than one reconstructive technique may be necessary for an optimal cosmetic result.

Conclusion

This review provides surgeons with a comprehensive overview of the most commonly published flaps for nasal skin reconstruction. It also highlights the assessment of patient-reported outcomes after reconstruction is limited in the literature. Future studies that measure patient satisfaction with a standardized questionnaire will guide surgeons and patients in selecting a reconstructive method based on the surgical defect and the patients' needs.

References

1. Iorio, C. B., Christophel, J. J. & Park, S. S. Nasal Reconstruction: Defects that Cross Anatomical Subunits. *Facial Plast. Surg.* **36**, 091–101 (2020).
2. Salgarelli, A. C. *et al.* Reconstruction of Nasal Skin Cancer Defects with Local Flaps. *J. Skin Cancer* **2011**, (2011).
3. Rustemeyer, J., Günther, L. & Bremerich, A. Complications after nasal skin repair with local flaps and full-thickness skin grafts and implications of patients' contentment. *Oral Maxillofac. Surg.* **13**, 15–19 (2009).
4. Potenza, C. *et al.* A Review of the Literature of Surgical and Nonsurgical Treatments of Invasive Squamous Cells Carcinoma. *BioMed Res. Int.* **2018**, 9489163 (2018).
5. Mohs Surgery. *The Skin Cancer Foundation* https://www.skincancer.org/treatment-resources/mohs-surgery/.
6. Lobeck, A. *et al.* [Single center analysis of the dermatosurgical patient cohort of a tumor center in Germany]. *Hautarzt Z. Dermatol. Venerol. Verwandte Geb.* **68**, 377–384 (2017).
7. Wollina, U., Bennewitz, A. & Langner, D. Basal cell carcinoma of the outer nose: overview on surgical techniques and analysis of 312 patients. *J. Cutan. Aesthetic Surg.* **7**, 143–150 (2014).
8. Michelotti, B. & Mackay, D. Nasal reconstruction. *Clin. Anat. N. Y. N* **25**, 86–98 (2012).
9. Burget, G. C. & Menick, F. J. The Subunit Principle in Nasal Reconstruction. *Plast. Reconstr. Surg.* **76**, 239–247 (1985).
10. Rumsey, N., Clarke, A. & White, P. Exploring the psychosocial concerns of outpatients with disfiguring conditions. *J. Wound Care* **12**, 247–252 (2003).
11. Sobanko, J. F., Sarwer, D. B., Zvargulis, Z. & Miller, C. J. Importance of physical appearance in patients with skin cancer. *Dermatol. Surg. Off. Publ. Am. Soc. Dermatol. Surg. Al* **41**, 183–188 (2015).
12. Mori, S. *et al.* Association of Quality of Life With Surgical Excision of Early-Stage Melanoma of the Head and Neck. *JAMA Dermatol.* **155**, 85–89 (2019).
13. Albornoz, C. R. *et al.* Measuring health-related quality of life outcomes in head and neck reconstruction. *Clin. Plast. Surg.* **40**, 341–349 (2013).
14. Koster, M. E. & Bergsma, J. Problems and coping behaviour of facial cancer patients. *Soc. Sci. Med. 1982* **30**, 569–578 (1990).
15. Pusic, A. L., Lemaine, V., Klassen, A. F., Scott, A. M. & Cano, S. J. Patient-reported outcome measures in plastic surgery: use and interpretation in evidence-based medicine. *Plast. Reconstr. Surg.* **127**, 1361–1367 (2011).
16. Manson, P. N., Hoopes, J. E., Chambers, R. G. & Jaques, D. A. Algorithm for nasal reconstruction. *Am. J. Surg.* **138**, 528–532 (1979).

17. Guo, L., Pribaz, J. R. & Pribaz, J. J. Nasal Reconstruction with Local Flaps: A Simple Algorithm for Management of Small Defects. *Plast. Reconstr. Surg.* **122**, 130e (2008).
18. Parrett, B. M. & Pribaz, J. J. An Algorithm for Treatment of Nasal Defects. *Clin. Plast. Surg.* **36**, 407–420 (2009).
19. Yoon, T., Benito-Ruiz, J., García-Díez, E. & Serra-Renom, J. M. Our algorithm for nasal reconstruction. *J. Plast. Reconstr. Aesthet. Surg.* **59**, 239–247 (2006).
20. Marsh, J. L. *Decision Making in Plastic Surgery*. (B.C. Decker, 1993).
21. Bramer, W. M., Giustini, D., de Jonge, G. B., Holland, L. & Bekhuis, T. De-duplication of database search results for systematic reviews in EndNote. *J. Med. Libr. Assoc. JMLA* **104**, 240–243 (2016).
22. Liberati, A. *et al.* The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med.* **6**, e1000100 (2009).
23. Oxford Centre for Evidence-based Medicine - Levels of Evidence (March 2009). *CEBM* https://www.cebm.net/2009/06/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/ (2009).
24. Salgarelli, A. C., Cangiano, A., Sartorelli, F., Bellini, P. & Collini, M. The bilobed flap in skin cancer of the face: our experience on 285 cases. *J. Cranio-Maxillo-fac. Surg. Off. Publ. Eur. Assoc. Cranio-Maxillo-fac. Surg.* **38**, 460–464 (2010).
25. Jacobs, M. A. *et al.* Clinical outcome of cutaneous flaps versus full-thickness skin grafts after Mohs surgery on the nose. *Dermatol. Surg. Off. Publ. Am. Soc. Dermatol. Surg. Al* **36**, 23–30 (2010).
26. Riml, S., Wallner, H., Larcher, L., Amann, U. & Kompatscher, P. Aesthetic improvements of skin grafts in nasal tip reconstruction. *Aesthetic Plast. Surg.* **35**, 475–479 (2011).
27. de Pochat, V. D. *et al.* Nasal reconstruction with the paramedian forehead flap using the aesthetic subunits principle. *J. Craniofac. Surg.* **25**, 2070–2073 (2014).
28. Dessy, L. A., Marcasciano, M., Fanelli, B., Mazzocchi, M. & Ribuffo, D. Surgical treatment of nasal non-melanoma skin cancer in elderly patients using dermal substitute. *Acta Otolaryngol. (Stockh.)* **136**, 1299–1303 (2016).
29. Guzman, A. K. *et al.* Intrasubunit V-Y Muscle Sling Myocutaneous Island Advancement Flap for Small Defects Isolated to the Nasal Ala. *Dermatol. Surg.* **46**, 546–553 (2020).
30. Ozkan, A., Topkara, A., Ozcan, R. H. & Tasli, L. The management of nasal defects after non-melanoma skin cancer excision. *Nasal Reconstr.* 9.
31. Han, S.-K., Kim, S.-Y., Choi, R.-J., Jeong, S.-H. & Kim, W.-K. Comparison of tissue-engineered and artificial dermis grafts after removal of basal cell carcinoma on face--a pilot study. *Dermatol. Surg. Off. Publ. Am. Soc. Dermatol. Surg. Al* **40**, 460–467 (2014).

32. Rotunda, A. M. & Bennett, R. G. The forehead flap for nasal reconstruction: how we do it. *Skin Ther. Lett.* **11**, 5–9 (2006).
33. Menick, F. Nasal Reconstruction. *Plast. Reconstr. Surg.* **125**, (2010).
34. Wolfswinkel, E. M., Weathers, W. M., Cheng, D. & Thornton, J. F. Reconstruction of Small Soft Tissue Nasal Defects. *Semin. Plast. Surg.* **27**, 110–116 (2013).
35. Park, Y. J., Kwon, G. H., Kim, J. O., Ryu, W. S. & Lee, K. S. Reconstruction of nasal ala and tip following skin cancer resection. *Arch. Craniofacial Surg.* **20**, 382–387 (2019).
36. Mole, R. J. & Badri, T. Bilobed Flaps. in *StatPearls* (StatPearls Publishing, 2020).
37. Sylaidis, P., Wood, S. & Murray, D. S. Postoperative infection following clean facial surgery. *Ann. Plast. Surg.* **39**, 342–346 (1997).
38. Vaidya, T. S. *et al.* Appearance-related psychosocial distress following facial skin cancer surgery using the FACE-Q Skin Cancer. *Arch. Dermatol. Res.* **311**, 691–696 (2019).
39. Vaidya, T. S. *et al.* Patient-reported Aesthetic Satisfaction following Facial Skin Cancer Surgery Using the FACE-Q Skin Cancer Module. *Plast. Reconstr. Surg. Glob. Open* **7**, e2423 (2019).
40. Lee, E. H. *et al.* Patient experiences and outcomes following facial skin cancer surgery: A qualitative study. *Australas. J. Dermatol.* **57**, e100-104 (2016).
41. Lee, E. H., Klassen, A. F., Cano, S. J., Nehal, K. S. & Pusic, A. L. FACE-Q Skin Cancer Module for measuring patient-reported outcomes following facial skin cancer surgery. *Br. J. Dermatol.* **179**, 88–94 (2018).
42. Lee, E. H., Pusic, A. L., Cano, S. J. & Klassen, A. F. The FACE-Q Skin Cancer Module addresses post-resection aesthetic and quality of life outcomes. *Br. J. Dermatol.* **180**, 953–954 (2019).
43. Pusic, A. L., Klassen, A. F., Scott, A. M. & Cano, S. J. Development and psychometric evaluation of the FACE-Q satisfaction with appearance scale: a new patient-reported outcome instrument for facial aesthetics patients. *Clin. Plast. Surg.* **40**, 249–260 (2013).

Supplementary files

Supplementary file 1: Search.

	references	references after deduplication
Embase.com	1554	1535
Medline ovid	1227	273
Cochrane CENTRAL	78	37
Total	**2859**	**1845**

Embase.com

(((‘face malformation’/mj/exp) AND (skin/mj/exp)) OR ((face/mj/exp OR forehead/mj/de) AND ‘skin defect’/mj/exp) OR ‘face burn’/mj/de OR ‘face cancer’/exp/mj OR (((face OR facial OR midfacial OR craniofacial OR cranial OR periocular* OR nose OR nasal OR nasolabial* OR chin OR cheek) NEAR/6 (skin OR tissue OR cutane*) NEAR/6 (defect* OR deform* OR injur* OR trauma* OR wound* OR cancer* OR carcinom* OR tumor* OR loss)) OR ((forehead* OR ear OR columella* OR auricular* OR scalp* OR eyebrow* OR cheek OR eyelid OR lip OR oral-commissure OR lips OR canthus OR vertex OR ala OR alae OR nose OR nasal OR nasolabi*) NEAR/6 (defect* OR injur* OR trauma* OR wound* OR cancer* OR tumor* OR excision OR resection OR loss OR reconstruct* OR burn* OR constrict*)) OR ((face OR facial OR craniofacial) NEAR/6 (burn*))):ti) AND (‘reconstructive surgery’/de OR ‘plastic surgery’/de OR ‘eyelid reconstruction’/de OR ‘nose reconstruction’/de OR ‘lip reconstruction’/de OR ‘ear reconstruction’/exp OR ‘skin transplantation’/exp OR autotransplantation/de OR ‘surgical flaps’/exp OR ‘tissue flap’/exp OR ‘nose surgery’/exp OR ‘surgical technique’/de OR ‘esthetic surgery’/de OR (reconstruct* OR flap OR flaps OR graft* OR micrograft* OR transplant* OR autotransplant* OR donor* OR repair OR (nose NEAR/3 surg*) OR (tissue NEAR/3 transfer*) OR rhinoplast* OR (surgical* NEAR/3 (technique* OR esthet* OR aesthet*))):ab,ti,kw) NOT ([Conference Abstract]/lim) AND [english]/lim NOT (‘case report’/de OR ‘case report’:ti) AND (‘systematic review’/exp OR ‘meta analysis’/exp OR ‘randomized controlled trial’/exp OR ‘cohort analysis’/exp OR ‘longitudinal study’/exp OR ‘retrospective study’/exp OR ‘prospective study’/exp OR ‘follow up’/de OR ‘major clinical study’/de OR ‘case study’/exp OR ((systematic* NEAR/3 review*) OR meta-analy* OR (random* NEAR/3 controlled NEAR/3 trial*) OR cohort* OR longitudinal* OR retrospectiv* OR prospectiv* OR ‘follow up’ OR followup OR ((case) NEAR/3 (study OR studies OR serie*))):ab,ti)

Medline ovid

(((* face/ab) AND (* skin/)) OR ((exp *face/) AND *Skin Abnormalities/) OR (((face OR facial OR midfacial OR craniofacial OR cranial OR periocular* OR nose OR nasal

OR nasolabial* OR chin OR cheek) ADJ6 (skin OR tissue OR cutane*) ADJ6 (defect* OR deform* OR injur* OR trauma* OR wound* OR cancer* OR carcinom* OR tumor* OR loss)) OR ((forehead* OR ear OR columella* OR auricular* OR scalp* OR eyebrow* OR cheek OR eyelid OR lip OR oral-commissure OR lips OR canthus OR vertex OR ala OR alae OR nose OR nasal OR nasolabi*) ADJ6 (defect* OR injur* OR trauma* OR wound* OR cancer* OR tumor* OR excision OR resection OR loss OR reconstruct* OR burn* OR constrict*)) OR ((face OR facial OR craniofacial) ADJ6 (burn*))).ti.) AND (exp Reconstructive Surgical Procedures/ OR exp Surgery, Plastic/ OR exp Skin Transplantation/ OR exp Surgical Flaps/ OR (reconstruct* OR flap OR flaps OR graft* OR micrograft* OR transplant* OR autotransplant* OR donor* OR repair OR (nose ADJ3 surg*) OR (tissue ADJ3 transfer*) OR rhinoplast* OR (surgical* ADJ3 (technique* OR esthet* OR aesthet*))).ab,ti,kf.) AND english. la. NOT (case reports/ OR case report.ti.) AND (Meta-Analysis/ OR Randomized Controlled Trial/ OR exp Cohort Studies/ OR ((systematic* ADJ3 review*) OR meta-analy* OR (random* ADJ3 controlled ADJ3 trial*) OR cohort* OR longitudinal* OR retrospectiv* OR prospectiv* OR follow up OR followup OR (case ADJ3 (study OR studies OR serie*))).ab,ti.)

8

Cochrane CENTRAL

((((face OR facial OR midfacial OR craniofacial OR cranial OR periocular* OR nose OR nasal OR nasolabial* OR chin OR cheek) NEAR/6 (skin OR tissue OR cutane*) NEAR/6 (defect* OR deform* OR injur* OR trauma* OR wound* OR cancer* OR carcinom* OR tumor* OR loss)) OR ((forehead* OR ear OR columella* OR auricular* OR scalp* OR eyebrow* OR cheek OR eyelid OR lip OR oral-commissure OR lips OR canthus OR vertex OR ala OR alae OR nose OR nasal OR nasolabi*) NEAR/6 (defect* OR injur* OR trauma* OR wound* OR cancer* OR tumor* OR excision OR resection OR loss OR reconstruct* OR burn* OR constrict*)) OR ((face OR facial OR craniofacial) NEAR/6 (burn*))):ti) AND ((reconstruct* OR flap OR flaps OR graft* OR micrograft* OR transplant* OR autotransplant* OR donor* OR repair OR (nose NEAR/3 surg*) OR (tissue NEAR/3 transfer*) OR rhinoplast* OR (surgical* NEAR/3 (technique* OR esthet* OR aesthet*))):ab,ti)

Supplementary file 2: Reported articles on nasal reconstructions that include the subunit, defect size and reconstruction type.

#	First author	Year	Subunit N	Total patients N (total reconstructions)	Defect size	Type of reconstruction
1	Akdagli, S.	2015	Nasal ala: 7	7	11 mm Range: 6-15 mm	Bilobed flap
2	Akhil K Seth	2019	ala 7, dorsum 2, sidewall 3, tip 4	16	Mean: 4.0 ± 3.7	Integra Dermal Regeneration Template
3	Albertini, J.G.	2010	Nasal ala: 10 Nasal tip: 20 Nasal dorsum: 1	31	Mean: 1.6 cm diameter Median: 1.5 cm diameter	Trilobed flap
4	Aldosari, B.F.	2019	Nasal tip	15	Range: 1.4-2.5 cm:	Axial frontonasal flap
5	Altun, Serdar MD	2019	Nasal tip (2), nasal wing (5), supratip region (3), nasal dorsum (8)	18	Average: 1.6 x 1.56 cm Range: 1x1 tot 2.5x2cm	Omega (Ω) advancement flap
6	Baltu, Y.	2016	Nasal dorsum: 9 Unilateral medial canthal region/nasal dorsum: 2	11	Range: 2x2 - 3.5x4 cm	Central artery perforator propellar flaps
7	Baltu, Y.	2019	Large nasal defects including dorsum and nasal sidewall and/or dome: 13	13	Range: 3 x 3 - 4 x 5 cm	Extended central artery perforator propeller flap
8	Benoit, A.	2017	Lateral nasal tip: 31 Lateral nasal tip/anterion alar junction: 11 Soft triangle: 9 (may also involve surrounding subunits, including nasal tip and/or anterior ala) Anterior ala: 4	55	Median: 8 mm Range: 4 - 21 mm	Nasal tip rotation flap
9	Blázquez-Sánchez, N.	2015	Proximal (dorsum, lateral wall): 8 (20%) Distal (tip,ala): 33 (80%)	41	Mean: 21.6 mm Range: 15-40 mm	Paramedian fore-head flap
10	Booth, S.A.	1993	Nasal tip: 120	120	Range: 0.7-3.7	Primary closure Second intention healing Bilobed Advancement flap Rotation flap Pedicle (forehead or island) FTSG
11	Borchard, K.L.A.	2013	Lateral sidewall: 25	25	Range: 1.3 - 3.0 cm	Perialar crescentic advancement flap
12	Boyd, C.M.	2000	Nasal tip: 48 Ala: 47 Sidewall: 36 Dorsum/bridge: 20 2 lesions involving >1 subunit: 4	147	Mean: 2.5 x 3.0 Range: 1.0 x 1.0 - 5.0 x 5.6 cm	Forehead flap
13	Cecchi, R.	2017	Dorsum and tip: 10.	14	Mean: 26 mm Range: 22 - 33 mm	Forehead flap
14	Chang, C.S.	2017	Columella: 14	14	Mean: 1.0 x 0.5 cm	Composite graft
15	Collar, R. M.	2011	Isolated nasal tip: 51 Nasal tip/ala: 15 Nasal tip, nasal sidewall and/or nasal dorsum: 6	72	Mean: VHL: 2.8 cm FTSG: 1.7 cm Bilobed: 1.3 cm ATT: 1.0 cm	Full-thickness skin grafts Forehead flap Bilobed flap Nasal cutaneous flap
16	Cöloğlu, H.	2006	Nasal tip: 15	15	Mean: 2.5 cm diameter Range: 2.1 - 3.1 cm diameter	Orbicularis oculi musculocutaneous island flap

17	Dessy, L.A.	2016	Columella: 1 Nasal ala: 4 Dorsum/tip: 3 side wall: 2	10	Range: 1.5 - 4 cm diameter	Immediate dermal substitute coverage and delayed skin graft
18	Drisco, P.D.	2001	Nasal Ala: 50	50	Forehead flap: Mean: 7.45 cm^2 Range 4-21.5 cm^2 Cheek flap: Mean: 3.8 cm^2 Range 1-6.5 cm^2	Forehead flap Interpolated cheek flap
19	Durgun, M.	2015	Nasal ala: 8	8	Range: 15x16 - 23x28mm	Nasolabial perforator flaps
20	Eberlin, K.R.	2013	Lateral nasal tip or medial ala: 29	29	Mean: 0.7 cm Range: 0.4 - 1.0 cm	Z-advancement flap
21	Ezzat, W.H.	2017	Alar/sidewall nasal subunits: 38	38	Mean: 2.04 cm Range: 0.4-7 cm	Paramedian forehead flap Soft-tissue flap Local flap FTSG
22	Fader, D. J.	1997	Deep nasal alar rim/lobule: 18	18	Mean: 1.3 x 1.4 cm Range: 0.9 x 1.0 - 2.0 x 2.0 cm	Staged cheek-to-nose interpolation flap
23	Friduss, M.	1995	Dorsum: 4 Dorsum/alae: 1 Dorsum/tip: 2 Dorsum/tip/lateral walls: 2 Supratip: 1 Lateral wall: 1 Bilateral alar: 1 Dorsum and lobule: 1	13	Mean: 3.87 x 2,84 cm Range: 2.35 x 2.1 - 7.5 x 4.4 cm	Forehead flap
24	Grieco, M.P.	2018	Lower third nose: 50% Nasal ala: 24% Tip: 20% Sidewall: 6%	86	Diameter: Mean: 1.54 cm Range: 1.3-1.7cm	Modified Zitelli bilobed flap
25	Guzman, Anthony K	2019	Nasal ala	17	Mean defect surface area: 0.42 6 0.19 cm2	V-Y island advancement flap (intrasubunit V-Y muscle sling myocutaneous island advancement flap (SMIAF))
26	Han, D.H.	2012	Nasal ala: 17	17	Mean: 1.71 cm Range: 1-4 cm	Nasolabial flap Paramedian forehead flap Composite graft Bilobed flap
27	Haug, M.D.	2009	Ala lobule: 37 Soft triangle: 5 Columella: 9 External and internal valve: 59	97 (110 grafts)	Mean: 13 mm Range: 12-25 mm	Composite grafts from the ear
28	Howe, N.M.	2019	Distal nasal sidewall: 18 Lateral nasal tip: 16 Medial nasal ala: 9 Medial alar crease: 5	48	Mean: 1.29 cm^2 Range: 0.25 - 3.8 cm^2	Island Pedicle Rotation Flaps with Crescentic Modification
29	Inozu, E.	2016	Central tip: 6 Nasaltip/supratip: 3 Lateral tip: 3	12	Range: 20x17-25x29 mm	Pincer flap
30	Jayarajan, R	2018	ala and the lateral wall of the nose (skin only - full thickness)	11	Range: 2-3.5x2-4.25cm	Cheek advancement flap with nasolabial flap

Supplementary file 2: Continued

#	First author	Year	Subunit N	Total patients N (total reconstructions)	Defect size	Type of reconstruction
31	Kalbermatten, D.F.	2005	Ala: 9 Tip: 5	14	Ala: Mean: 2 cm^2 Range: 1.0-2.5 cm2 Tip: Mean: 2.5 cm^2 Range: 1.8-2.7 cm^2	Perichondrial cutaneous graft
32	Kelly-Sell, M.	2018	Nasal dorsum: 22 Tip: 7 Ala: 5 Supratip: 2 Nasal sidewall: 3 Alar groove: 2	40 (41)	Median: 1.4 cm Range: 0.8-2.3 cm	Superiorly based bilobed flap
33	Kerem, H.	2017	Tip: 2 Wall: 3 Dorsum: 6 Dorsum/tip: 1 Dorsum/tip/ala: 1 Ala/wall: 4 Ala/malar region: 1	18	Range: 2.5 × 2.5 cm to 4 × 5 cm	Cranially-based nasolabial flaps
34	Kim,Y.H.	2018	Alar area: 22 Nasal tip: 12	36	Mean: 0.99 cm^2	Rotation flaps with an S-shape Croissant-shaped modified V-Y flap
35	Kishi, K.	2012	Ala/alar base: 2 Ala: 2 Ala/cheek: 1	5	Mean: 2.8 x 3.4 cm Range: 1.0 x 2.0 - 6.0 x 6.0	Forehead flap
36	Knackstedt, T.	2018	Bilobed (%) - Trilobed (%) Nasal dorsum: 28 Nasal sidewall: 19 Nasal supratip: 54 Nasal tip/infratip: 41 Anterior nasal ala: 35 Posterior nasal ala: 8	185	Bilobed mean: 1.33 (± 0.72) Trilobed mean: 1.32 (± 0.69)	Bilobed flap Trilobed flap
37	Kostopoulos, E.	2015	Lateral wall: 8 Tip: 9 Dorsum: 6 Nasal ala: 5 Inner canthus: 2	30	Mean: 1.46 cm diameter Range: 0.7-2.5 cm	Keystone perforator island flap
38	Kreutzer, M.	2014	Alar: 14 Nasal tip: 13 Alar base: 5 Alar crease: 4 Alar including weak triangle: 3 Nasal dorsum/supratip: 2 Isolated weak triangle: 1	42	Median: 83 cm^2 Range: 20 - 18 cm^2 5x4 - 15x22 mm	Skin-fat-grafts
39	Kwon, S.G.	2013	Nasal dorsum: 3 Columella: 1 Nasal tip: 2 Alar: 1	7	Mean: 0.71 x 0,14 cm Range: 1 x 0.8 - 3 x 2.8	Skin-Fat composite grafts
40	Kwon, S.-H.	2019	Supratip: 20	20	Mean: 1.20 cm Range: 0.5 - 1.9 cm	Double tangential advancement flap Single tangential advancement flap
41	Lin, W.	2014	Alar rim: 6	6	Mean: 0.7 x 1.1 Range: 0.4 - 0.9 x 0.8 - 1.3	Alar flap combined with free auricular composite flap
42	Mahlberg, M.J.	2011	Alar body: 25 Alar groove: 38	63	Mean: 10 mm Range: 5-15	Spiral flap

43	Meyers, S.	2001	Alar rim: 7 Sidewall: 3 Tip: 3 Dorsum: 1	15	Mean: 1.6 x 1.4 cm Range: 0.8 x 0.9 - 3.1 x 2.6 cm	Cheek advancement flap FTSG Bilobed flap Rhombic flap
44	Monarca, C.	2012	Nasal ala: 60	60	Mean: 0.5-2.5	Nasolabial flap Island flap
45	Monarca, C.	2012	Nasal dorsum: 30 Nasal ala: 90	120	Range: 0.5-1.5cm diameter	Island pedicle flap Bilobed flap
46	Moratin, K.	2019	Nasal sidewall: 21 Nasal ala: 13 Nasal tip: 12 Columella: 1 Nasal dorsum: 12 Extranasal aesthetic areas: 17	35 (36)	Mean: 9.6 (±1.6) cm^2	Dermal regeneration templates (DRT) followed by split-skin grafting or FTSG
47	Mutaf, M.	2011	Nasal sidewall: 5	5	Mean: 2.6 Range: 2.0 - 3.2 cm	Reading man procedure
48	Newlove, T.	2016	Dorsum: 38	38	Mean: 17 mm diameter Range: 7 - 32 mm	Bilateral dufourmentel rhomboid flap (Birhombic flap)
49	Ong, S.	2016	Nasal tip: 18 Alar rim: 5 Nasal sidewall: 2 Infratip: 1 Nasal bridge: 1	27	Range: 0.7 x 0.5 cm - 3.0 x 1.0 cm	Quadrilobed transposition flaps
50	Ozkan, A.	2016	Dorsum: 58 Sidewalls: 68 Ala: 39 Tip: 24 Columella: 6 Combined: 29	224	Mean: 1.8 cm	Nasolabial flap Bilobed flap Forehead flap VY Rotation adv. flap Glabellar flap FTSG Transposition flap
51	Jayasekera, P.S.A	2019	Dorsum: 14	14	Ranged from 10 mm to 18 mm	proximal Peng flap
52	Redondo, P.	2017	Distal portion nasal pyramid: 27	27	Median: 24 mm diameter Range: 15x21 - 32x37mm	Dorsal-modified flap
53	Riml, S.	2010	Nasal tip: 30	29	Range: 11 - 35 mm	Matriderm Composite graft FTSG
54	Sapthavee, A.	2015	Skin graft - Local flap, total Ala: 33 Tip: 39 Dorsum and/or sidewall: 26	103	Skin graft: Mean: 10.6x12.9mm Local flap: Mean: 13.7x16.9mm	FTSG Local flap
55	Scheufler, O.	2016	Tip: 22 Supratip: 7	29	Mean: 2 cm Surface area: 4 cm^2	Standard frontonasal flap Extended frontonasal flap
56	Smith, H.	2003	Ala: 10 Nasal tip: 18	28	Mean: 2.2-1.8 cm Range: 1.2 x 1.0 - 3.0 x 2.5 cm	Burget flap Interpolation flap
57	Sohn, W.I.	2012	Nasal ala: 8	8	Mean: 5.16 cm^2	Nasolabial perforator flap Advancement flap Propellar flap
58	Takeda, A.	2014	Ala: 5	5	Range: 16 - 23 mm diameter	Nasolabial flap

Supplementary file 2: Continued

#	First author	Year	Subunit N	Total patients N (total reconstructions)	Defect size	Type of reconstruction
59	Tan, E.	2014	Ala sidewall: 111 Ala rim: 21 Supra-ala crease: 30 Ala-facial junction: 22 Supra-ala crease and ala-facial junction: 2	181 (186)	Mean: 1.0 - 1.2 cm diameter Range: 0.3 x 0.4 - 2.0 - 2.7 cm	FTSG
60	Tan, E.	2010	Nasal tip: 47 Bridge: 8 Supratip: 4 Infratip: 1 Alar crease: 1 Lower nasal sidewall: 3 Dorsum: 1	65	Median and mean: 1.1 x 1.0 cm Range: 0.4 - 2.0 cm diameter	Nasal sidewall rotation flap
61	Tan, O.	2009	Nasal dorsum/side wall: 9	9	Range: 2.5 x 2 cm - 7.5 x 5 cm	Forehead flap
62	Teltzrow, T.	2011	Alar rim/soft triangle: 75 (94%) Nasal tip, columella or columella-lobular junction: 5 (6%)	70 (80)	2-3 cm width: 46 (57%) 1-2 cm width: 34 (43%)	Modified auricular composite grafts
63	Thornton, J.F.	2008	Tip: 14 Tip/soft triangle: 3 Tip/Sidewall: 1 Tip/ala: 13 Dorsum/tip/ala: 1 Tip/dorsum: 4 Ala/tip/sidewall: 1 Tip/columella: 1	38	Mean: 1.34 Range: 1 - 2.2 cm	Nasolabial flap
64	Xu, M.	2015	Nasal dorsum: 6 Nasal tip: 5 Nasal tip/alar junction: 4 Nasal tip/dorsum: 5	20	Range: 0.8 x 0.8 - 2 x 1.8 cm	V-Y advancement flap
65	Xue, C.-Y	2008	Nasal tip: 21	21	Mean: 17 x 20 mm Range: 15x16 – 21x23	Axial frontonasal flap
66	Xue, C.-Y.	2009	Soft triangle: 3 Tip: 4 Alar: 4	11	Mean: 1.38 x 1.38 Range: 1.2 x 1.2 - 1.6 x 1.6 cm	Modified Zitelli bilobed flap
67	Yazar, M.	2017	Nasal tip: 9 Lateral nasal wall/dorsum: 8	17	Mean: 20.5 mm diameter Range: 16 – 26,	Paramedian forehead flap
68	Yong, J.S.	2014	Ala: 85 Nasal tip: 69 Dorsum: 28 Sidewall: 17 Combination of 2 of more subuntis: 116	315	Mean: 19.2 mm	Composite grafts Melolabial Forehead flap Local flap FTSG
69	Yoon, T.	2005	Dorsum/tip/unilateral ala: 3 Ala: 9 Tip: 5 Ala/lobule/columella: 1 Sidewall: 3 Tip/lobule: 3 Vestibule from soft triangle: 1 All subunits: 2 Dorsum/tip: 2 Middle vault/alar collaps: 1 Complete: 1 Sidewall/ala: 1 Dorsum: 1 Columella/anterior septum: 1	35	Mean: 2.2 cm Range: 1.2 - 4.1 cm	Forehead flap Nasolabial turnover flap Cheek advancement Bilobed FTSG V-Y advancement Costocondral graft Dorsonasal flap Helical root free flap Costocondral graft/ pericraneal flap
70	Zelken, J.A.	2016	Cheek/sidewall/dorsum/ala: 1 Sidewall/dorsum/ala: 2 Bilateral sidewall/ala/dorsum/tip: 1 Sidewall/ala/tip: 1 sidewall/ala/dorsum/tip/columella:1	6	2.5 x 3 - 7 x 6.5 cm	Forehead flap
71	Zopf, D.A.	2013	Nasal ala: 20	20	Mean: 2.0 cm^2 Range: 0.8 - 5.9 cm^2	Full-thickness skin graft

Chapter 9

Nasal Skin Reconstruction: Time to Rethink the Reconstructive Ladder?

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Submitted

Abstract

Background: Nasal scarring can compromise aesthetics and function given its complex three-dimensional structure and central location. This study aims to measure patients' satisfaction and appearance-related distress after reconstruction for nasal defects following Mohs micrographic surgery.

Methods: Patients presenting with nasal non-melanoma skin cancer at Memorial Sloan Kettering Cancer Center New York, USA and Catharina Hospital Eindhoven, Netherlands from April 2017 to November 2019 were asked to participate. Reconstruction type, complications, and patients satisfaction were assessed. Patients completed the FACE-Q Skin Cancer - Satisfaction with Facial Appearance scale (pre-operative and one-year post-operative) and the Appraisal of Scars scale (one-year post-operative).

Results: A total of 128 patients completed the pre-and post-operative scales. There were 35 (27%) surgical defects repaired with primary closures, 71 (55.5%) with flaps, and 22 (17.2%) with full-thickness skin grafts (FTSG). Patients that underwent a flap or FTSG reconstruction had higher scar satisfaction scores than primary closures ($p = 0.03$). A trend was seen with patients following flap reconstructions scoring 7.8 points higher than primary closures and patients with upper nose defects scoring 6.4 points higher than lower nose defects. Males were significantly more satisfied than females. There was no significant difference in the pre-operative and post-operative facial appearance scores between the three groups ($p = 0.39$).

Conclusion: Patients are more satisfied in the long-term with their scars after flap reconstructions compared to primary closures. Therefore, nasal skin reconstruction may not follow the traditional reconstructive ladder and more complex approaches may lead to higher long-term scar satisfaction.

Introduction

non-melanoma skin cancer (NMSC) is the most commonly diagnosed malignancy worldwide.[1] NMSC has a predilection for the head and neck area, with 25-30% occurring on the nose.[2–7] The majority are treated with surgical resection, such as Mohs micrographic surgery (MMS). Given its central location on the face and its role in breathing and airway entry, scars from surgical treatment may pose significant psychosocial and function morbidity to the patient.[8] Furthermore, the nose has a unique three-dimensional contour, which often requires a more complex reconstructive approach to maintain its optimal function and cosmesis.[8,9]

The reconstructive ladder is commonly followed to repair surgical defects on the skin, starting with primary closure to more complex reconstruction (i.e., flaps and grafts).[10] In addition, repairs are usually oriented to follow resting skin tension lines (RSTLs) to hide the scar in the natural skin lines and render it less noticeable. In areas with multiple cosmetic subunits, such as the nose, each subunit border is respected surgically to allow for the best cosmetic results.[11] Given overlapping RSTLs and multiple small subunits, reconstruction of nasal surgical defects may not follow the traditional ladder, requiring complex reconstruction to provide a superior cosmetic outcome. Choosing a reconstructive option depends on multiple factors such as the size and depth of the defect, subunit of the nose involved, and patient characteristics (e.g., age and comorbidities). Defects on the nose, notably the lower nose, have less skin laxity; therefore, when closing primarily, this could easily distort the shape of the nose. More complex reconstructive techniques such as full-thickness skin grafts (FTSG), locoregional flaps, or free tissue transfer are well described in the literature.[12–16] However, there is a paucity of literature evaluating patient satisfaction with these reconstructions.

Facial scars can impact an individuals' self-perception and social interactions.[17,18] Therefore, understanding patient satisfaction and maintaining quality of life after surgery is especially important since scars are permanent and in turn, can have long-term effects.[19,20] To understand the impact of surgery on sensitive areas such as the nose, patient-reported outcome measures (PROMs), such as the FACE-Q Skin Cancer, are increasingly being used.[20–23] In a study that involved over 400 patients who underwent facial skin cancer surgery and completed the FACE-Q Skin Cancer, nose reconstructions were associated with lower scar satisfaction and appearance scores.[24] Though there is an increasing use of PROMs in reconstructive surgery, most of the literature lacks long-term satisfaction assessments. This study evaluates long-term patient satisfaction after nasal reconstruction and analyzes the reconstructive options with the FACE-Q Skin Cancer PROM.

Methods

This study was approved by the institutional review boards at Memorial Sloan Kettering Cancer Center (MSK), New York, USA and Catharina hospital, Eindhoven, the Netherlands.

Patient recruitment

Patients who presented with nasal NMSC at Catharina Hospital and MSK, who underwent MMS between April 2017 and November 2019, were identified. Patients under 18 years of age or those unable to speak or read Dutch or English were excluded. Also, patients who were reconstructed with a multi-staged procedure such as a forehead flap or patients who did not have a reconstruction (second intention healing) were excluded. Relevant demographic and clinical information, including post-operative complications such as bleeding, infection, or contour abnormalities (e.g., hypertrophic scarring), were abstracted from electronic medical records. The longest diameter of the lesion after surgery and before the reconstruction, in any axis, was termed "defect size." Nasal subunits were summed and categorized into a) upper nose: nasal root, dorsum, and sidewall b) lower nose: nasal ala, alar rim, and tip.

Data collection

Patients completed the Dutch or English version of the FACE-Q Skin Cancer – Satisfaction with Facial Appearance scale via email or in the clinic prior to surgery.[20–23,25] At MSK, this questionnaire is given to patients as part of clinical care; at Catharina hospital, patients were asked to participate in the study prior to surgery. One year after surgery, patients were contacted by telephone and given the option to complete the FACE-Q Skin Cancer scales - Satisfaction with Facial Appearance and Appraisal of Scars by email or answer the questions directly on the telephone (Table 1). The Satisfaction with Facial Appearance scale consists of 9 questions regarding their satisfaction with overall facial appearance (e.g., shape, contour). The Appraisal of Scars scale consists of 8 questions regarding the scars' characteristics (e.g., color, length, thickness). There are 4 response options in a Likert-type scale that are summed and then transformed on a scale from 0 to 100. Higher values for the scales represent higher satisfaction with their facial appearance and post-surgical scar (less bother by scar), while lower values represent lower satisfaction with their facial appearance and post-surgical scar (more bother by scar).

Table 1: FACE-Q Skin Cancer scales per time-point.

Pre-operative	One-year post-operative
Satisfaction with Facial Appearance	Satisfaction with Facial Appearance
	Appraisal of Scars

Statistical analysis

Descriptive statistics were used to analyze patient and clinical characteristics and carried out using IBM SPS Statistics 25.0 (IBM, USA). Chi-Square tests or Fisher exact tests for small sample sizes were used. For the satisfaction with facial appearance scale, which was completed pre-operative and one-year post-operative, the change between the two scales was calculated by subtracting the post-operative FACE-Q score from the pre-operative score for every individual patient. This difference was then compared with the reconstruction type by using the Kruskal Wallis H test. The Kruskal Wallis H test was also used to determine whether the remaining post-operative FACE-Q Skin Cancer scale scores were dependent on reconstruction type. Linear mixed-effect models were used to address the relationship between the reconstruction type and the post-operative FACE-Q Skin Cancer scales. Location, defect size, and gender were considered possible effect modifiers on the relationship between the reconstruction method and FACE-Q Skin Cancer scores and were therefore considered as covariates. A $p < 0.05$ was considered significant.

Results

Six hundred seventy-four patients with facial skin cancer completed the pre-operative FACE-Q Skin Cancer – Satisfaction with Facial Appearance scale, of which 192 patients had a nasal defect. A total of 128 patients (66.7%) completed the FACE-Q Skin Cancer scales one year after surgery. Forty-one patients (32%) were from MSK and 87 (68%) from Catharina hospital. The mean age was 67±10 years and 51.6% of the patients were male. Patient demographic and clinical characteristics are shown in Table 2.

Table 2: Clinical and demographic characteristics of patients.

Variables	Primary (n = 35) n (%)	FTSG (n = 22) n (%)	Flap (n = 71) n (%)	Total (n = 128) n (%)	p-value
Age, y					
≤65	10 (28.6)	9 (40.9)	29 (40.8)	48 (37.5)	0.44
≤65	25 (71.4)	13 (59.1)	42 (59.2)	80 (64.0)	
Gender					
Male	18 (51.4)	11 (50.0)	37 (52.1)	66 (51.6)	0.99
Female	17 (48.6)	11 (50.0)	34 (47.9)	62 (48.4)	
History facial skin cancer surgery					
Yes	17 (48.6)	7 (31.8)	27 (38.0)	51 (39.8)	0.41
No	18 (51.4)	15 (68.2)	44 (62.0)	77 (60.2)	
Smoking					
Yes/Former	22 (62.9)	13 (59.1)	39 (54.9)	74 (57.8)	0.73
No	13 (37.1)	9 (40.9)	32 (45.1)	54 (42.2)	
Blood thinners					
Yes	6 (17.1)	6 (27.3)	22 (31.0)	34 (26.6)	0.32
No	29 (82.9)	16 (72.7)	49 (69.0)	94 (73.4)	

Table 2: Continued

Variables	Primary (n = 35) n (%)	FTSG (n = 22) n (%)	Flap (n = 71) n (%)	Total (n = 128) n (%)	p-value
Location					
Upper	14 (40.0)	13 (59.1)	43 (60.6)	70 (54.7)	0.12
Lower	21 (60.0)	9 (40.9)	28 (39.4)	58 (45.3)	
Side					
Left	15 (42.9)	10 (45.5)	34 (47.9)	59 (46.1)	0.87
Right	11 (31.4)	7 (31.8)	25 (35.2)	43 (33.6)	
Midline	9 (25.7)	5 (22.7)	12 (16.9)	26 (20.3)	
Defect size, cm					
≤1.0	24 (68.6)	8 (36.4)	34 (47.9)	66 (51.6)	0.04
>1.0	11 (31.4)	14 (63.6)	37 (52.1)	62 (48.4)	
Complications					
Yes	1 (2.9)	1 (4.5)	3 (4.2)	5 (3.9)	0.93
No	34 (97.1)	21 (95.5)	68 (95.8)	123 (96.1)	

Nasal reconstruction

Of the 128 patients, 70 (54.7%) had a defect on the upper nose and 58 (45.3%) on the lower nose. The mean defect size was 1.2±0.4cm. Patients were reconstructed using a primary closure (n = 35, 27.3%), single-stage flap reconstruction (n = 71, 55.5%), or FTSG (n = 22, 17.2%). Of the 71 flap reconstructions, 39 were reconstructed using a bilobed flap. Other flap reconstructions were the Rintala flap, V-Y advancement flap, rotation flap, and rhombic flap. No significant differences between the reconstruction techniques and patient demographics were observed (Table 2).

The mean defect size of the flap and FTSG groups were similar (1.2±0.5cm, 1.2±0.3cm, respectively). The mean defect size of primary closures was 1.0±0.3cm. The defect size was categorized into ≤1.0cm and >1.0cm groups for further comparisons (Table 2). There were more primary closures performed in defects ≤1.0cm than >1.0cm (≤1.0cm, 68.6% vs >1.0cm 31.4%), whereas more FTSG reconstructions were reported in defects >1.0cm compared to ≤1.0cm (≤1.0cm, 36.4% vs >1.0cm 63.6%, p = 0.04). Flap reconstructions were performed similarly in both defect size groups (≤1.0cm, 47.9% vs >1.0cm, 52.1%).

Five patients (3.9%) had complications: 1 after FTSG reconstruction, 1 after primary closure, and 3 after flap reconstructions. Complications reported were: hypertrophic scarring (n = 2), ectropion (n = 1), infection (n = 1) and contour abnormality (n = 1). There was no statistically significant difference in complication rates between the three groups (p = 0.93).

FACE-Q Skin Cancer

The mean score for the Satisfaction with Facial Appearance scale before surgery was 60.2±19.6, and one year after surgery, the mean score increased to 73.4±21.9.

There was no significant difference in pre-operative and post-operative scores for the facial satisfaction scale in the three reconstruction groups (p = 0.39) (Fig. 1).

The mean Appraisal of Scar score one-year after surgery was 80.1±21. Among the three reconstruction types, the flap reconstruction group had the most patients that scored the highest score (i.e., 100 on a scale from 0-100) on the Appraisal of Scars scale (n=31, 43.7%), followed by the FTSG group (n=9, 40.9%), and the primary closure group (n=9, 25.7%). There was a significant association (p = 0.03) between reconstruction type and the Appraisal of Scar score, with lower scores seen in patients who underwent primary closure (Fig. 2). On multivariate analysis, accounting for the location, defect size, and gender, a trend was seen with patients undergoing a flap reconstruction reporting 7.8 points higher scar satisfaction compared to primary closures (p = 0.08). There was also a trend seen in patients with reconstruction on the upper nose who scored 6.4 points higher than lower nose reconstructions (p = 0.09). There was a significant difference with male patients reporting higher scar satisfaction compared to female patients (p = 0.01)(Table 3).

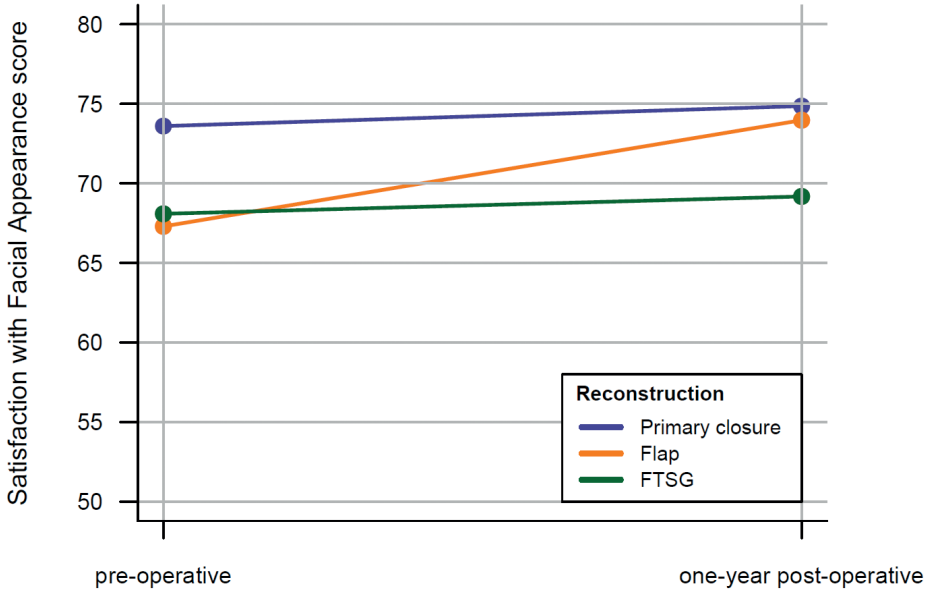

Figure 1. FACE-Q Skin Cancer - Satisfaction with Facial Appearance score pre- and post-operative by reconstruction type.

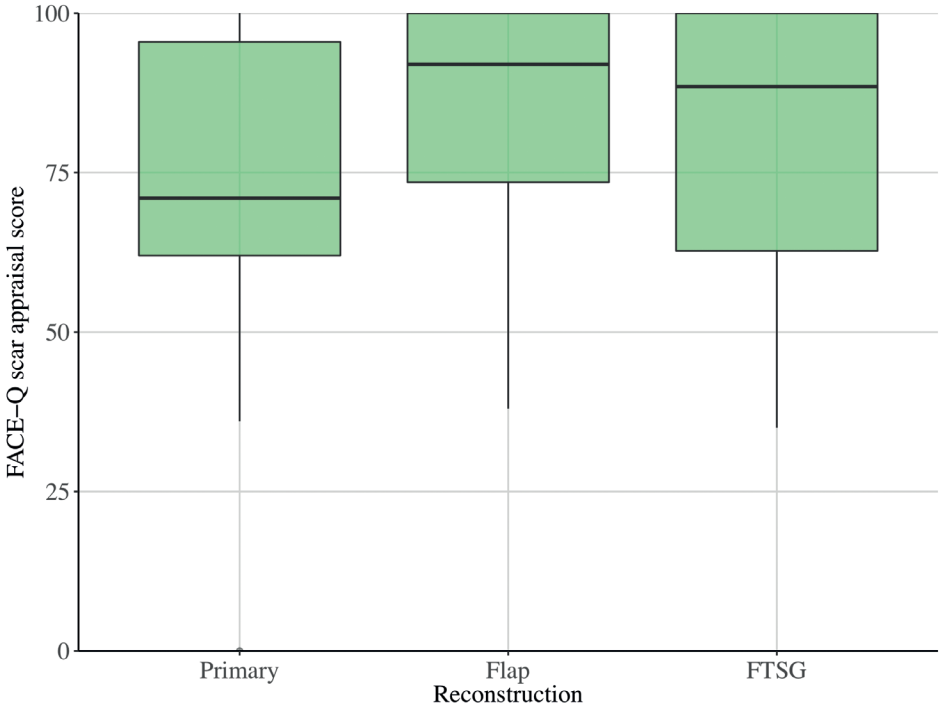

Figure 2. Reconstruction type by FACE-Q Skin Cancer – Appraisal of Scars scores.

Table 3: Multivariate analysis of the FACE-Q Skin Cancer scales.

	Appraisal of scars scale		
	Estimate	**Standard Error**	**P-Value**
Intercept (reference case)	65.63	4.09	< 0.001*
Reconstruction (reference: primary)			
Flap	7.77	4.39	0.08
FTSG	4.99	5.59	0.38
Location (reference: lower nose)			
Upper nose	6.43	3.66	0.09
Defect size (reference: ≤ 1 cm)			
> 1 cm	0.60	0.37	0.87
Sex (reference: female)			
Male	10.65	3.70	0.01*

* Significant with $p < 0.05$

Discussion

This study explored long-term patient-reported aesthetic satisfaction with multiple nasal skin reconstructive techniques. Surgeons are traditionally taught to follow the reconstructive ladder, performing simple reconstructions such as primary closures first over more complex reconstructions, such as a flap. However, in our study, we demonstrated that patients who underwent one-stage flap reconstructions for both small and large nasal skin defects had the highest scar satisfaction compared to primary closure in the long-term. In addition, there was no significant difference in the complication rate and the overall satisfaction with facial appearance scores before and after surgery in all three groups.

Patients who underwent primary closure were the least satisfied with their post-operative scar in comparison to patients who underwent flap or FTSG reconstructions. As primary closure scars are linear and uninterrupted, they have a higher likelihood of crossing multiple subunits or running into a free margin. Flap scars are typically more curved and angulated and can be redirected away from adjacent subunits or free margins.[26] Furthermore, flap reconstruction scar lines are interrupted, which can break the reflection of light and camouflage the scar in the observer's eye. Given the limited skin laxity of the nose, a linear uninterrupted straight scar may also lead to a bowstring tension effect resulting in depression of the scar in convex areas and ridge in concave areas.[27]

Reconstructions performed on the lower nose had lower scar appraisal scores compared to reconstructions on the upper nose, although this difference was not statistically significant. This is likely as the lower nose (nasal ala, alar rim, and tip) has a complex contour with more subunits compared to the upper nose (nasal root, dorsum, and sidewall). Therefore, reconstruction of the lower nose can easily distort the nasal contour (e.g., alar notching or flaring of the nostrils) or function (e.g., airway compromise), resulting in a decrease in patients' satisfaction with their post-operative scars.[28] Future research with a larger population might bring more insight into potential differences between nasal subunits. Among patients' characteristics, female patients had overall lower long-term post-surgical scar satisfaction in all reconstruction groups compared to male patients. This finding is supported by previous studies where female patients were less satisfied with post-operative scars.[24,29,30]

This study is limited by the single time-point assessment of patient outcome in the post-operative period. In addition, only patients who completed the Satisfaction with Facial Appearance scale prior to surgery were contacted to participate in the study; therefore, it is possible those who were not contacted were less satisfied. Patients who underwent two-staged procedures such as paramedian forehead flaps were excluded since these repairs are for large defects with limited options

for reconstruction. Future prospective studies surveying patients at multiple time points and larger groups could help to better understand the changes in patient satisfaction over time.

Conclusion

We demonstrated that patients undergoing flap reconstructions after MMS for nasal NMSC show a higher satisfaction with their scars compared to primary closures. This may suggest that when selecting a reconstructive option for a nasal skin defect, consider a flap reconstruction over a primary closure to optimize function and aesthetic satisfaction.

References

1. Apalla, Z., Lallas, A., Sotiriou, E., Lazaridou, E. & Ioannides, D. Epidemiological trends in skin cancer. *Dermatol. Pract. Concept.* **7**, 1–6 (2017).
2. Ouyang, Y.-H. Skin cancer of the head and neck. *Semin. Plast. Surg.* **24**, 117–126 (2010).
3. Rustemeyer, J., Günther, L. & Bremerich, A. Complications after nasal skin repair with local flaps and full-thickness skin grafts and implications of patients' contentment. *Oral Maxillofac. Surg.* **13**, 15–19 (2009).
4. Potenza, C. *et al.* A Review of the Literature of Surgical and Nonsurgical Treatments of Invasive Squamous Cells Carcinoma. *BioMed Res. Int.* **2018**, 9489163 (2018).
5. Mohs Surgery. *The Skin Cancer Foundation* https://www.skincancer.org/treatment-resources/mohs-surgery/.
6. Lobeck, A. *et al.* [Single center analysis of the dermatosurgical patient cohort of a tumor center in Germany]. *Hautarzt Z. Dermatol. Venerol. Verwandte Geb.* **68**, 377–384 (2017).
7. Wollina, U., Bennewitz, A. & Langner, D. Basal cell carcinoma of the outer nose: overview on surgical techniques and analysis of 312 patients. *J. Cutan. Aesthetic Surg.* **7**, 143–150 (2014).
8. Iorio, C. B., Christophel, J. J. & Park, S. S. Nasal Reconstruction: Defects that Cross Anatomical Subunits. *Facial Plast. Surg.* **36**, 091–101 (2020).
9. Salgarelli, A. C. *et al.* Reconstruction of Nasal Skin Cancer Defects with Local Flaps. *J. Skin Cancer* **2011**, (2011).
10. Simman, R. Wound Closure and the Reconstructive Ladder in Plastic Surgery. *J. Am. Coll. Certif. Wound Spec.* **1**, 6–11 (2009).
11. Burget, G. C. & Menick, F. J. The Subunit Principle in Nasal Reconstruction. *Plast. Reconstr. Surg.* **76**, 239–247 (1985).
12. Başağaoğlu, B., Ali, K., Hollier, P. & Maricevich, R. S. Approach to Reconstruction of Nasal Defects. *Semin. Plast. Surg.* **32**, 75–83 (2018).
13. Friduss, M., Dagum, P., Mandych, A. & Reppucci, A. Forehead flap in nasal reconstruction. *OTOLARYNGOL HEAD NECK SURG* **113**, 740–747 (1995).
14. Mole, R. J. & Badri, T. Bilobed Flaps. in *StatPearls* (StatPearls Publishing, 2020).
15. Park, Y. J., Kwon, G. H., Kim, J. O., Ryu, W. S. & Lee, K. S. Reconstruction of nasal ala and tip following skin cancer resection. *Arch. Craniofacial Surg.* **20**, 382–387 (2019).
16. Marcasciano, M. *et al.* Surgical Treatment with Locoregional Flap for the Nose. *BioMed Res. Int.* **2017**, (2017).
17. Rumsey, N., Clarke, A. & White, P. Exploring the psychosocial concerns of outpatients with disfiguring conditions. *J. Wound Care* **12**, 247–252 (2003).

18. Sobanko, J. F., Sarwer, D. B., Zvargulis, Z. & Miller, C. J. Importance of physical appearance in patients with skin cancer. *Dermatol. Surg. Off. Publ. Am. Soc. Dermatol. Surg. Al* **41**, 183–188 (2015).
19. van der Lei, B. & Bouman, T. Validating Facial Aesthetic Surgery Results with the FACE-Q. *Plast. Reconstr. Surg.* **141**, 184e–185e (2018).
20. Pusic, A. L., Klassen, A. F., Scott, A. M. & Cano, S. J. Development and psychometric evaluation of the FACE-Q satisfaction with appearance scale: a new patient-reported outcome instrument for facial aesthetics patients. *Clin. Plast. Surg.* **40**, 249–260 (2013).
21. Lee, E. H. *et al.* Patient experiences and outcomes following facial skin cancer surgery: A qualitative study. *Australas. J. Dermatol.* **57**, e100-104 (2016).
22. Lee, E. H., Klassen, A. F., Cano, S. J., Nehal, K. S. & Pusic, A. L. FACE-Q Skin Cancer Module for measuring patient-reported outcomes following facial skin cancer surgery. *Br. J. Dermatol.* **179**, 88–94 (2018).
23. Lee, E. H., Pusic, A. L., Cano, S. J. & Klassen, A. F. The FACE-Q Skin Cancer Module addresses post-resection aesthetic and quality of life outcomes. *Br. J. Dermatol.* **180**, 953–954 (2019).
24. Vaidya, T. S. *et al.* Patient-reported Aesthetic Satisfaction following Facial Skin Cancer Surgery Using the FACE-Q Skin Cancer Module. *Plast. Reconstr. Surg. Glob. Open* **7**, e2423 (2019).
25. Ottenhof, M. J. *et al.* Patient-reported Outcome Measures: The FACE-Q Skin Cancer Module: The Dutch Translation and Linguistic Validation. *Plast. Reconstr. Surg. Glob. Open* **7**, (2019).
26. Wolfswinkel, E. M., Weathers, W. M., Cheng, D. & Thornton, J. F. Reconstruction of Small Soft Tissue Nasal Defects. *Semin. Plast. Surg.* **27**, 110–116 (2013).
27. Borges, A. F. Principles of scar camouflage. *Facial Plast. Surg. FPS* **1**, 181–190 (1984).
28. Wesley, N. O., Yu, S. S., Grekin, R. C. & Neuhaus, I. M. Primary Linear Closure for Large Defects of the Nasal Supratip. *Dermatol. Surg.* **34**, 380–385 (2008).
29. Zhang, J. *et al.* Patient quality of life fluctuates before and after Mohs micrographic surgery: A longitudinal assessment of the patient experience. *J. Am. Acad. Dermatol.* **78**, 1060–1067 (2018).
30. Vaidya, T. S. *et al.* Appearance-related psychosocial distress following facial skin cancer surgery using the FACE-Q Skin Cancer. *Arch. Dermatol. Res.* **311**, 691–696 (2019).

Chapter 10

Nasal Reconstruction with One-stage Dermal Regeneration Template and Full-thickness Skin Graft: Long-term Patient Outcomes and Complications

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The nose is a common location for skin cancer, with surgical resection being the treatment of choice. However, due to its unique three-dimensional structure, reconstruction can be challenging. When a simple approach may result in undesirable distortion and a flap is less favored due to prior scars or poor skin quality, a graft is often performed. In addition to the traditional skin grafts, skin substitutes are increasingly used in reconstructive surgery.[1] Integra dermal regeneration template (Integra; Integra LifeSciences, Plainsboro, N.J.) is a skin substitute recently shown to have favorable aesthetic outcomes after a single-stage method for nasal defect reconstructions.[2] However, studies have not yet assessed for patient satisfaction following dermal regeneration template reconstructions. This study compared patient-reported outcomes and complications following single-stage dermal renegeration template and full-thickness skin graft (FTSG) after oncologic resection.

A single-center, cross-sectional study was performed. Patients with nasal defects who underwent reconstruction with one-staged dermal regeneration template or FTSG between March 2017 and December 2019 were identified by an institutional database search. Patients were asked to complete the Satisfaction with Facial Appearance, Appearance-related Distress, and Appraisal of Scar scales, and the Adverse Effects checklist of the FACE-Q Skin Cancer Module.[3,4] Higher scores represent greater facial appearance satisfaction, increased distress, and less scar bother, respectively. The Adverse Effects checklist assesses for ten symptoms (e.g., itchiness, tingling, and numbness) with four response options (1-not at all, 2-a little, 3-moderately, 4-extremely).

A total of 90 patients were identified (n = 45, dermal regeneration template and n = 45, FTSG). The mean surgical defect diameter was 1.5cm±0.9cm for dermal regeneration template and 1.5cm±0.8cm for FTSG. Patient characteristics and complications are reported in Table 1. There were no significant differences between the two groups. Twenty-one patients from each group (46.7%) completed the FACE-Q Skin Cancer. The mean time from surgery to completion of the scales was similar in both groups (16.6±9.4 months dermal regeneration template and 16.5±9.2 months FTSG). The scores of the facial appearance satisfaction (78.7±22.2 dermal regeneration template vs. 87.1±19.1 FTSG, p = 0.19) and scar appraisal scales (82.6±17.9 dermal regeneration template, 85.0±18.0 FTSG, p = 0.67) were higher in the FTSG group, but the differences were not significant. The appearance-related distress score difference was also not significant (14.0±22.0 dermal regeneration template vs.7.8±12.9 FTSG, p = 0.27). The Adverse Effects scores were low in both groups, with mean scores < 2 for each symptom. However, dermal regeneration template patients reported more symptoms than FTSG patients, including itchiness, sensitivity, tingling, numbness, and discomfort (Fig. 1).

Table 1: Clinical and demographic characteristics of patients by reconstruction type.

Variables	Integra (n = 45)	FTSG (n = 45)	p-value
Age, mean (SD), y	66.4 (11.8)	70.6 (12.5)	0.10
Gender, N (%)			
Male	25 (55.6)	21 (46.7)	0.40
Female	20 (44.4)	24 (53.3)	
Diabetes, N (%)			
No	44 (97.8)	42 (93.3)	0.31
Yes	1 (2.2)	3 (6.7)	
Smoking, N (%)			
No	37 (82.2)	36 (80.0)	0.70
Yes	3 (6.7)	1 (2.2)	
Former	5 (11.1)	8 (17.8)	
Anticoagulation, N (%)			
No	30 (66.7)	29 (64.4)	0.86
ASA/Clopidogrel/Ticagrelor	10 (22.2)	11 (24.4)	
Xarelto/Pradaxa/Apixaban	3 (6.7)	3 (6.7)	
Warfarin	0 (0.0)	1 (2.2)	
≥2 types	2 (4.4)	1 (2.2)	
Type of skin cancer, N (%)			
Basal cell carcinoma	39 (86.7)	36 (80.0)	0.38
Squamous cell carcinoma	2 (4.4)	4 (8.9)	
Melanoma	4 (8.9)	5 (11.1)	
Surgical defect diameter, mean (SD), cm	1.5 (0.9)	1.5 (0.8)	0.88
Subunit defect, N (%)			
Ala	32 (69.6)	27 (60.0)	0.27
Dorsum	5 (14.3)	7 (15.6)	
Tip	8 (16.1)	10 (22.2)	
Intranasal	0 (0.0)	1 (2.2)	
Laterality, N (%)			
Left	24 (53.3)	19 (42.2)	0.17
Right	14 (31.1)	13 (28.9)	
Central	7 (15.6)	13 (28.9)	
Complications			
Contour abnormality‡	1 (2.2)	3 (6.7)	0.33
Pigmentation‡	1 (2.2)	2 (4.4)	
Partial/complete failure	1 (2.2)	2 (4.4)	
Telangiectasia‡	1 (2.2)	0 (0.0)	
None	41 (91.1)	38 (84.4)	

‡ Treated surgically (scar revision) or non-surgically (laser, Kenalog injection)
SD, standard deviation; ASA, Acetylsalicylic Acid

Skin graft substitutes have expanded the therapeutic possibilities for wound healing and reconstruction. Although this study is a cross-sectional design at a single center, the dermal regeneration template group reported relatively high long-term satisfaction similar to the FTSG group, suggesting dermal regeneration template to be a satisfactory option for nasal defects. As the group differences were small, larger prospective studies are needed to assess for differences across different wound healing approaches and reconstructive techniques. Although dermal regeneration

template has limitations due to availability and cost, with its increasing use for head and neck defects,[5] assessing outcomes including the patients' experience and satisfaction is important for a shared-decision-making approach to reconstruction.

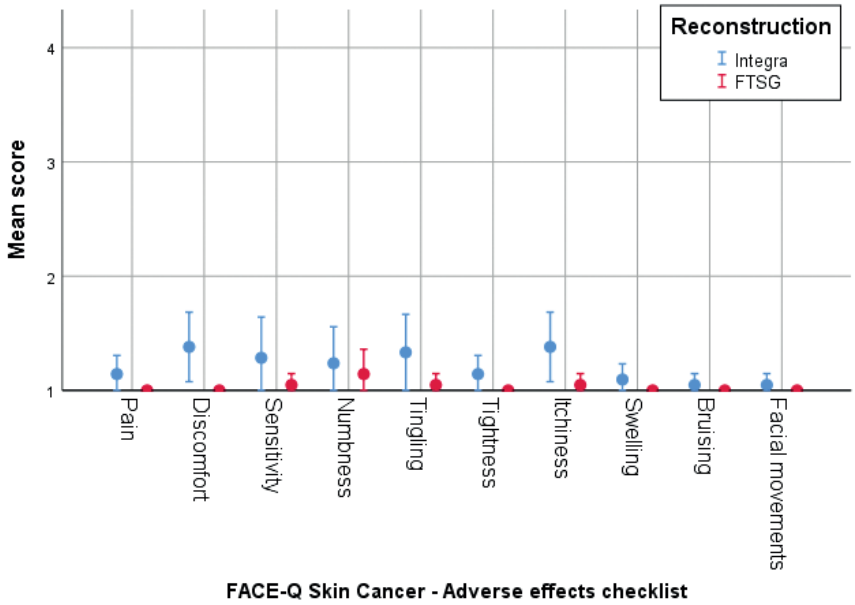


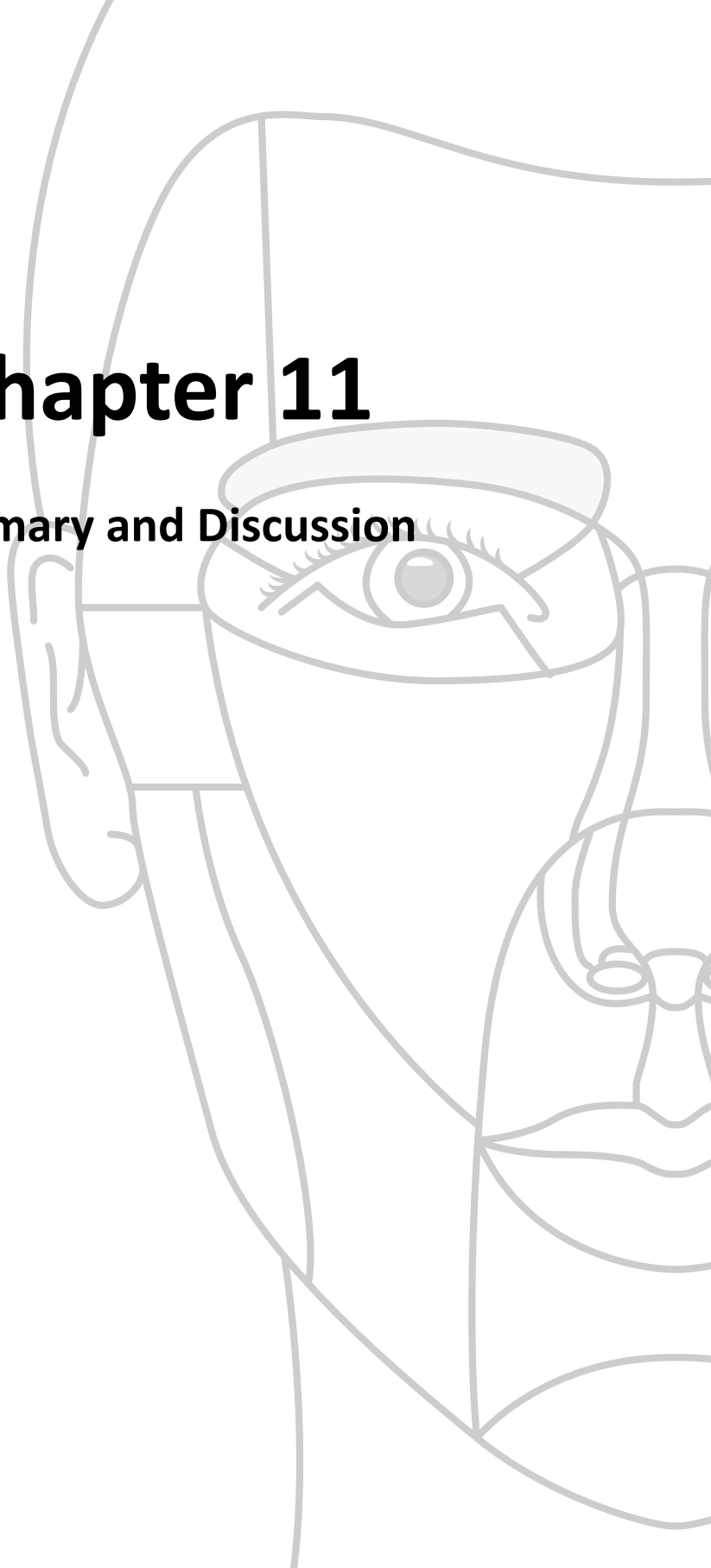
Figure 1. The mean scores for each item of the Adverse Effects checklist by reconstruction.

References

1. Capo, J. T. *et al.* The use of skin substitutes in the treatment of the hand and upper extremity. *Hand N. Y. N* **9**, 156–165 (2014).
2. Seth, A. K., Ratanshi, I., Dayan, J. H., Disa, J. J. & Mehrara, B. J. Nasal Reconstruction Using the Integra Dermal Regeneration Template. *Plast. Reconstr. Surg.* **144**, 966–970 (2019).
3. Lee, E. H., Klassen, A. F., Cano, S. J., Nehal, K. S. & Pusic, A. L. FACE-Q Skin Cancer Module for measuring patient-reported outcomes following facial skin cancer surgery. *Br. J. Dermatol.* **179**, 88–94 (2018).
4. Vaidya, T. S., Nehal, K. S., Rossi, A. M. & Lee, E. H. Patient-reported adverse effects after facial skin cancer surgery: Long-term data to inform counseling and expectations. *J. Am. Acad. Dermatol.* **81**, 1423–1425 (2019).
5. Burd, A. & Wong, P. S. Y. One-stage Integra reconstruction in head and neck defects. *J. Plast. Reconstr. Aesthetic Surg. JPRAS* **63**, 404–409 (2010).

Chapter 11

Summary and Discussion



Globally, nonmelanoma skin cancer (NMSC) is the most common type of cancer in fair-skinned Caucasians, with incidence rates rising every year.[1] Since most NMSC is located in the head and neck area and surgical treatment is the treatment of choice,[2–5] many authors have researched various reconstructive methods for surgical facial defects. This thesis aims to further improve these reconstructive methods by incorporating patient satisfaction and psychosocial distress before and after surgery while using patient-reported outcome measures (PROMs). With this information, an increase in health-related quality of life (HR-QoL) can be achieved. This thesis can also be used to counsel patients regarding preventative measurements, complications and alter their expectations. This chapter summarizes and discusses all individual articles, with specific attention to "prevention and targeted counseling" and "peri-operative care."

Prevention and targeted counseling

In **chapter 2,** a new checklist of the FACE-Q Skin Cancer Module has been described: the sun protection behavior checklist. As already known, ultraviolet radiation (UVR) is a major risk factor for skin cancer development.[6–8] Therefore, after a skin cancer diagnosis, it is crucial to advise patients to change their sun protection behavior. Patients tend to change their sun-protection habits after a skin cancer diagnosis,[9–11] but some return to their pre-diagnoses sun-protective habits after a period of time.[12–15] This may be due to low levels of perceived risk, lack of knowledge, or inconvenience.[16] Due to the importance of sun protection for preventing recurrence of skin cancer, the authors felt the inclusion of a sun protection behavior questionnaire in the FACE-Q Skin Cancer Module was especially relevant for this population.

In contrast to rating scales, each item in this checklist represents a clinically important issue.[17] Therefore, the checklist is not converted into a Rasch score, and all items are discussed separately. This checklist aims not to counsel patients with the nuances of UVR index or sunscreen volume but to see if patients are aware of the need and importance of sun-protective behavior. Therefore, questions are short and straightforward without specific patient recall. The checklist exists of 5 questions with 4 answer options. After development, the checklist was completed by 531 patients prior to their facial skin cancer surgery.

From the 531 patients, most patients reported using sun protection behavior "often" to the items. However, 3-11% of responses reported "never," notably with wearing a hat and protective clothing. Women were more likely to use sunscreen and avoid the sun, as seen in prior studies.[16,18–20] Women were also less likely to wear a hat. These findings may reflect each genders' expectations of appearance and societal pressures and indicate different areas for improvement in both genders.

In addition, patients with a prior history of skin cancer were significantly more likely to practice sun protection behaviors than patients without this prior history. Engagement in these behaviors increased with the number of skin cancers.

As seen in this study, skin cancer patients, depending on demographic and clinical variables, have different degrees of sun protection behavior practices. Although not many patients report using sun protection behavior "never," an improvement in sun protection behavior is possible. The FACE-Q Skin Cancer – Sun Protection Behavior checklist provides the physician with a clinically relevant and simple tool to help clinicians identify areas of improvement to better target educational efforts on an individual and a population base.

The previous chapter introduces the sun protection behavior checklist and describes its use in clinic prior to surgery. Since patients have an increased risk of developing new skin cancers and UVR exposure to a developing scar can cause delayed wound healing and hyperpigmentation,[21,22] it is also crucial to change sun protection behavior post-surgery. In **chapter 3**, patients' sun protection behavior was assessed prior to, three-months and one-year post-surgery. A total of 125 patients completed the checklist before and three-months after and 89 (71.2%) completed the checklist one-year after surgery. This study showed that sun protection behavior significantly increased over time, especially within the first three months post-surgery. However, further improvement is possible. Specific patient demographics showed a greater increase in sun protection behavior in patients with a history of prior facial skin cancer compared to no history. A reason could be that patients who have a history of facial skin cancer are more aware of their wound healing and risk of having new skin cancers in the future. In contrast, patients who had a defect on the ear or scalp showed decreased sun protection behavior three months post-surgery. Since these patients can not see their scars in the mirror, they may be less reminded of their post-surgical scars. Therefore, they are less aware of their prior skin cancer and forget the use of sun protection. Although patients increasingly use sun protection measures, counseling is still necessary to increase awareness of sun protection behavior and lower the risk of developing new skin cancers in the future.

In the previous chapter, the importance of counseling patients on sun protection behavior is emphasized. However, it is also essential to take into account that some patients will experience increased psychosocial distress after a skin cancer diagnosis. From the moment of diagnosis, patients will have some cancer-related worry.[23] In addition, surgery-induced scarring will be a constant physical reminder of the skin cancer, resulting in an increased level of worry about their NMSC and risk of new skin cancers. In **chapter 4**, cancer worry in patients before and after Mohs micrographic surgery (MMS) treatment for facial NMSC is analyzed with the use of

the FACE-Q Skin Cancer – Cancer Worry scale. A total of 151 patients completed the scale before and three months after their MMS. Of these, 99 (65.6%) also completed the one-year post-surgery questionnaire.

Most patients (92.7%) experienced some degree of cancer worry before surgery. These worries decreased over time. However, a lot of patients still experience levels of cancer worry after treatment. Patients without a history of prior facial NMSC showed a larger decrease in cancer worry post-surgery compared to patients with a history of NMSC. In addition, patients who did not undergo any facial surgery prior to treatment demonstrated a larger decrease in cancer worry than patients who did undergo a facial surgery procedure. Informing patients about the five-year recurrence rates and the importance of regular skin examinations and sun protection behavior might reduce some of their worries. Also, counseling and guiding patients in helping them go through the process of adapting to their facial alterations may help patients cope with visible scarring post-surgery. Although it is important to reduce certain cancer worries, some levels of cancer worry might be beneficial to motivate patients to change their sun protection behavior. This study's outcomes could offer physicians a better understanding of cancer worry before and after treatment of MMS for NMSC. Physicians can use the FACE-Q Skin Cancer – Cancer Worry scale to identify patients with higher levels of cancer worry in need of more supportive care.

While the previous chapter describes the psychosocial implication of cancer worry and its importance in the skin cancer population, recently, patients experience a new problem; COVID-19 worry. January 20, 2020, the United States reported its first case of COVID-19. By the end of March 2020, hospitals were urged to delay elective and nonurgent surgeries, resulting in a delay in the treatment of NMSC. In **chapter 5**, the impact of the COVID-19 pandemic on patient perception of their skin cancer and surgical outcomes of MMS for NMSC was evaluated during the COVID-19 pandemic compared to one year prior to the pandemic. Patients were included in the two cities most heavily hit by the first wave of the COVID-19 pandemic, Boston and New York City. A total of 143 patients completed the FACE-Q Skin Cancer - Cancer Worry scale and COVID-19 specific questions during the first wave of the COVID-19 pandemic. The control group consists of 381 patients who completed the scale during the same time period in 2019. Patients during the COVID-19 pandemic had a significant treatment delay compared to patients before the COVID-19 pandemic. Yet, no difference was observed in pre-operative tumor diameter, post-operative defect size, or reconstruction type. However, a quarter of the patients in the COVID-19 group were more worried about their skin cancer than COVID-19. Although many hospitals are trying to provide ambulatory services while managing COVID-19 surges, delays in MMS may still occur. This study shows the low impact of

a delay in NMSC treatment which could help patients cope with their worry during the ongoing COVID-19 pandemic.

Peri-operative care

Previously the importance of prevention and targeted counseling are discussed. However, by changing intra-operative care, an increase in HR-QoL can also be established. When patients' appearance is altered (e.g., by post-surgical scars), patients might experience anxiety, depression, and avoidance of social situations.[24–26] MMS can minimize the surgical defect compared to wide local excision; however, there is a chance that multiple resections are required before free margins are achieved. Therefore, both the physician and the patient can not predict the surgical defect diameter and consequently the post-surgical scar. In a recent study, an unrealistic expectation of the patient regarding scar length was seen.[27] This might result in lower satisfaction and higher psychosocial distress. In **chapter 6**, short- and long-term satisfaction was evaluated using the FACE-Q Skin Cancer Module in patients who looked at their post-surgical defect in the mirror prior to reconstruction compared to patients who did not. A total of 113 patients completed the scales prior to surgery, and 108 (95.6%) completed the one-week, 113 (100%) the three-months, and 93 (82.3%) the one-year post-operative survey. Sixty-eight patients (60.2%) looked in the mirror, 45 patients (36.8%) did not look in the mirror. Although all female patients were less satisfied with the reconstruction, similar to previous research,[28] females were significantly impacted by looking in the mirror. Higher patient satisfaction was observed when females viewed their facial skin cancer defect in the mirror prior to the reconstruction. Since female patients experience greater difficulty adapting to their facial skin cancer and value facial aesthetics more than male patients,[29,30] looking at their defect might enhance their acceptance of their post-surgical scar. In addition, patients before flap reconstruction benefitted from looking at their defect, with lower appearance-related distress observed after looking in the mirror. A reason could be that flap reconstructions can result in multiple, complex scars while patients expect a linear scar. Also, flap reconstructions often require greater tissue movement, which could result in swelling and bruising. When a patient looks at the defect, the patient could understand that a simple reconstruction might not be possible and restoration of their facial contour may require a larger surgical intervention with more extensive scarring.

While the previous chapter showed the importance of involving the patient in the peri-operative care, involving the patient in the reconstructive method could also contribute to higher satisfaction. In **chapter 7**, a national survey study was

conducted. Plastic surgeons received a picture of a patient who underwent MMS for NMSC. Participants were asked to report their first-choice treatment method for this specific defect. In addition, the patient from the picture was asked to complete the FACE-Q Skin Cancer Module before, one-week, three-months, and one-year post-reconstruction. A total of 132 members of the Dutch society of plastic surgery (Nederlandse Vereniging voor Plastische Chirurgie – NVPC) completed the survey (29.1%). An extensive range of different reconstructive options was reported. Most physicians chose a flap (97.0%), with a total of 9 different flap options. However, the patient was reconstructed with a primary closure and showed high satisfaction rates post-surgery. A simple reconstruction can often yield the best overall outcome. By taking into account the patient's expectations and discussing the various possible reconstructions, optimal patient satisfaction can be achieved. As this is a single-case survey study, not all patients are suitable for a simple reconstruction. However, this study showed that there are many different reconstructive options for one specific defect. This offers the possibility to involve the patient in the decision-making process in order to improve patient satisfaction.

While simple reconstructions are sometimes favored, the nose often requires more complex reconstructions. With its unique framework of cartilage and bone, symmetry, and limited skin laxity, deformities can easily distort nasal contour and sometimes reduce airflow. Therefore, a lot of previous authors have described different reconstructive options after acquired nasal deformities. However, no systematic review examining nasal skin reconstructions exists. In **chapter 8**, a systematic review of the literature on reconstructions of acquired nasal deformities was conducted. The most commonly used flap reconstructions were analyzed, and complications and patient outcomes were assessed. A total of 176 articles (11,370 patients, 11,442 nose reconstructions) were included. This review showed that most of the acquired nasal deformities are a result of nasal skin cancer resection. Also, many options can be considered for nasal skin reconstructions. However, although many reconstructive options exist, this review clearly shows the limitation in the literature, with almost no articles reporting patient satisfaction with the reconstruction.

Therefore, in **chapter 9**, long-term patient satisfaction was evaluated in patients following nasal skin reconstruction. A total of 128 patients from Memorial Sloan Kettering Cancer Center, New York and Catharina Hospital, Eindhoven completed the pre-operative and one-year post-operative FACE-Q Skin Cancer scales. Patients were reconstructed using a primary closure (n = 35, 27.3%), single-stage flap reconstruction (n = 71, 55.5%), or full-thickness skin graft (FTSG) (n = 22, 17.2%). Patients who underwent a primary closure were the least satisfied with their post-

operative scar. This study also showed lower scar satisfaction of patients undergoing lower nose reconstructions (nasal ala, alar rim, and tip) compared to upper nose reconstructions (nasal bridge, dorsum, and sidewall). With the lower nose being more central on the face and having a more complex contour with smaller subunits compared to the upper nose, reconstructions can easily distort the nasal contour. Distortion of nasal contour can consequently result in lower scar satisfaction. Female patients also showed overall lower long-term post-surgical scar satisfaction compared to males, as seen in previous studies.[26,31,32] In conclusion, although surgeons learn to reconstruct a surgical defect by following the reconstructive ladder, starting with a simple reconstruction (primary closure) to a more complex reconstruction (i.e., flaps or FTSG), this study suggests to rethink this ladder and consider a flap over a primary closure to optimize function and aesthetic satisfaction.

While the previous chapter showed the difficulties of nasal skin reconstructions, a new reconstructive method for nasal skin reconstructions is introduced in **chapter 10**. Although flap reconstructions show high patient satisfaction, sometimes flaps are less favored due to prior scars, poor skin quality, or patients with multiple skin cancers. Graft reconstructions can then be performed. Besides the traditional skin graft, skin substitutes are increasingly used in reconstructive surgery.[33] Integra dermal regeneration template (Integra; Integra LifeSciences, Plainsboro, N.J.) is a skin substitute that is recently used as a single-stage method for nasal defect reconstruction.[34] However, this technique is not yet compared to the traditional FTSG and patient satisfaction is not yet assessed. In this study, a total of 90 patients that received either Integra or FTSG after nasal skin cancer resection were included (Integra n=45 vs. FTSG n=45). Twenty-one patients from each group (46.7%) completed the FACE-Q Skin Cancer scales. No significant difference between Integra and FTSG in patient satisfaction was observed. However, Integra patients reported more, mostly mild, symptoms like itchiness, sensitivity, tingling, numbness, and discomfort. This suggests Integra to be a satisfactory option for some nasal skin defect reconstructions.

Limitations

The studies of this thesis have limitations. In general, the limitations of the study are related to the nature of the study design. C**hapters 2 and 10** had a cross-sectional nature, whereas **chapters 3, 4, and 6** had a prospective nature but were single-center studies. **Chapters 5 and 9** captured data from two centers but were limited by the time-points used. Chapter 5 captures patients' cancer worry at one time-point pre-operative and chapter 9 captures patients' scar satisfaction at one pre-

operative and only one post-operative time-point. **Chapter 7** was limited by the single case used.

Besides the nature of the study design, patient satisfaction is inherently difficult to measure. As patient satisfaction can be influenced by individual experience and expectations, measuring patient satisfaction on a fixed scale can be challenging. PROMs are specifically designed to quantify patients' experience and satisfaction. However, open-ended questions could gather more information for reasons why patients chose an answer on the Likert-type scale. In addition, not all patients who were invited to the studies participated; it is possible that those who did not complete the scales and checklists were less compliant or satisfied.

Future perspectives

The first part of the thesis (chapters 2-5) focuses on improving patient counseling to prevent new skin cancers, optimize patients' expectations and lower their cancer worry. These chapters show that improvement in primary and secondary prevention is needed. There have already been considerable improvements in targeted counseling for patients with other diseases (e.g., breast cancer), with patient-tailored advice and personal recommendations, sometimes even before consulting with the surgeon (e.g., mammacare). In addition, multimedia is often used to give advice and create awareness. The results of the studies in this thesis show that more multimedia attention regarding primary prevention and more tailored care for patients with skin cancer can lead to a lower incidence and better quality of care.

As for chapters 6-10, the importance of involving the patient in the decision-making process is demonstrated. By considering the location, defect size, patients' age, gender, and preferences regarding the scar and operation, a well-considered decision regarding the reconstruction can be made. More PROM data from patients after skin cancer resection and reconstruction could help physicians and patients choose the best reconstructive option for specific defects. Our research group is currently conducting a study investigating this in a multicenter setting.
I am looking forward to the future of HR-QoL in facial skin cancer patients.

References

1. Ultraviolet (UV) radiation and skin cancer. https://www.who.int/news-room/q-a-detail/ultraviolet-(uv)-radiation-and-skin-cancer.
2. de Vries, E., Louwman, M., Bastiaens, M., de Gruijl, F. & Coebergh, J. W. Rapid and Continuous Increases in Incidence Rates of Basal Cell Carcinoma in the Southeast Netherlands Since 1973. *Journal of Investigative Dermatology* **123**, 634–638 (2004).
3. Netscher, D. T. *et al.* Cutaneous Malignancies: Melanoma and Nonmelanoma Types: *Plastic and Reconstructive Surgery* **127**, 37e–56e (2011).
4. Mansouri, B. *et al.* Mohs Micrographic Surgery for the Management of Cutaneous Malignancies. *Facial Plast Surg Clin North Am* **25**, 291–301 (2017).
5. van Loo, E. *et al.* Surgical excision versus Mohs' micrographic surgery for basal cell carcinoma of the face: A randomised clinical trial with 10 year follow-up. *Eur J Cancer* **50**, 3011–3020 (2014).
6. Street, W. Cancer Facts & Figures 2020. 76 (1930).
7. Flohil, S. C., van der Leest, R. J. T., Arends, L. R., de Vries, E. & Nijsten, T. Risk of subsequent cutaneous malignancy in patients with prior keratinocyte carcinoma: a systematic review and meta-analysis. *Eur. J. Cancer* **49**, 2365–2375 (2013).
8. van der Leest, R. J. T., Flohil, S. C., Arends, L. R., de Vries, E. & Nijsten, T. Risk of subsequent cutaneous malignancy in patients with prior melanoma: a systematic review and meta-analysis. *J Eur Acad Dermatol Venereol* **29**, 1053–1062 (2015).
9. Idorn, L. W., Datta, P., Heydenreich, J., Philipsen, P. A. & Wulf, H. C. Sun behaviour after cutaneous malignant melanoma: a study based on ultraviolet radiation measurements and sun diary data. *Br. J. Dermatol.* **168**, 367–373 (2013).
10. Rhee, J. S. *et al.* Quality of Life and Sun-Protective Behavior in Patients With Skin Cancer. *Arch Otolaryngol Head Neck Surg* **130**, 141–146 (2004).
11. von Schuckmann, L. A. *et al.* Sun protection behavior after diagnosis of high-risk primary melanoma and risk of a subsequent primary. *J. Am. Acad. Dermatol.* **80**, 139-148.e4 (2019).
12. Lee, T. K., Brazier, A. S. A., Shoveller, J. A. & Gallagher, R. P. Sun-related behavior after a diagnosis of cutaneous malignant melanoma. *Melanoma Res.* **17**, 51–55 (2007).
13. Nahar, V. K. *et al.* Skin cancer prevention practices among malignant melanoma survivors: a systematic review. *J. Cancer Res. Clin. Oncol.* **142**, 1273–1283 (2016).

14. Idorn, L. W., Datta, P., Heydenreich, J., Philipsen, P. A. & Wulf, H. C. A 3-Year Follow-up of Sun Behavior in Patients With Cutaneous Malignant Melanoma. *JAMA Dermatol* **150**, 163–168 (2014).
15. Lai, Y. C. & Yew, Y. W. Sunburns and Sun-Protective Behaviors after a Diagnosis of Melanoma. *Skinmed* **16**, 379–383 (2018).
16. Nahar, V. K. *et al.* Sun-related behaviors among individuals previously diagnosed with non-melanoma skin cancer. *Indian J Dermatol Venereol Leprol* **81**, 568–575 (2015).
17. McGrail, K., Bryan, S. & Davis, J. Let's all go to the PROM: the case for routine patient-reported outcome measurement in Canadian healthcare. *Healthc Pap* **11**, 8–18; discussion 55-58 (2011).
18. Novak, C. B., Young, D. S., Lipa, J. E. & Neligan, P. C. Evaluation of sun protection behaviour in patients following excision of a skin lesion. *Can J Plast Surg* **15**, 38–40 (2007).
19. Falk, M. & Anderson, C. D. Influence of age, gender, educational level and self-estimation of skin type on sun exposure habits and readiness to increase sun protection. *Cancer Epidemiol* **37**, 127–132 (2013).
20. Santmyire, B. R., Feldman, S. R. & Fleischer, A. B. Lifestyle high-risk behaviors and demographics may predict the level of participation in sun-protection behaviors and skin cancer primary prevention in the United States: results of the 1998 National Health Interview Survey. *Cancer* **92**, 1315–1324 (2001).
21. Liu, H. *et al.* Ultraviolet B (UVB) Inhibits Skin Wound Healing by Affecting Focal Adhesion Dynamics. *Photochem Photobiol* **91**, 909–916 (2015).
22. Chadwick, S., Heath, R. & Shah, M. Abnormal pigmentation within cutaneous scars: A complication of wound healing. *Indian J Plast Surg* **45**, 403–411 (2012).
23. Zhang, J. *et al.* Patient quality of life fluctuates before and after Mohs micrographic surgery: A longitudinal assessment of the patient experience. *J Am Acad Dermatol* **78**, 1060–1067 (2018).
24. Sobanko, J. F., Sarwer, D. B., Zvargulis, Z. & Miller, C. J. Importance of physical appearance in patients with skin cancer. *Dermatol Surg* **41**, 183–188 (2015).
25. Rumsey, N. Psychosocial adjustment to skin conditions resulting in visible difference (disfigurement): What do we know? Why don't we know more? How shall we move forward? *Int J Womens Dermatol* **4**, 2–7 (2018).
26. Zhang, J. *et al.* Patient quality of life fluctuates before and after Mohs micrographic surgery: A longitudinal assessment of the patient experience. *J. Am. Acad. Dermatol.* **78**, 1060–1067 (2018).
27. Fix, W. C. *et al.* Comparison of Accuracy of Patient and Physician Scar Length Estimates Before Mohs Micrographic Surgery for Facial Skin Cancers. *JAMA Netw Open* **3**, e200725–e200725 (2020).

28. Vaidya, T. S. *et al.* Patient-reported Aesthetic Satisfaction following Facial Skin Cancer Surgery Using the FACE-Q Skin Cancer Module. *Plast Reconstr Surg Glob Open* **7**, e2423 (2019).
29. Katz, M. R., Irish, J. C., Devins, G. M., Rodin, G. M. & Gullane, P. J. Psychosocial adjustment in head and neck cancer: The impact of disfigurement, gender and social support. *Head & Neck* **25**, 103–112 (2003).
30. Koster, M. E. & Bergsma, J. Problems and coping behaviour of facial cancer patients. *Soc Sci Med* **30**, 569–578 (1990).
31. Vaidya, T. S. *et al.* Patient-reported Aesthetic Satisfaction following Facial Skin Cancer Surgery Using the FACE-Q Skin Cancer Module. *Plast Reconstr Surg Glob Open* **7**, e2423 (2019).
32. Vaidya, T. S. *et al.* Appearance-related psychosocial distress following facial skin cancer surgery using the FACE-Q Skin Cancer. *Arch. Dermatol. Res.* **311**, 691–696 (2019).
33. Capo, J. T. *et al.* The use of skin substitutes in the treatment of the hand and upper extremity. *Hand (N Y)* **9**, 156–165 (2014).
34. Seth, A. K., Ratanshi, I., Dayan, J. H., Disa, J. J. & Mehrara, B. J. Nasal Reconstruction Using the Integra Dermal Regeneration Template. *Plast. Reconstr. Surg.* **144**, 966–970 (2019).

Chapter 12

Nederlandse Samenvatting en Discussie

Voor mensen met een blanke huidskleur is niet melanome huidkanker (NMHK) wereldwijd de meest voorkomende vorm van kanker met een jaarlijks stijgende incidentie.[1] Aangezien de meeste NMHK zich in het hoofd-halsgebied bevindt en chirurgische behandeling de voorkeursbehandeling is,[2–5] is er veel onderzoek gedaan naar de verschillende reconstructieve methoden na het verwijderen van huidkanker in het gelaat. Dit proefschrift heeft tot doel deze reconstructieve methoden verder te verbeteren door patiënttevredenheid en psychosociale stress voor en na de operatie te onderzoeken met behulp van patient-gerapporteerde uitkomsten (patient-reported outcome measures - PROMs). Met deze informatie kan gezondheid gerelateerde kwaliteit van leven (health-related quality of life – HR-QoL) worden verhoogd. In dit proefschrift wordt ook aandacht besteed aan het adviseren van patiënten over preventie, verwachtingen na de operatie en complicaties. In dit hoofdstuk worden alle afzonderlijke artikelen samengevat en besproken met specifieke aandacht voor “preventie en gerichte counseling” en “peri-operatieve zorg”.

Preventie en gerichte counseling

In **hoofdstuk 2** wordt een nieuwe checklist van de FACE-Q Huidkanker Module beschreven: de checklist Beschermingsmaatregelen tegen Zon. Zoals reeds bekend, is ultraviolette straling (UVS) een belangrijke risicofactor voor de ontwikkeling van huidkanker.[6–8] Het is daarom belangrijk om patiënten na de diagnose huidkanker te adviseren om hun zonbeschermingsgedrag te veranderen. Patiënten hebben de neiging om hun zonbeschermingsgedrag direct te veranderen nadat zij de diagnose huidkanker hebben gekregen,[9–11] maar sommigen keren na verloop van tijd terug naar hun eerdere zonbeschermingsgedrag.[12–15] Dit kan komen doordat de patiënt het risico op huidkanker laag inschat, door een gebrek aan kennis of door ongemak.[16] Omdat zonbescherming het risico op een recidief kan voorkomen, waren de auteurs van mening dat een checklist over zonbescherming in de FACE-Q Huidkanker Module erg relevant is voor deze specifieke patiënten populatie.[17] In tegenstelling tot de scales van de FACE-Q Huidkanker Module vertegenwoordigt elk item in deze nieuwe checklist een klinisch belangrijke kwestie. De checklist wordt niet omgezet in een Rasch-score en alle items worden apart besproken. Deze checklist is niet bedoeld om patiënten te counselen over zonstraling of het volume van de zonnebrandcrème, maar om te zien of patiënten zich bewust zijn van de noodzaak en het belang van zonbescherming. De vragen zijn eenvoudig en kort zonder dat de patiënt zich iets specifiek hoeft te herinneren. De checklist bestaat uit 5 vragen met 4 antwoord opties. Na het ontwikkelen van de checklist werd deze ingevuld door 531 patiënten met NMHK in het gelaat voorafgaand aan hun operatie. Van de 531 patiënten gaven de meeste patiënten aan zich ‘vaak’ aan zonwerend gedrag te houden. Echter, 3-11% van de patiënten gaf bij sommige vragen

aan zich 'nooit' aan zonwerend gedrag te houden, met name met betrekking tot het dragen van een hoed en beschermende kleding. Vrouwen gebruikten vaker zonnebrandcrème en vermeden vaker de zon, wat ook blijkt uit eerdere onderzoeken.[16,18–20] Vrouwen droegen ook minder snel een hoed. Deze bevindingen weerspiegelen de verwachtingen van elk geslacht met betrekking tot het uiterlijk en maatschappelijke druk. Op dit gebied is voor mannen en voor vrouwen dus ook verbetering mogelijk. Het hebben van huidkanker in de voorgeschiedenis verhoogde ook de kans een verbetering van zonbeschermingsgedrag in vergelijking met patiënten zonder huidkanker in de voorgeschiedenis. Ook toonde dit onderzoek dat het doorgemaakt hebben van meer huidkankers in het verleden de kans op adequaat zonbeschermingsgedrag deed toenemen.

Zoals blijkt uit deze studie, hebben huidkankerpatiënten, afhankelijk van demografische en klinische variabelen, verschillende gradaties van zonbeschermingsgedrag. Hoewel niet veel patiënten aangeven zonbescherming 'nooit' te gebruiken, is verbetering van zonbescherming wel mogelijk. De FACE-Q Huidkanker – Beschermingsmaatregelen tegen Zon checklist biedt de arts een relevant en eenvoudig hulpmiddel om verbeterpunten ten aanzien van zonbescherming te identificeren en zo educatie van specifieke patiënten en patiëntengroepen te optimaliseren.

Het vorige hoofdstuk introduceert de FACE-Q Huidkanker – Beschermingsmaatregelen tegen Zon checklist en beschrijft het gebruik ervan in de kliniek voorafgaand aan de operatie. Aangezien patiënten na hun eerste huidkanker een verhoogd risico hebben op het ontwikkelen van nieuwe huidkankers en een vers litteken dat wordt blootgesteld aan UVS kan leiden tot vertraagde wondgenezing en hyperpigmentatie,[21,22] is het van belang om na de operatie het zonbeschermingsgedrag te veranderen. In **hoofdstuk 3** werd het zonbeschermingsgedrag van patiënten met behulp van de FACE-Q Huidkanker – Beschermingsmaatregelen tegen Zon checklist beoordeeld vóór, drie maanden en een jaar na de operatie. In totaal waren er 125 patiënten die de checklist vóór en drie maanden na de operatie hadden ingevuld en 89 (71,2%) patiënten die de checklist een jaar na de operatie hadden ingevuld. Deze studie toonde aan dat het zonbeschermingsgedrag na de operatie aanzienlijk toenam, vooral in de eerste drie maanden, met zeker nog ruimte voor verdere verbetering. Specifieke demografische gegevens van patiënten lieten een grotere toename van het zonbeschermingsgedrag zien bij patiënten met een voorgeschiedenis van eerdere huidkanker in het gelaat vergeleken met patiënten zonder voorgeschiedenis. Een reden zou kunnen zijn dat patiënten met een voorgeschiedenis van huidkanker in het gelaat zich meer bewust zijn van hun wondgenezing en het risico op nieuwe huidkanker in de toekomst. Daarentegen vertoonden patiënten met een defect aan het oor of de (behaarde) hoofdhuid drie maanden na de operatie juist een daling

in hun zonbeschermingsgedrag. Een reden hiervoor kan zijn dat deze patiënten hun littekens niet in de spiegel kunnen zien en dus ze mogelijk minder herinnerd worden aan hun postoperatieve littekens. Ze zijn zich daarom minder bewust van hun eerdere huidkanker en vergeten het gebruik van zonbescherming. Hoewel patiënten steeds vaker zonbeschermingsmaatregelen nemen, is counseling nodig om zonbeschermingsgedrag te vergroten en het risico op het ontwikkelen van nieuwe huidkankers in de toekomst te verkleinen.

In het vorige hoofdstuk wordt het belang van counselen van de patiënten over zonbescherming benadrukt. Het is echter ook van belang voor de behandelaar om zich te realiseren dat sommige patiënten psychosociale problemen zullen ervaren na de diagnose huidkanker. Patiënten hebben vanaf het moment van de diagnose huidkanker zorgen over kanker.[23] Bovendien zullen de door operaties veroorzaakte littekens een constante fysieke herinnering aan de huidkanker zijn, wat resulteert in meer bezorgdheid over hun NMHK en het risico op nieuwe huidkanker in de toekomst. In **hoofdstuk 4** wordt de bezorgdheid over de kanker bij patiënten voor en na Mohs micrografische chirurgie (MMS) voor NMHK in het gelaat geanalyseerd met behulp van de FACE-Q Huidkanker – Zorgen over Kanker schaal. In totaal voltooiden 151 patiënten de vragenlijst vóór en drie maanden na MMS. Van hen vulden 99 (65,6%) ook de vragenlijst een jaar na de operatie in.

Vóór de operatie maakten de meeste patiënten (92,7%) zich zorgen over kanker. Deze zorgen namen in de loop van de tijd af. Veel patiënten ervaarden echter na de behandeling nog steeds zorgen over kanker. Patiënten zonder een voorgeschiedenis van eerdere NMHK in het gelaat vertoonden een grotere afname van zorgen over kanker na de operatie in vergelijking met patiënten met een voorgeschiedenis van NMHK. Bovendien vertoonden patiënten die in de voorgeschiedenis geen eerdere aangezichtsoperaties hebben ondergaan een grotere daling in hun zorgen over kanker in vergelijking met patiënten die wel eerder een aangezichtsoperatie hebben ondergaan. Door patiënten te informeren over de kans op een recidief en het belang van regelmatig huidonderzoek en zonbescherming, zou een deel van hun zorgen kunnen worden weggenomen. Ook kan het adviseren en begeleiden van patiënten na de operatie, patiënten helpen omgaan met hun zichtbare littekens. Hoewel het belangrijk is om bepaalde zorgen over kanker te verminderen, kan enige bezorgdheid over kanker gunstig zijn om patiënten te motiveren hun zonbeschermingsgedrag te veranderen. De resultaten van deze studie zouden artsen meer inzicht kunnen bieden met betrekking tot de zorgen over kanker vóór en na de behandeling van MMS voor NMHK. Artsen kunnen de FACE-Q Huidkanker – Zorgen over Kanker schaal gebruiken om patiënten die zich meer zorgen maken over kanker te identificeren en dit gebruiken om zo nodig meer ondersteunende zorg te bieden.

Terwijl in het vorige hoofdstuk de psychosociale implicatie van bezorgdheid over kanker en het belang ervan voor de huidkanker populatie is beschreven, is er recentelijk voor veel patiënten een nieuw probleem ontstaan; COVID-19 zorg. Op 20 januari 2020 meldden de Verenigde Staten hun eerste geval van COVID-19 en tegen eind maart 2020 werden ziekenhuizen aangespoord om electieve en niet-urgente operaties uit te stellen, wat resulteerde in een vertraging in de behandeling van NMHK. In **hoofdstuk 5** werd de impact van de COVID-19-pandemie op de perceptie van de patiënt over hun huidkanker en de chirurgische resultaten van MMS voor NMHK geëvalueerd tijdens de COVID-19-pandemie in vergelijking met één jaar voorafgaand aan de pandemie. Patiënten werden geïncludeerd in de twee steden die het zwaarst werden getroffen door de eerste golf van de COVID-19-pandemie, Boston en New York City. Tijdens de eerste golf van de COVID-19-pandemie hebben in totaal 143 patiënten de FACE-Q Huidkanker – Zorgen over Kanker schaal en COVID-19-specifieke vragen ingevuld. De controlegroep bestaat uit 381 patiënten die de FACE-Q Huidkanker – Zorgen over Kanker schaal in dezelfde periode in 2019 hebben ingevuld. Tijdens de COVID-19-pandemie ontstond er een aanzienlijke vertraging in behandeling in vergelijking met de situatie vóór de COVID-19-pandemie. Toch werd er geen verschil waargenomen in preoperatieve tumordiameter, postoperatieve defectgrootte en reconstructietype. Een kwart van de patiënten in de COVID-19-groep maakte zich echter meer zorgen over hun huidkanker dan over het risico op COVID-19. Hoewel veel ziekenhuizen poliklinische zorg proberen te verlenen terwijl ze COVID-19-pieken proberen te beheersen, kunnen er nog steeds vertragingen in MMS optreden. Deze studie toont aan dat er weinig impact is op de resultaten bij een vertraging van NMHK-behandeling. Deze resultaten kunnen patiënten helpen omgaan met hun zorgen tijdens de aanhoudende COVID-19-pandemie.

Peri-operatieve zorg

Eerder werd het belang van preventie en gerichte counseling besproken. Door de intraoperatieve zorg te veranderen, kan mogelijk ook toename van de HR-QoL worden bereikt. Wanneer het uiterlijk van een patiënt veranderd (bijv. door postoperatieve littekens), kan de patiënt zich angstig of depressief voelen en een sociale fobie ervaren.[24–26] MMS kan het chirurgische defect minimaliseren in vergelijking met een lokale excisie; Er is echter een kans dat er meerdere resecties nodig zijn voordat vrije marges worden bereikt. Daarom kunnen zowel de arts als de patiënt de diameter van het chirurgische defect en dus het postoperatieve litteken niet voorspellen. In een recent onderzoek werd een onrealistische verwachting van de patiënt gezien met betrekking tot de verwachte lengte van het litteken.[27] Dit zou kunnen resulteren in een lagere patiënt tevredenheid en meer psychosociaal leed. In **hoofdstuk 6** werd de tevredenheid met behulp van de FACE-Q Huidkanker Module

op korte en lange termijn geëvalueerd bij patiënten die vóór de reconstructie naar het huidkanker defect keken in de spiegel, in vergelijking met patiënten die niet naar het defect keken. In totaal voltooiden 113 patiënten de vragenlijst voorafgaand aan de operatie, 108 (95,6%) één week na de operatie, 113 (100%) drie maanden en 93 (82,3%) een jaar na de operatie. Achtenzestig patiënten (60,2%) keken in de spiegel, 45 patiënten (36,8%) keken niet in de spiegel. Vrouwelijke patiënten waren minder tevreden met de reconstructie vergeleken met mannelijke patiënten, ook aangetoond in eerder onderzoek.[28] Echter, een hogere patiënttevredenheid werd waargenomen wanneer vrouwen voorafgaand aan de reconstructie hun huidkankerdefect in de spiegel bekeken. Aangezien vrouwelijke patiënten meer moeite hebben om zich aan te passen aan hun litteken en zij esthetiek meer waarderen dan mannelijke patiënten,[29,30] kan het bekijken van hun defect zorgen voor betere acceptatie van het postoperatieve litteken. Patiënten, waarbij een flap reconstructie nodig was, hadden ook baat bij het kijken naar hun huidkanker defect, met als resultaat minder uiterlijk gerelateerde psychosociaal leed na het kijken in de spiegel. Een reden zou kunnen zijn dat flap reconstructies kunnen leiden tot meerdere en vaak complexe littekens terwijl de patiënt een lineair litteken verwacht. Ook vereisen flap reconstructies vaak een grotere weefselbeweging, wat kan leiden tot zwelling en hematoomvorming. Wanneer een patiënt naar het defect kijkt, kan de patiënt begrijpen dat een eenvoudige reconstructie niet mogelijk is en dat het herstel van de gezichtscontour een grotere chirurgische ingreep met meer littekens vereist.

Terwijl in het vorige hoofdstuk het belang werd aangetoond van het betrekken van de patiënt tijdens de peri-operatieve zorg, zou het betrekken van de patiënt bij de reconstructieve methode ook kunnen bijdragen aan een hogere tevredenheid. In **hoofdstuk 7** is een landelijke enquête uitgevoerd waarbij plastisch chirurgen een foto ontvingen van een patiënt die MMS voor NMHK onderging. Aan de deelnemers werd gevraagd om hun behandelmethode van dit specifieke defect te geven. Bovendien werd de patiënt op de foto gevraagd om de FACE-Q Huidkanker Module in te vullen vóór, een week, drie maanden en een jaar na de reconstructie. In totaal hebben 132 leden van de Nederlandse Vereniging voor Plastische Chirurgie (NVPC) deelgenomen aan het onderzoek (29,1%). De leden van de NVPC gaven een uitgebreide reeks van verschillende reconstructieve opties. De meeste artsen kozen voor een flap (97,0%), met in totaal 9 verschillende flap opties. Het defect van de patiënt werd echter primair gesloten waarbij de patiënt een hoge mate van tevredenheid na de operatie aangaf. Het beste algehele resultaat kan vaak al worden behaald door een simpele reconstructie. Door rekening te houden met de verwachtingen van de patiënt en de verschillende mogelijke reconstructies te bespreken kan een optimale patiënt tevredenheid worden behaald. De auteurs

begrijpen dat niet alle patiënten geschikt zijn voor een eenvoudige reconstructie en dit een onderzoek betreft met slechts één casus. Deze studie toont echter aan dat er veel verschillende opties bestaan voor het sluiten van een specifiek defect. Dit biedt de mogelijkheid de patiënt te betrekken bij het besluitvormingsproces om zo de patiënttevredenheid te verbeteren.

Hoewel een eenvoudige reconstructie soms de voorkeur geniet, vereist de neus vaak complexere reconstructies. Met zijn unieke structuur van kraakbeen en botten, symmetrie en beperkte huidlaxiteit, kunnen misvormingen gemakkelijk de neuscontour aantasten en soms zelfs de luchtstroom verminderen. Daarom is er veel onderzoek verricht naar verschillende reconstructieve methodes na verworven nasale misvormingen. Er bestaat echter geen systematische review waarin de verschillende huidreconstructies van de neus worden onderzocht en vergeleken. **Hoofdstuk 8** is een systematische review van de literatuur over de verschillende reconstructies van verworven nasale misvormingen. De meest gebruikte flap reconstructies werden geanalyseerd en complicaties en patiënttevredenheid werden beoordeeld. In totaal werden 176 artikelen (11.370 patiënten, 11.442 neusreconstructies) geïncludeerd. Deze review toont aan dat de meeste verworven nasale misvormingen het gevolg zijn van huidkanker resecties. Ook toont deze review aan dat er veel verschillende reconstructieve methodes zijn voor het sluiten van de huid van de neus. Hoewel er veel reconstructieve opties beschreven zijn in de literatuur, zijn er bijna geen artikelen die de tevredenheid van de patiënt over de reconstructie rapporteren.

Daarom werd in **hoofdstuk 9** de patiënttevredenheid op de lange termijn geëvalueerd bij patiënten na een huidreconstructie ten gevolge van huidkanker op de neus. In totaal vulden 128 patiënten van het Memorial Sloan Kettering Cancer Center, New York en het Catharina Ziekenhuis, Eindhoven de preoperatieve en eenjarige postoperatieve FACE-Q Huidkanker vragenlijsten in. De defecten van de patiënten werden primair (n = 35, 27,3%), met een flap reconstructie (n = 71, 55,5%) of met een huidtransplantaat van volledige dikte (full-thickness skin graft - FTSG) (n = 22, 17,2%) gesloten. Patiënten waarbij het defect primair werd gesloten, waren het minst tevreden over hun postoperatieve litteken. Deze studie toonde ook een lagere littekentevredenheid aan bij patiënten die een reconstructie ondergingen aan het onderste gedeelte van de neus (neusvleugels, neus rand en neus tip) in vergelijking met het bovenste gedeelte van de neus (neusbrug, dorsum en de zijwanden). Omdat het onderste gedeelte van de neus meer centraal in het gezicht ligt en een complexere contour heeft met kleinere subeenheden in vergelijking met het bovenste gedeelte van de neus, kunnen reconstructies de nasale contour gemakkelijk vervormen. Vervorming van de neuscontour kan resulteren in een

verminderde littekentevredenheid. Vrouwelijke patiënten vertoonden over het algemeen ook een lagere lange termijn tevredenheid met hun postoperatieve littekens in vergelijking met mannen. Deze bevinding wordt ondersteund door eerdere studies.[26,31,32] Hoewel artsen leren een chirurgisch defect te reconstrueren met behulp van de reconstructieve ladder, beginnend met een eenvoudige reconstructie (primaire sluiting) tot een meer complexe reconstructie (bijv. flaps of FTSG), geeft deze studie argumenten aan om de reconstructieve ladder te heroverwegen en vaker te kiezen voor een flap boven een primaire sluiting, om zo de functie en esthetiek en daarmee de patiënt tevredenheid te optimaliseren.

Terwijl in het vorige hoofdstuk de valkuilen omtrent huidreconstructies van de neus zijn besproken, wordt in **hoofdstuk 10** een nieuwe reconstructiemethode voor nasale huiddefecten geïntroduceerd. Ondanks dat flap reconstructies hoge patiënt tevredenheid laten zien, is dit chirurgisch technisch niet altijd mogelijk, bijvoorbeeld door eerdere littekens, slechte kwaliteit van de huid of patiënten met meerdere huidkankers op of rondom de neus. In dat geval kan een huidtransplantaat worden overwogen. Naast de traditionele huidtransplantaten worden huidvervangers steeds vaker gebruikt bij reconstructieve chirurgie.[33] Integra dermal regeneration template (Integra; Integra LifeSciences, Plainsboro, NJ) is een huidvervanger die sinds kort als een eenmalige reconstructieve methode wordt gebruikt voor neusdefecten.[34] Integra is echter nog niet eerder vergeleken met de traditionele FTSG, daarnaast is de patiënttevredenheid ook nog niet eerder beoordeeld. In deze studie werden in totaal 90 patiënten geïncludeerd die een reconstructie middels Integra of FTSG na resectie van nasale huidkanker ondergingen (Integra n = 45 vs. FTSG n = 45). Eenentwintig patiënten uit elke groep (46,7%) vulden de FACE-Q Huidkanker vragenlijsten in. Er werd geen significant verschil waargenomen tussen Integra en FTSG met betrekking tot patiënttevredenheid. Integra-patiënten meldden echter meer, vooral milde, symptomen van jeuk, gevoeligheid, tintelingen, gevoelloosheid en ongemak. Dit suggereert dat Integra in bepaalde gevallen een goede optie is voor reconstructies van nasale huiddefecten.

Limitaties

De studies van dit proefschrift hebben limitaties. Over het algemeen hangen de beperkingen van de studies samen met de aard van de studieopzet. Zowel **hoofdstuk 2 als hoofdstuk 10** hadden een cross-sectioneel karakter, terwijl **hoofdstuk 3, 4 en 6** een prospectief karakter hadden maar single-center studies waren. **Hoofdstuk 5 en 9** verzamelden gegevens van twee centra, maar waren beperkt door de tijdpunten, waarbij hoofdstuk 5 slechts één preoperatief tijdspunt had en hoofdstuk 9 één

preoperatief en slechts één postoperatief tijdspunt had. **Hoofdstuk 7** werd beperkt door het gebruik van slechts één casus.

Naast de aard van de onderzoeksopzet is de patiënttevredenheid erg lastig te meten aangezien de tevredenheid van de patiënt kan worden beïnvloed door individuele ervaringen en verwachtingen. Het meten van de patiënttevredenheid met een vaste schaal kan daardoor een uitdaging zijn.

PROMs zijn specifiek ontworpen om de ervaring en tevredenheid van patiënten te kwantificeren. Open vragen zouden echter meer informatie kunnen geven over de redenen waarom patiënten een bepaald antwoord op de Likert-schaal kozen. Bovendien namen niet alle patiënten die waren uitgenodigd voor de onderzoeken deel aan het onderzoek, daardoor is het mogelijk dat degenen die de schalen en checklists niet hebben ingevuld, minder meegaand of tevreden waren.

Toekomstperspectief

Het eerste deel van het proefschrift (hoofdstukken 2-5) is gericht op de verbetering van counseling van patiënten, het optimaliseren van verwachtingen van patiënten en het verminderen van zorgen over kanker. Deze hoofdstukken laten zien dat er winst te behalen is in zowel primaire als secondaire preventie. Bij andere medische aandoeningen (bijv, borstkanker) zijn er reeds aanzienlijke verbeteringen bereikt met betrekking tot gerichte counseling (bijv, mammacare), waarbij advies op maat en persoonlijke aanbevelingen worden gegeven, soms zelfs vóór overleg met de chirurg, hierbij wordt ook multimedia gebruikt voor het ondersteunen van de adviezen en het creëren van awareness. De resultaten van de studies in dit proefschrift pleiten voor meer multimedia aandacht voor primaire preventie en gerichte zorg voor patiënten met huidkanker, wat kan leiden tot een lagere incidentie en een betere kwaliteit van zorg.

In de hoofdstukken 6-10, wordt het belang van het betrekken van de patiënt bij het besluitvormingsproces aangetoond. Door rekening te houden met de locatie, de grootte van het defect, de leeftijd, het geslacht en de voorkeuren van de patiënt met betrekking tot zowel het litteken als de operatie, kan een weloverwogen beslissing over de reconstructie worden genomen. Meer PROM data van patiënten die een reconstructie hebben ondergaan na resectie van huidkanker in het gelaat, kunnen artsen en patiënten helpen bij het kiezen van de beste reconstructieve optie. De studie met deze vraagstelling wordt momenteel door onze onderzoeksgroep in een multicenter setting uitgevoerd.
Ik kijk uit naar de toekomst van HR-QoL voor patiënten met huidkanker in het gelaat.

Referenties

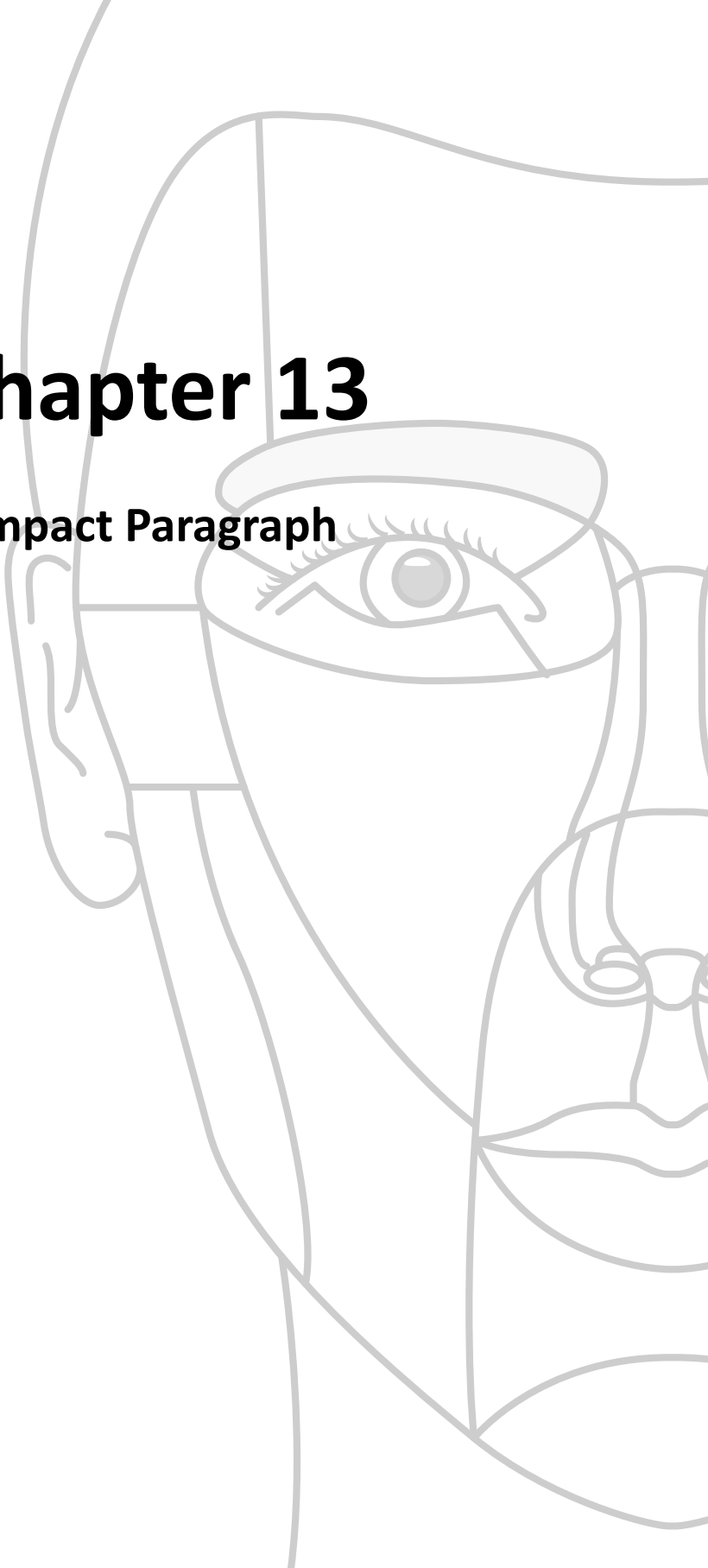
1. Ultraviolet (UV) radiation and skin cancer. https://www.who.int/news-room/q-a-detail/ultraviolet-(uv)-radiation-and-skin-cancer.
2. de Vries, E., Louwman, M., Bastiaens, M., de Gruijl, F. & Coebergh, J. W. Rapid and Continuous Increases in Incidence Rates of Basal Cell Carcinoma in the Southeast Netherlands Since 1973. *Journal of Investigative Dermatology* **123**, 634–638 (2004).
3. Netscher, D. T. *et al.* Cutaneous Malignancies: Melanoma and Nonmelanoma Types: *Plastic and Reconstructive Surgery* **127**, 37e–56e (2011).
4. Mansouri, B. *et al.* Mohs Micrographic Surgery for the Management of Cutaneous Malignancies. *Facial Plast Surg Clin North Am* **25**, 291–301 (2017).
5. van Loo, E. *et al.* Surgical excision versus Mohs' micrographic surgery for basal cell carcinoma of the face: A randomised clinical trial with 10 year follow-up. *Eur J Cancer* **50**, 3011–3020 (2014).
6. Street, W. Cancer Facts & Figures 2020. 76 (1930).
7. Flohil, S. C., van der Leest, R. J. T., Arends, L. R., de Vries, E. & Nijsten, T. Risk of subsequent cutaneous malignancy in patients with prior keratinocyte carcinoma: a systematic review and meta-analysis. *Eur. J. Cancer* **49**, 2365–2375 (2013).
8. van der Leest, R. J. T., Flohil, S. C., Arends, L. R., de Vries, E. & Nijsten, T. Risk of subsequent cutaneous malignancy in patients with prior melanoma: a systematic review and meta-analysis. *J Eur Acad Dermatol Venereol* **29**, 1053–1062 (2015).
9. Idorn, L. W., Datta, P., Heydenreich, J., Philipsen, P. A. & Wulf, H. C. Sun behaviour after cutaneous malignant melanoma: a study based on ultraviolet radiation measurements and sun diary data. *Br. J. Dermatol.* **168**, 367–373 (2013).
10. Rhee, J. S. *et al.* Quality of Life and Sun-Protective Behavior in Patients With Skin Cancer. *Arch Otolaryngol Head Neck Surg* **130**, 141–146 (2004).
11. von Schuckmann, L. A. *et al.* Sun protection behavior after diagnosis of high-risk primary melanoma and risk of a subsequent primary. *J. Am. Acad. Dermatol.* **80**, 139-148.e4 (2019).
12. Lee, T. K., Brazier, A. S. A., Shoveller, J. A. & Gallagher, R. P. Sun-related behavior after a diagnosis of cutaneous malignant melanoma. *Melanoma Res.* **17**, 51–55 (2007).
13. Nahar, V. K. *et al.* Skin cancer prevention practices among malignant melanoma survivors: a systematic review. *J. Cancer Res. Clin. Oncol.* **142**, 1273–1283 (2016).

14. Idorn, L. W., Datta, P., Heydenreich, J., Philipsen, P. A. & Wulf, H. C. A 3-Year Follow-up of Sun Behavior in Patients With Cutaneous Malignant Melanoma. *JAMA Dermatol* **150**, 163–168 (2014).
15. Lai, Y. C. & Yew, Y. W. Sunburns and Sun-Protective Behaviors after a Diagnosis of Melanoma. *Skinmed* **16**, 379–383 (2018).
16. Nahar, V. K. *et al.* Sun-related behaviors among individuals previously diagnosed with non-melanoma skin cancer. *Indian J Dermatol Venereol Leprol* **81**, 568–575 (2015).
17. McGrail, K., Bryan, S. & Davis, J. Let's all go to the PROM: the case for routine patient-reported outcome measurement in Canadian healthcare. *Healthc Pap* **11**, 8–18; discussion 55-58 (2011).
18. Novak, C. B., Young, D. S., Lipa, J. E. & Neligan, P. C. Evaluation of sun protection behaviour in patients following excision of a skin lesion. *Can J Plast Surg* **15**, 38–40 (2007).
19. Falk, M. & Anderson, C. D. Influence of age, gender, educational level and self-estimation of skin type on sun exposure habits and readiness to increase sun protection. *Cancer Epidemiol* **37**, 127–132 (2013).
20. Santmyire, B. R., Feldman, S. R. & Fleischer, A. B. Lifestyle high-risk behaviors and demographics may predict the level of participation in sun-protection behaviors and skin cancer primary prevention in the United States: results of the 1998 National Health Interview Survey. *Cancer* **92**, 1315–1324 (2001).
21. Liu, H. *et al.* Ultraviolet B (UVB) Inhibits Skin Wound Healing by Affecting Focal Adhesion Dynamics. *Photochem Photobiol* **91**, 909–916 (2015).
22. Chadwick, S., Heath, R. & Shah, M. Abnormal pigmentation within cutaneous scars: A complication of wound healing. *Indian J Plast Surg* **45**, 403–411 (2012).
23. Zhang, J. *et al.* Patient quality of life fluctuates before and after Mohs micrographic surgery: A longitudinal assessment of the patient experience. *J Am Acad Dermatol* **78**, 1060–1067 (2018).
24. Sobanko, J. F., Sarwer, D. B., Zvargulis, Z. & Miller, C. J. Importance of physical appearance in patients with skin cancer. *Dermatol Surg* **41**, 183–188 (2015).
25. Rumsey, N. Psychosocial adjustment to skin conditions resulting in visible difference (disfigurement): What do we know? Why don't we know more? How shall we move forward? *Int J Womens Dermatol* **4**, 2–7 (2018).
26. Zhang, J. *et al.* Patient quality of life fluctuates before and after Mohs micrographic surgery: A longitudinal assessment of the patient experience. *J. Am. Acad. Dermatol.* **78**, 1060–1067 (2018).
27. Fix, W. C. *et al.* Comparison of Accuracy of Patient and Physician Scar Length Estimates Before Mohs Micrographic Surgery for Facial Skin Cancers. *JAMA Netw Open* **3**, e200725–e200725 (2020).

28. Vaidya, T. S. *et al.* Patient-reported Aesthetic Satisfaction following Facial Skin Cancer Surgery Using the FACE-Q Skin Cancer Module. *Plast Reconstr Surg Glob Open* **7**, e2423 (2019).
29. Katz, M. R., Irish, J. C., Devins, G. M., Rodin, G. M. & Gullane, P. J. Psychosocial adjustment in head and neck cancer: The impact of disfigurement, gender and social support. *Head & Neck* **25**, 103–112 (2003).
30. Koster, M. E. & Bergsma, J. Problems and coping behaviour of facial cancer patients. *Soc Sci Med* **30**, 569–578 (1990).
31. Vaidya, T. S. *et al.* Patient-reported Aesthetic Satisfaction following Facial Skin Cancer Surgery Using the FACE-Q Skin Cancer Module. *Plast Reconstr Surg Glob Open* **7**, e2423 (2019).
32. Vaidya, T. S. *et al.* Appearance-related psychosocial distress following facial skin cancer surgery using the FACE-Q Skin Cancer. *Arch. Dermatol. Res.* **311**, 691–696 (2019).
33. Capo, J. T. *et al.* The use of skin substitutes in the treatment of the hand and upper extremity. *Hand (N Y)* **9**, 156–165 (2014).
34. Seth, A. K., Ratanshi, I., Dayan, J. H., Disa, J. J. & Mehrara, B. J. Nasal Reconstruction Using the Integra Dermal Regeneration Template. *Plast. Reconstr. Surg.* **144**, 966–970 (2019).

Chapter 13

Impact Paragraph



This chapter aims to reflect on the social impact and future implementations of this thesis. As nonmelanoma skin cancer (NMSC) is the most diagnosed cancer in fair-skinned Caucasians globally, and the incidence rate is still rising yearly,[1] increased attention to preventative and therapeutic measures is of the utmost importance. With surgical excision still being the first choice treatment, yearly over 1 million people need surgical treatment for NMSC.[2] This study mainly seeks to optimize patients satisfaction and expectations following NMSC resection. Therefore, the studies' findings may impact the health-related quality of life (HR-QoL) of many patients around the world.

The first part of the thesis focuses on the best way to counsel patients with NMSC before and after surgical treatment. The estimated 3-year risk of patients having a new NMSC after being treated with NMSC lies between 18-44% and is shown to rise according to the number of prior occurrences in the medical history.[3] In addition, a proportion of patients, after skin cancer treatment, will return to their pre-diagnosis habits.[4–7] By counseling patients on skin cancer behavior, patients might use more sun protection, and therefore fewer patients will have new skin cancer in the future. Also, patients will be more aware of the risk of getting new skin cancers and consequently visit the doctor when they notice suspected lesions.

A study in 2019 from Canada showed that the mean cost per person for facial skin cancer was $425.27. For multiple episodes, the costs were $773.33.[8] Costs were calculated purely by outpatient expenses and treatment with wide local excision, meaning all costs were direct expenses (treatment costs), and expenses might double when using Mohs micrographic surgery as a treatment. During their observation period, their overall costs grew by 12.08% (2004, $527,458.76; 2008, $845,954.98). However, also indirect costs like time away from work seeking medical care, morbidity costs, home production losses associated with morbidity and premature mortality, and intangible costs (HR-QoL costs) need to be considered.[9] In another study in Canada, the total indirect costs were estimated at $1.1 million ($401 per case) for BCC and $7.5 million ($4,379 per case) for SCC. The estimated intangible costs, using a value of $50,000 per Quality-Adjusted Life-Years (QALY), were $0.6 million ($202 per case) for BCC and $5.1 million (2,978 per case) for SCC.[9] Since ultraviolet radiation (UVR) exposure is the leading cause of BCC and SCC,[10] counseling patients on sun protection behavior can decrease the chance of new skin cancers and therefore decrease direct and indirect costs. With estimated annual expenses between $1,028 and $8,130 and a yearly increasing NMSC incidence rate of 3,3 – 11,6%,[11] counseling patients could save millions of dollars worldwide and could increase their HR-QoL.

Cancer worry levels were another aspect that was assessed throughout this thesis. Cancer worry over time could help doctors identify patients or patient groups that need targeted counseling. This could help patients cope with their cancer worry and help the physician during consultation. In the future, when using the FACE-Q Skin Cancer – Cancer Worry scale in clinical care at multiple time-points, patients with extreme cancer worry can be flagged to expedite follow-up visits. Consequently, some follow-up visits can also be reduced without decreasing the quality of life of the patients.

The last part of the thesis shows the importance of patient-reported outcome measures (PROMs) in facial skin cancer surgery and the importance of involving the patient in the decision-making process. As shared decision-making becomes a crucial part of 21st-century medicine, patients with facial NMSC have to be able to participate in the decision-making process. By involving the patient in the decision-making process, patients feel more aware of their skin cancer and their post-operative scar, increasing patient satisfaction and, therefore, HR-QoL. Since multiple reconstructive methods exist after skin cancer resection, explaining the patient's different reconstructive options can be difficult. Patients need to decide an option based on the explanation given by the physician. However, some patients would like to know esthetic outcomes or learn more about what curtain simple or complex reconstructions entail. More patient-centered information can be collected by capturing PROM data, which could help patients with their decision. With more PROM data, the physician can guide patients with specific demographics by using data from other patients with the same demographics. Consequently, patients have more guidance for choosing the best reconstructive method. This is the first step to a larger database collecting PROM data from skin cancer patients with different demographics.

Throughout this thesis, the FACE-Q Skin Cancer Module is used. Memorial Sloan Kettering Cancer Center owns the FACE-Q Skin Cancer Module; therefore, a license is needed to use this module. A license for this module for clinical care and research can be requested at *www.qportfolio.org* without any additional costs.

References

1. Ultraviolet (UV) radiation and skin cancer. https://www.who.int/news-room/q-a-detail/ultraviolet-(uv)-radiation-and-skin-cancer.
2. 17-Non-melanoma-skin-cancer-fact-sheet.pdf.
3. Marcil, I. & Stern, R. S. Risk of Developing a Subsequent Nonmelanoma Skin Cancer in Patients With a History of Nonmelanoma Skin Cancer: A Critical Review of the Literature and Meta-analysis. *Arch. Dermatol.* **136**, 1524–1530 (2000).
4. Lee, T. K., Brazier, A. S. A., Shoveller, J. A. & Gallagher, R. P. Sun-related behavior after a diagnosis of cutaneous malignant melanoma. *Melanoma Res.* **17**, 51–55 (2007).
5. Nahar, V. K. *et al.* Skin cancer prevention practices among malignant melanoma survivors: a systematic review. *J. Cancer Res. Clin. Oncol.* **142**, 1273–1283 (2016).
6. Idorn, L. W., Datta, P., Heydenreich, J., Philipsen, P. A. & Wulf, H. C. A 3-Year Follow-up of Sun Behavior in Patients With Cutaneous Malignant Melanoma. *JAMA Dermatol.* **150**, 163–168 (2014).
7. Lai, Y. C. & Yew, Y. W. Sunburns and Sun-Protective Behaviors after a Diagnosis of Melanoma. *Skinmed* **16**, 379–383 (2018).
8. Tran, D. A., Coronado, A. C., Sarker, S. & Alvi, R. Estimating the health care costs of non-melanoma skin cancer in Saskatchewan using physician billing data. *Curr. Oncol.* **26**, 114–118 (2019).
9. Mofidi, A. *et al.* The economic burden of occupational non-melanoma skin cancer due to solar radiation. *J. Occup. Environ. Hyg.* **15**, 481–491 (2018).
10. Armstrong, B. K. & Kricker, A. The epidemiology of UV induced skin cancer. *J. Photochem. Photobiol. B* **63**, 8–18 (2001).
11. Rudolph, C., Schnoor, M., Eisemann, N. & Katalinic, A. Incidence trends of nonmelanoma skin cancer in Germany from 1998 to 2010. *J. Dtsch. Dermatol. Ges. J. Ger. Soc. Dermatol. JDDG* **13**, 788–797 (2015).

Chapter 14

Acknowledgements – Dankwoord
Curriculum Vitae

Acknowledgements – Dankwoord

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"Gratitude can transform common days into thanksgiving, turn routine jobs into joy and change ordinary opportunities into blessings."
– William Arthur Ward

Curriculum Vitae

Inge Veldhuizen was born on the 6th of October 1994 in Brunssum, the Netherlands.
After graduating from high school at Dr. Knippenbergcollege in 2013, she started medical school at Maastricht University in Maastricht. Before she began her rotations, she went to Tanzania in Africa to work at St. Kizito hospital. She performed her research internship as well as her clinical internship at the Plastic Surgery department of the Catharina Hospital. Afterward, she completed a clinical internship at the Plastic Surgery department of Maastricht UMC+. She obtained her medical degree in 2019.

In January 2020, she went to New York to work as a full-time Ph.D.-student at Memorial Sloan Kettering Cancer Center for 1 year under the supervision of prof. dr. R.R.W.J. van der Hulst (Maastricht UMC+), dr. M.M. Hoogbergen (Catharina hospital), and dr. E.L. Lee (Memorial Sloan Kettering Cancer Center). This year, she finished multiple articles, started a large multicenter study, helped organize an international conference, and started supervising multiple students writing articles. She is currently working as a resident not in training (ANIOS) at the Department of Plastic Surgery of Slingeland Hospital, Doetinchem.