Surgical treatment of non-melanoma skin cancer of the head and neck: expanding reconstructive options
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Chapter 8

Survival of full-thickness skin grafts and perichondrial cutaneous grafts on subcutaneous soft tissue hinge flaps used in nasal reconstruction

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P.A. van der Eerden
H.D. Vuyk

In press Laryngoscope
ABSTRACT

Objective: To assess the survival of full-thickness skin grafts and perichondrial cutaneous grafts when placed on subcutaneous soft tissue flaps used in nasal reconstruction.

Methods
Twenty-eight patients with nasal defects secondary to basal cell carcinoma excision were included. Clinical information, including case notes and photography, was obtained and analyzed. Graft survival was assessed in relation to type of graft and subcutaneous soft tissue flap employed for the reconstruction.

Results
Overall graft survival was 79%, with 89% and 74% for perichondrial cutaneous graft and full thickness skin grafts respectively. Anecdotally, procerus and nasalis flaps were found to yield higher graft survival than cheek fat flaps.

Conclusion
The combination of subcutaneous soft tissue flap and skin graft cover offers a valuable addition to the treatment algorithm for nasal reconstruction following cutaneous malignancy excision.
INTRODUCTION

Reconstruction of defects of the nose can be challenging. The goal is to achieve both an excellent cosmetic and functional outcome. The surgical options for this include healing by secondary intention, primary closure, local flap repair or skin grafting. Each has benefits and pitfalls, which need to be weighed up prior to decision-making. This paper concentrates on full-thickness skin grafting in combination with a subcutaneous soft tissue flap to provide bulk and aid graft take.

The full-thickness skin graft (FTSG) remains a workhorse for nasal reconstruction. Together with the perichondrial cutaneous graft (PCCG) it can be used for either restoration of skin defects or replacement of missing lining in full thickness nasal defects. It provides a simple, one-stage solution for nasal defects. However, there are limitations. Traditionally, skin graft resurfacing has been considered contraindicated for defects that are deep and/or lack an adequate vascular bed. This can be overcome with the employment of a pedicled subcutaneous soft tissue flap (SCSTF) hinged to offer volume as well as to fill the defect and a vascular bed onto which a skin graft may be applied.\(^1\) For centrally located nasal defects, nasalis muscle can be used as the SCSTF,\(^2\) whereas defects on the lower lateral side of the nose or ala may be filled with soft tissue harvested from the adjacent cheek area.\(^1,3,4\) Deep lesions on the upper third of the nose can be filled with soft tissue and muscle harvested from the glabella region. The defect, once filled with the SCSTF, may be left to heal by secondary intention or resurfaced with a skin graft.\(^5\) This combination of SCSTF and skin grafting has versatility for application in a large number of cases where a traditional skin flap alone would not be ideal.

Using this technique, even relatively large defects can be reconstructed in a straightforward, one-stage procedure.

This paper draws attention to the combination of FTSG or PCCG with a vascularized subcutaneous soft tissue hinge flap in nasal reconstruction of deep skin defects following cutaneous carcinoma excision. Surgical techniques and results of a case series are presented.

METHODS

Patients

This series describes 28 consecutive cases of nasal reconstruction using combination SCSTF and either FTSG or PCCG in 28 patients (ten males, mean age 72). All defects were confirmed basal cell carcinoma, 20 were Mohs excisions with immediate reconstruction while eight were ‘rush paraffin sections’ with reconstruction approximately three days later when histology was confirmed. All patients were examined at seven days after surgery to assess graft viability. This was graded as success, partial failure and total failure. Failure was assumed to have occurred if the graft became blackened at day seven review after surgery. In these cases closure by secondary intention was ensured by regular follow-up. No revision grafting was required. The nature of the SCSTF was determined by the location of the skin defect, with upper-third lesions employing a procerus/glabella flap, mid-third lesions, a nasalis flap and lower-third/lateral lesions a cheek advancement flap. Skin defects were photographed with a ruler in shot to allow calculation of defect area. Follow up ranged from one to 68 months, with a median of 8.5 months and a mean of 11.
Figure 1
Procerus muscle flap:
A- Deep nasal defect following Moh’s excision. B,C- Procerus transposition flap elevated and positioned into recipient site. D,E- Flap sutured in place and FTSG applied. F- Result at seven months
Surgical Technique
The surgical technique employed for nasal reconstruction in this paper combined subcutaneous soft tissue local flaps (SCSTF) hinged into the defects with either full thickness skin graft (FTSG) or perichondrial cutaneous graft (PCCG) for defect coverage. Subsequently, the choice of SCSTF was determined by the location of the lesion on the nose with the donor graft chosen according to the recipient site skin characteristics.

Procerus muscle flap for upper third cephalic dorsal defects
For deep defects over the dorsum of the upper third of the nose, soft tissue can be harvested from the glabella region. This has the benefit of having a vascularized pedicle with robust supply. The flap constitutes the procerus muscle combined with subcutaneous tissue and is vascularized by the dorsal nasal branch of the angular artery. Skin incisions to allow access to the procerus muscle are made preferably in the relaxed skin tension lines. This usually results in a broken incision ideally to prevent untoward scar contraction obliterating the naso-frontal angle. Once the procerus is mobilized, it can be hinged or rotated into the dorsal defect. The donor site can be closed primarily and appropriate FTSG/PCCG harvested to cover the remaining defect. This technique is demonstrated in Figure 1.

Nasalis muscle flap² for Mid third nasal defects
The Superficial Musculo Aponeurotic System of the nose (SMAS) can usually be readily identified through the primary defect or by dissection beneath the dermis along the lateral surface of the nose. The SMAS contains the transverse and anomalous nasalis muscles (Figure 2). The

Figure 2. Intrinsic muscles of the nose. Nasalis and procerus can be utilized in SCSTF for bulk and to provide vascular bed.
SMAS including the contained muscles is dissected free of the overlying dermis and the underlying mobile anomalous fascia layer by sharp dissection, paying close attention to maintain an adequate vascular pedicle. The nasalis muscle can be mobilized from superior to inferior as a simple hinge flap, and secured in place with absorbable sutures. Alternatively, extra mobility and length can be achieved (such as for dorsal and supratip tip defects) by adapting the design of the soft tissue flap and sliding it into the defect. Alternative mobility and length can be achieved (such as for dorsal and supratip tip defects) by adapting the design of the soft tissue flap and sliding it into the defect.

The nasalis muscle can be mobilized from superior to inferior as a simple hinge flap, and secured in place with absorbable sutures. Alternatively, extra mobility and length can be achieved (such as for dorsal and supratip tip defects) by adapting the design of the soft tissue flap and sliding it into the defect. The defect, with soft tissue flap in place, can then be covered with FTSG or PCCG as described above. This technique is demonstrated in Figure 3.

### Table 1. Donor site for grafting in relation to recipient defect site.

<table>
<thead>
<tr>
<th>Recipient site</th>
<th>Skin graft donor site</th>
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<tbody>
<tr>
<td></td>
<td>Pre-auricular</td>
</tr>
<tr>
<td>Upper third</td>
<td>1</td>
</tr>
<tr>
<td>Mid third</td>
<td>1</td>
</tr>
<tr>
<td>Lower third</td>
<td>1</td>
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</table>

### Table 2. The subcutaneous soft tissue flap (SCSTF) utilized in relation to recipient defect site.

<table>
<thead>
<tr>
<th>Recipient site</th>
<th>Subcutaneous soft tissue flap (SCSTF)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Glabella/ procerus muscle</td>
</tr>
<tr>
<td>Upper Third</td>
<td>6</td>
</tr>
<tr>
<td>Mid Third</td>
<td>8</td>
</tr>
<tr>
<td>Lower third</td>
<td>4</td>
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</table>

**Subcutaneous Hinge Cheek Flap for lower third nasal defects.**

This flap is most commonly used to repair small but deep skin and soft tissue defects of the ala and lateral nasal wall or the melolabial junction. Subcutaneous tissue, usually fat with some deeper muscle from the cheek and cephalic portion of the melo-labial junction is elevated as a hinge flap based medially. The flap is turned like a page in a book to fill the internal nasal portion of the defect and tacked in place with dissolvable sutures. The melo-labial incision necessary to develop the soft tissue flap is closed primarily. A FTSG or PCCG can be secured onto the hinge flap to complete the nasal repair. Possible donor
Figure 3
Nasalis Muscle Flap:
A- Nasal defect in patient following Mohs surgery. B- To create a muscle flap, a releasing incision has been performed for approach along the aesthetic border of the left dorsal to lateral nasal wall junction. Nasalis muscle flap developed from superior to inferior is hinged into the defect. C- As the patient had thin skin the donor side volume deficit was compensated for by a small deep temporalis fascia graft. E- The remaining surface defect was covered with FTSPG from conchal bowl. E,F- Results at 11 months
Figure 4
Cheek advancement fat flap.
A- Lateral lower third nasal defect. B- Autologous cartilage graft is inserted to support the lateral nasal wall and ala with soft tissue hinge flap from adjacent check region overlying. C- Meshed skin graft applied. D- Note partial failure of skin graft with healing by second intention. E,F- Final cosmetic result.
sites include the conchal bowl, melo-labial fold, forehead and supraclavicular region. Skin color, texture and thickness vary according to site so the donor site is chosen with respect to skin characteristics at recipient site. The graft is then harvested, trimmed, and sutured in place with 6-0 absorbable sutures. A small bolster dressing is secured over the repair with steristrips. This technique is demonstrated in Figure 4.

**Table 3. Graft survival in relation to defect site.**

<table>
<thead>
<tr>
<th>Recipientsite</th>
<th>Success</th>
<th>Partial Failure</th>
<th>Total Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Third</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Mid Third</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Third</td>
<td>9</td>
<td>2</td>
<td>3</td>
</tr>
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</table>

**Table 4. Graft survival in relation to donor tissue type.**

<table>
<thead>
<tr>
<th>Graft type</th>
<th>Success</th>
<th>Partial Failure</th>
<th>Total Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCCG</td>
<td>9</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>FTSG</td>
<td>13</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Results

Tables 1 and 2 summarize the donor sites and reconstructive details of the 28 cases described in this paper. The mean size of defects following lesion excision was 1.5cm², with 21% of the lesions being in the upper third of the nose (n=6), 29% (n=8) in mid third of nose and half (n=14) in the lower third. Although not prescriptive, upper, mid and lower third lesions were generally reconstructed with procerus, nasalis and cheek flaps respectively. The exceptions were the nasal tip lesions for which a modified nasalis flap was employed to fill the defect.

Graft survival

Table 3 summarizes the graft survival in respect to recipient site. Overall graft success was 79% (n=22), with 7% (n=2) partial epidermolysis and 14% (n=4) total failure. Of the partial and total failures, five were involved with the cheek flap while one was with the procerus/glabella flap. However, the glabella FTSG was viable at one week and failed at three weeks. This late graft failure remained unexplained. No nasalis flap related graft failures occurred. Table 4 summarizes the graft survival in respect to graft type. PCCG graft survival is better than FTSG, 90% versus 72% (9/10 vs 13/18).
Cosmesis
No objective measure of cosmetic outcome was performed. However, subjectively it was deemed to be good by both surgeon and patient. The deep recipient wound beds were ‘plumped up’ by the soft tissue flaps ensuring excellent contouring of the graft in the follow-up period. When considering the graft failures, no further revision was considered necessary by either surgeon or patient. All patients were satisfied with the cosmetic outcome of surgical reconstruction.

DISCUSSION
Nasal defects following tumor excision are challenging to reconstruct. Many options lay open to the surgeon, but tumor clearance, patient comorbidity and patient expectations should be considered when planning reconstruction. The reconstructive options include closure by secondary intention, primary closure, loco-regional skin flap or skin grafting. Each technique has its advantages and disadvantages and, not surprisingly, there is no definitive correct technique. Algorithms have been suggested to aid the surgeon, but patient factors and surgeon experience should influence the reconstructive method chosen. In addition, the defect size, depth and location as well as skin status (thickness, relative excess) and availability of matching donor site skin must also guide the choice of reconstruction adopted.

The residual skin reservoir over the nose after tumor excision may limit the possibility for local flaps, leaving the surgeon to contemplate either skin grafting or more complicated multi-stage flap reconstruction. This paper demonstrates that good results can be achieved with a relatively straightforward single stage-procedure. Advocates of this technique describe the benefit of a good vascular bed supplied by the soft tissue flap in not only giving optimum conditions for grafting but also for bulking out deep defects and improving reconstructive contouring.

Donor site choice
Actinic change is an important factor to bear in mind when nasal reconstruction is being contemplated. A heavily sun damaged nose may not be suitable for local flap reconstruction due to the increased risk of a second primary malignancy in addition to tumor recurrence. In these cases, moving healthy skin in from a distant donor site may be advantageous. The donor site need to be chosen with care. Skin color, thickness and texture should be considered to optimize a good tissue match but tissue availability and the closure of donor site needs to be taken into account also. Table 5 demonstrates the characteristics of common donor graft sites. PCCG is the ideal choice when wound retraction is to be kept to a minimum. Harvesting is easy and the donor site can be left to heal by secondary intention once punch grafts through conchal cartilage are used to hasten granulation. However, healing, although almost invisible, takes several weeks to occur.

Graft Survival
Van der Eerden et al. have documented improved survival rates with PCCG over FTSG (94% versus 86%), but due to small numbers, the results were non-significant. The authors, however, expressed this trend and the ease with which the donor site can be managed as a reason to favour PCCGs as donor material of choice.

Data on the survival of FTSG is well docu-
Table 5. Advantages and disadvantages of donor graft sites.

<table>
<thead>
<tr>
<th></th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td><strong>Perichondrial cutaneous graft</strong></td>
<td>- Good color match</td>
<td>- Limited tissue reservoir</td>
</tr>
<tr>
<td></td>
<td>- Resists contraction</td>
<td>- Slow conchal bowl healing</td>
</tr>
<tr>
<td></td>
<td>- Simple donor site management</td>
<td>- Precludes use of conchal cartilage in future</td>
</tr>
<tr>
<td><strong>Post-auricular graft</strong></td>
<td>- Large tissue reservoir</td>
<td>- Poor color match</td>
</tr>
<tr>
<td></td>
<td>- Hidden scar</td>
<td></td>
</tr>
<tr>
<td><strong>Pre-auricular graft</strong></td>
<td>- Good color match</td>
<td>- Limited tissue reservoir</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Visible scar</td>
</tr>
<tr>
<td><strong>Supra-clavicular graft</strong></td>
<td>- Abundant tissue reservoir</td>
<td>- Poor color match</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Visible scar</td>
</tr>
<tr>
<td><strong>Melo-labial graft</strong></td>
<td>- Good color match</td>
<td>- Scar can leave asymmetric groove</td>
</tr>
</tbody>
</table>

mented. Multiple studies report ranges from 70 to 95%.\textsuperscript{10-13} These rates were comparable to a previous study from our center, which showed a survival rate of FTSG of 86%.\textsuperscript{9} However, literature is sparse on the survival of skin grafts on reconstructive flaps. Only three studies in literature address survival rates of FTSGs and PCCGs placed over local flaps. Menick reported a 70-80% ‘take’ rate on the under-surface of forehead flaps\textsuperscript{14} whilst Keck et al. report the survival rates of composite chondro-cutaneous auricular grafts applied to skin flaps in nasal lining reconstruction as 84% (16/19).\textsuperscript{15} A third study used FTSG over nasalis flaps in nasal reconstruction. This group reported no complete failures, but 8% partial epidermiolysis (2/26).\textsuperscript{2}

The overall survival rate of skin grafts on SC-STF in this paper, excluding grafts with total and partial loss, is 79%. However, the trend towards improved survival of PCCG over FTSG is again demonstrated in this paper with survival rates of 90% and 72% respectively. These results must be taken in context with the small sample sizes and the variability of the underlying SCSTF employed.

The survival rate of FTSG in this paper is seen to be lower than the 86% reported by the same center for general use. This is due to the more complex defects requiring reconstruction in this paper and the need for additional tissue
One could argue that the use of FTSG opens up an increased application of skin graft use. It is worth noting that the SCSTF types used in this paper varied in their effectiveness. Graft failures were increased with the cheek flap, suggesting inferior graft bed nutrition when compared with nasalis and procerus muscle flaps. However, due to the small numbers in this study, this finding must remain anecdotal.

The relative increased failure rate of Cheek SCSTF aside, the authors feel that FTSG/PCCG can be applied on flaps with reasonable confidence. As demonstrated, this opens up a whole range of alternative possibilities in nasal reconstruction where deficient graft beds, convex nasal areas and large deep defects have traditionally ruled out skin grafting as a closure option.

**Application of SCSTF with graft**

For complete tumor clearance, removal of underlying periosteum/ perichondrium may be required, leaving a deep defect with a relatively avascular base. In these circumstances, skin grafting is traditionally contra-indicated due to high graft failure and poor aesthetic contouring. More recently, however, it has been postulated that bare cartilage can make up 50% of recipient bed before graft vitality is compromised. In these circumstances, if a graft is the preferred closure option, the denuded surface can be made suitable by either leaving the surface to granulate before applying a graft or by employing a SCSTF repair. The former method, although the simpler, significantly delays the completion of the surgical pathway and is therefore less desirable.

More extensive tumor clearance may result in loss of underlying bone and cartilage, or even a full-thickness nasal defect. For the former, incorporating a SCSTF can allow single stage cartilage grafting. This can be achieved by placing a structural cartilage graft into the defect base, covering this with a SCSTF and then a FTSG/ PCCG. This is a valuable technique in the lower third of nose where ala collapse can lead to unacceptable functional results. For full-thickness defects, a simple trapdoor, turn-in flap with graft could be used or for larger defects a forehead flap with skin grafting for lining.

In a previous paper the authors focused on concave lateral nasal wall defects and showed that coverage of the SCSTF with FTSGs/ PCCGs is not always necessary. Indeed, good results can be achieved by leaving the exposed SCSTF to heal by secondary intention once a soft tissue flap is in place. However, this current study focuses on a different sub-type of nasal defect, namely large defects and defects located in convex nasal areas. Coverage of the SCSTF with a FTSG/PCCG in these cases yielded more predictable and natural results. Although FTSG/PCCGs on SCSTF do well it must be accepted that 14% failed completely. One would expect these failures to heal badly by secondary intention once a soft tissue flap is in place. However, in these graft failures, healing by secondary intention has still been surprisingly adequate. It could be postulated that if a SCSTF had not been employed in these larger and convex defects, then graft failures would have resulted in deep recipient beds where healing by secondary intention would leave an unacceptable cosmetic and functional defect prompting revision surgery.
CONCLUSION
This paper demonstrates that subcutaneous soft tissue flaps with either full-thickness skin grafts or perichondrial cutaneous grafts allow reliable and simple reconstruction of significant defects of the dorsum, side wall and lower third of the nose in a single-stage procedure. This technique is versatile enough to be used in the reconstruction of deep defects with poor vascularity and/or structural loss and should therefore be considered an important part of the closure algorithm in such cases.

References


