〔総説〕

Treatment of soft tissue defects with VY−plasties

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Key words : VY plastics, perforator flap, keystone flap

Abstract

Soft tissue defects in the head and neck region mainly originate in the operative treatment of malignant skin diseases and their precursor stages. A variety of techniques can be used to provide these lesions. In this article, various surgical procedures of the VY−plastics with special attention to the head and neck region are presented. These options result in very satisfactory solutions, both functionally and aesthetically, up to medium−sized defects. We herein report that demonstrated excellent results in 173 patients undergoing various procedures including VY−plasty for soft tissue defects.

Introduction

Soft tissue defects of the head and neck region have their in accidents, inflammations and – by far in the most cases − in the treatment of skin tumors. Because of the well known demographic development on the one hand and the predilection of caucasoid for sunbathing on the other hand more and more people need treatment of squamous cell carcinoma, basal cell carcinoma, Merkel cell carcinoma, melanoma or their precursors (Kallini et al., 2015 ; Arginelli et al., 2016). Therapy of choice in these cases undergo surgery total removing of the lesion, a so−called R0−resection. Depending on the histological result, X−ray and ultrasound examinations, additional therapies like chemo− and/or radiation therapy or lymph node dissection may be necessary. The defect of the skin in the face or neck region needs some kind of surgical reconstruction. Several techniques can be used :

1. Primary closure of the defect using extension flaps may be combined with so called “rapid tissue extension”.
2. Grafts
   1) Split skin grafts
   2) Full skin grafts
   3) Free composite grafts using microvascular anastomosing of donor and receptor arteries and venes. A lot of literature is available especially to this last mentioned and most complicated technique. Only one of the earliest reports by McGregor and Jackson concerning this method should be using various free flap (McGregor & Jackson, 1972).
3. Pedicled flaps
   1) Local flaps like the nasolabial flap (Elliott, 1976), temporalis muscle flap (McGregor, 1963) or the forehead flap (Converse, 1942).
   2) Regional flaps like the deltopectoral falp (Bakamjian, 1965), the platysma myo−cutaneous flap (Futrell et al., 1978 ; Hurwitz et al,. 1983), infrahyoidal muscle flap (Wang et al., 1986).
   3) Distant pedicled flaps based on a well defined axial nourishing artery and vein like the pectoralis myo−cutaneous flap (Ariyan, 1979), the latissimus−dorsi−flap (Olivari, 1976)or the trapezius−flap (Demergasso & Piazza, 1979).

The so−called “random pattern flaps” with a diffuse vascularisation belong to the local flaps. Because of the different and not exactly defined vascularisation the relation of length of the flap to the width of the pedicle should not exceed 3 to 2. Therefore the possibility to mobilize and transfer this kind of flap is reduced. The following techniques belong to this kind of flap.

(1)transposition flaps
(2)rotation flaps
(3)advancement flaps

A special technique of the advancement flap is the VY−plastic. Scientific interest nowadays is directed to define more exactly the vascularisation of the random pattern flaps by detecting and using tiny vessels the so−called perforator vessels in order to improve the vascularisation of these flaps. Those flaps are called “perforator flaps” (Blondeel & BoeckX, 1994). Because of these developments which are put down to the fundamental examinations of Taylor and Palmer (Taylor & Palmer, 1987), the strong differentiation between the above mentioned techniques is diminished. The different scientific results lead to new techniques that are transferred to all methods of covering defects : the free tissue transfer using micovascular re−anstomoses, the pedicled flap transfer using axial nourishing vessels and local plasties. These developments have led to several VY−plasties which can be differentiated by the variable nourishment of the transferred tissue.

Between 2010 and 2014, 173 patients were treated with some kind of VY−plasty in the departement of cranio−, maxillo− and facial surgery, plastic surgery of the Jung Stilling Diakonie Klinikum. All patients were treated by one surgeon. Our results presents the diverse diagnoses treated, overview of the number of patients treated with the different VY−techniques, the distribution of the different VY−plasties concerning the different regions of the face [Table 1.2.3.].

Table. 1 : Diagnoses of the patients

	Number of patients	%
Basal cell carcinoma	136	79
Squamous cell carcinoma	23	13
Kind of melanoma	7	4
Others	7	4
Number of all patients	173	100

Methods of VY−techniques and patients

Classical VY−technique

The classical VY−plasty which was originally described by Dieffenbach (Dieffenbach, 1829) uses a V−like incision through skin and subcutaneous fat beginning exactly at the basis of the defect. The incised tissue is mobilized using the mobility of the fatty tissue. The nourishment of the tissue depends on deeper lying structures and a kind of vertical nutrition of the mobilized tissue takes place. On the contra−lateral side of original defect a primary closure is performed leading to a Y−shape of sutures (Zook et al., 1980) [Fig. 1a−c].

Table. 2: Number of patients treated with the different VY−plasties

Classical procedure	18
Unilateral vascularisation	48
Bilateral vascularisation [Hammock−Flap]	27
2 opposite VY−Plasties	8
Perforator−vascularisation	17
Fish mouth flaps	7
Rotation of the nasal alar	15
Special flaps	
Rieger flap	29
Keystone flap	2
Modified flaps	2
Flap−in−flap−technique	0
Total :	173

Table. 3 : Distribution of the different VY−techniques used in the various regions of the face

	Flap type	Frontal	Lid		Temporal	Cheek	Nose	Lip		Jaws	Ear
	total		upper	lower				upper	Lower		
Classical	18	3		6	3	2	2	1			1
Unilateral	48	3				11	29	3			2
Bilateral	27				17	10					
2opposite VY−Plasties	8	2			2	2				1	1
Perforator−vascularisation	17						17				
Fish mouth flaps	7		2		3	2					
Rotation of the nasal alar	15						15				
Rieger	29						29				
Keystone	2									2	
Modified flap	2										2
Flap in flap	0										
Total 173											



Fig. 1a : Situation after resection of an in-situ-melanoma and planned incision through skin and subcutaneous fatty tissue



Fig. 1b : Y-like closure of wounds



Fig. 1c : Inconspicuous scar 6 months post-operatively

VY-plasty using a unilateral vascularisation (Li et al., 2007 ; Xu et al., 2015)

While using the same incision design the depth of the incision is different. One side of the V-like incision is incised through skin and fatty tissue on the contra-lateral side is incised through the skin and superficial subcutaneous tissue only. On that side the subcutaneous fat is dissected from the superficial skin to a far extend. After that beginning from the first incision the complete V-like flap as well as the fatty tissue detached from the contra-lateral skin is mobilized. The mobilized tissue (skin and fatty pedicle) is then transferred to cover the defect nourished by the mobilized fatty pedicle [Fig. 2a–d].

VY-Plasty with bilateral nourishment (Pontes et al., 2002)

Using a bilateral nourishment of the flap both sides of the incision are only cut through the skin leaving the fatty tissue

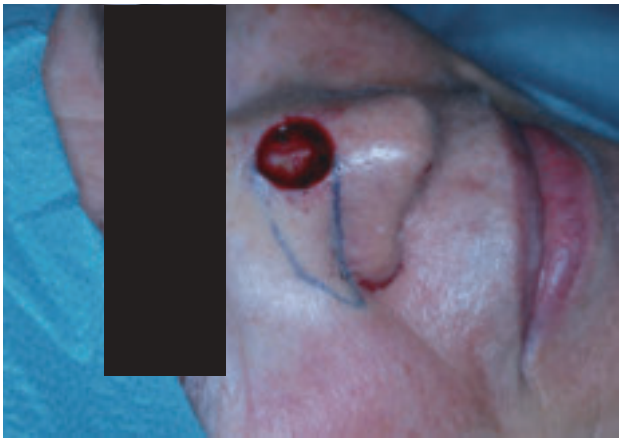


Fig. 2a : Situation after R0-resection of a basal cell carcinoma and planned VY-plasty

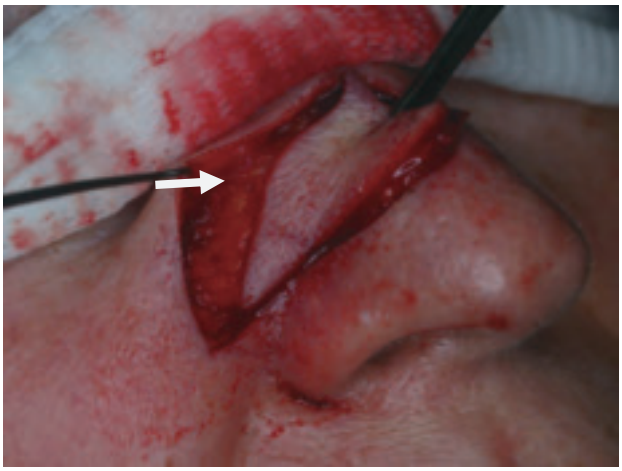


Fig. 2b : Mobilized V-like flap with unilateral fatty pedicle (arrow)

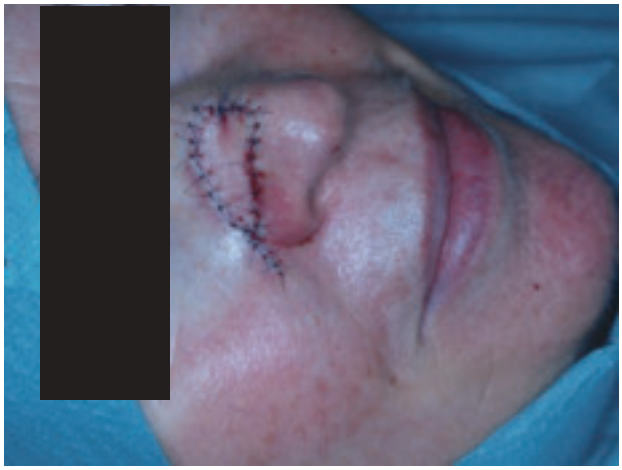


Fig. 2c : Y−like closure of the wound



Fig. 2d : 3 months later pleasant scars

completely untouched. The skin is now mobilized to a far extend from the deeper Fat. From the basis of the flap this means from the wide opening of the V−like incision the fatty tissue beneath the mobilized skin is detached from the deeper structure. The skin can now be advanced like on a hammock nourished by the bilateral fatty tissue [Fig. 3a–e].

VY−plasty on the basis of perforator vessels (Thornton & Reese, 2008 ; Demirsen et al., 2009 ; Schonauer et al., 2010)

This technique is based on the use of so−called perforator vessels. Perforator vessels are small branches running off a defined vessels nourishing a certain anatomic region. Identification of these vessels, sometimes using ultrasound examination pre− or intraopertive , and mobilization of these vessels allows a wider arc of rotation of the flap and additionally the pedicle can be thinned out and thus the pedicle becomes less visible [Fig. 4a–e].

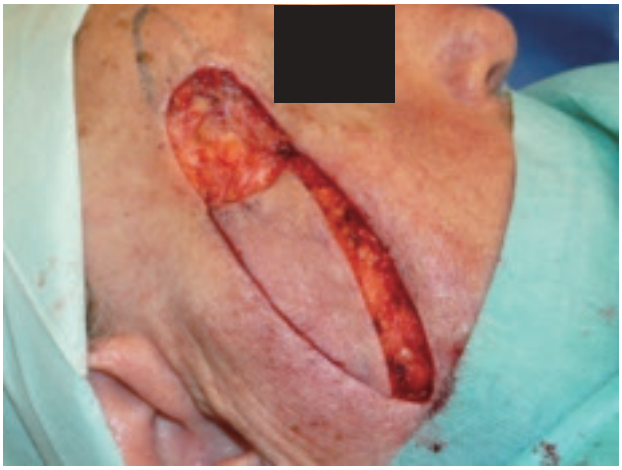


Fig. 3a : After removal of a basal cell carcinoma V−like superficial incision of the skin

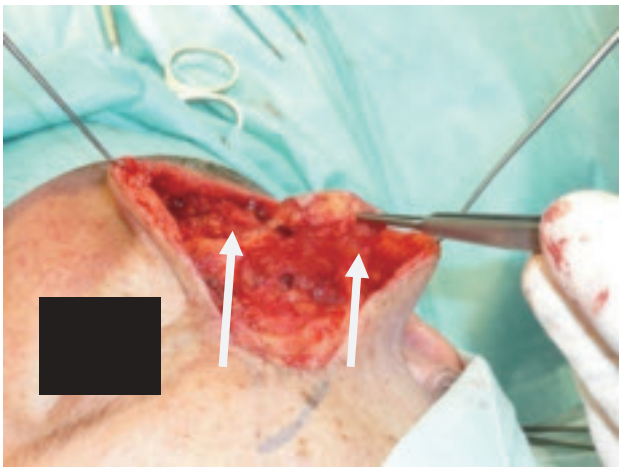


Fig. 3b : Mobilization of the bilateral nourishing fatty tissue (arrows), view from cranial

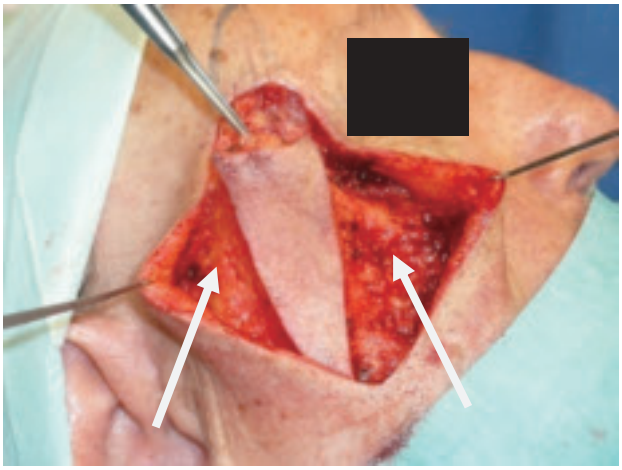


fig. 3c : Nourishing fatty tissue (arrows), view from lateral

VY−plasty as a fish mouth flap (Ellabban & Bremner, 2007)

No matter what kind of technique is used sometimes difficulties may arise to close a minor rest defect because of the



Fig. 3d : Y−like wound closure



Fig. 3e : Invisible scars 6 months after surgery



Fig. 4a : Planning a VY−perforator flap from the nasolabial fold after R0−resection of a basal cell carcinoma of the nose



Fig. 4b : The scissors are showing the arterial perforator running off the facial artery



Fig. 4c : The forceps (s) are showing the vein of the perforator flap



Fig. 4d : VY−like arrangement of the sutures after finishing the procedure

impossibility to further advance the flap. In this special situation it may be sufficient to mobilize the usually resected lateral edges of the flap and suture them together winning

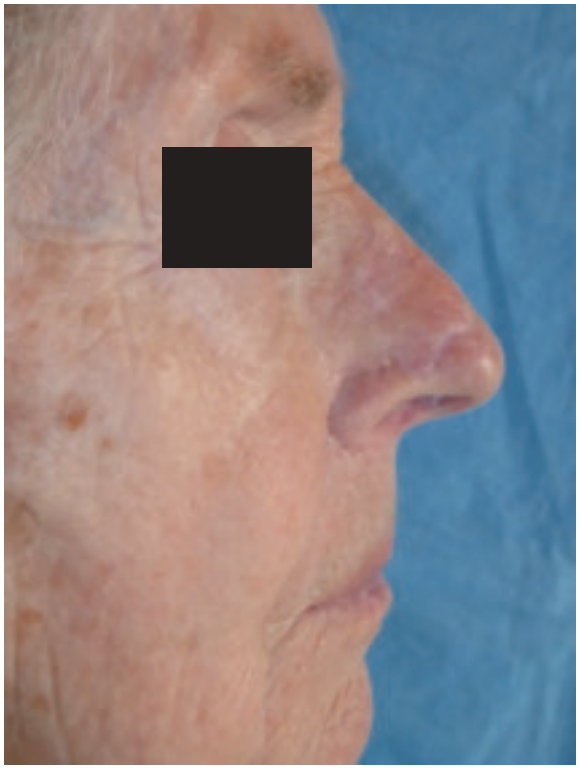


Fig. 4e : Inconspicuous result 15 months after the procedure



Fig. 5a : Incised VY−flap for coverage of a defect in the inner part of the upper lid after basal cell carcinoma resection

some distance of defect coverage. After finishing the procedure a fish−mouth− like image may be built in the most anterior part of the flap [Fig. 5a–d].

Flap−in−flap technique (Aoki et al., 2006)

A further possibility to enlarge the advancement of a VY−plasty is to perform a second VY−plasty in the first one, a so−called “flap−in−flap−technique” [Fig. 6a−d].

Modified VY−plasty (Hartzell et al., 2009)

One of the most important conditions for good wound



Fig. 5b : Mobilization of the flap using additionally the fish mouth effect



Fig. 5c : Finishing the VY−plasty using the mouth effect

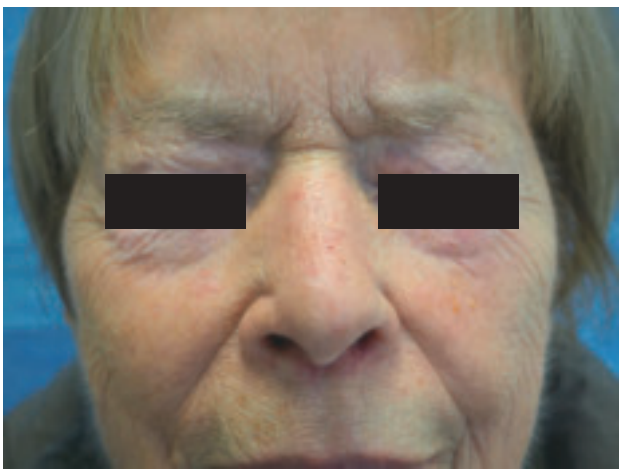


Fig. 5d : 10 months post−operatively a good functional and cosmetic result is achieved

healing is a good vascularisation of the involved tissues. Hartzell and co−workers described a modified VY−plasty in order to improve the vascularisation especially of the most distant tips of the flap. Using this technique the V−like inci-

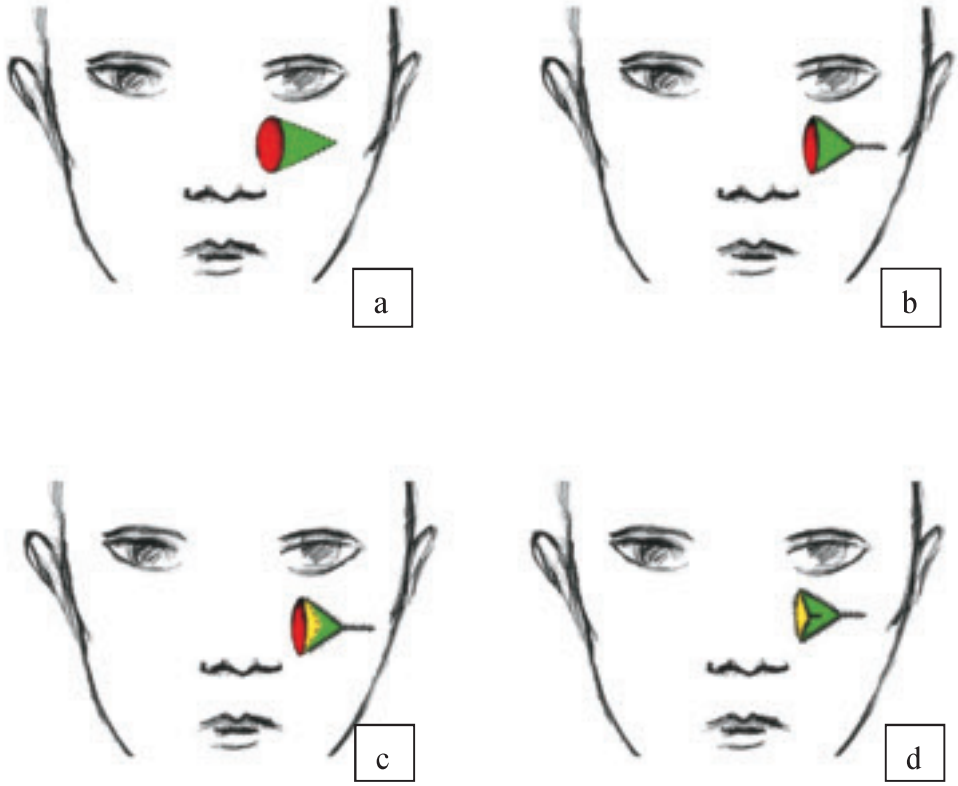


Fig. 6a–d: Sketches of a flap–in–flap technique. Red= defect; green= 1. VY–plasty; yellow=2. VY–plasty
a : Sketch of the first VY–plasty
b : Sketch of the finished first VY–plasty
c : Sketch of the second VY–plasty located in the first one
d : Sketch of the finished second VY–plasty inside the first VY–plasty

sions do not end at the basis of the defect but they end besides of the defect leaving a bridge of healthy tissue between the defect and the flap incision in order to support the nourishment of the flap. Using a pre–operative Doppler–ultrasound examination a perforator to the flap may be detected. Leaving this perforator undamaged during flap preparation also improves the vascularisation of the flap [Fig. 7 a–d].

Two opposite VY－plasties for defect coverage (Behan, 2003 ; Pelissier et al., 2007)

Defects too large for closure using one VY－plasty two opposite VY－plasties can be mobilized no matter of their vascularisation [Fig. 8a–c].

Special applications of VY–plasties

Reconstruction of nasal alar using a "nasal－alar VY－plasty" (Odobescu et al., 2011 ; Odobescu et al., 2014)

In case of resection up to one half of the nasal alar a reconstruction of all layers is possible using certain tissue surplus at the alar sill area. The main advantage of this technique is to reconstruct this sensible area in all layers of the nasal alar without any notch [Fig. 9a–f].



Fig. 7a : Defect after resection of a large basal cell carcinoma of the posterior part of the scapha and concha complex of the right ear



Fig. 7b : Planning of a modified VY−plasty



Fig. 7c : Preparation of a modified VY−flap



Fig. 7d : 3 weeks postoperatively a good wound healing had taken place. The scapha auriculae is a little bit dislocated posteriorly



Fig. 8a : after resection of a basal cell carcinoma two opposing VY−plasties are built

Lateral VY−plasty for eyelid reconstruction

The restoration of the upper and lower eyelids requires the reconstruction of all resected tissues without any disturbance like ectropion, entropion or epiphora. The technique of Calderon and co−workers (Caldaron et al., 2006) fullfills these demands using a transversal mobilized myo−cutaneous flap of the upper or lower eyelid even if the defects is as large as one third to one half of the lid. These results were confirmed by the group of Marchac (Marchac et al., 2009) [Fig. 10a–d].

Rieger−plasty

Rieger described in 1967 a technique for coverage of soft tissue defects of the nose that relies on a “transferred” VY−plasty. Using this method all the soft tissue of nose cranially to the defect of the nose up to the frontal area is mobilized and rotated caudally in the defect. In order to achieve this mobility of the tissue a v−like back−cut is performed at the top of the incision in the frontal area to the contralateral side. The tissue surplus in the glabellar region is used for covering the defect nearly at any region of the nose. The V−like incision is then closed a “Y” (Rieger, 1967)(Fig. 11a−d).

Key stone Flap (Behan, 2003 ; Pelissier et al., 2007 ; Behan et al., 2010 ; Khouri et al., 2011 ; Corrias et al., 2013 ; Stone et al., 2015)



Fig. 8b : Two Y−like transverse orientated wound closures are performed



Fig. 8c : Covered defects, however conspicuous scars 6 months after surgery



Fig. 9a : planning of a VY−plasty of the nasal sill area together with the remained nasal stamp of the nasal alar after resection of a basal cell carcinoma



Fig. 9b : After incision of the flap

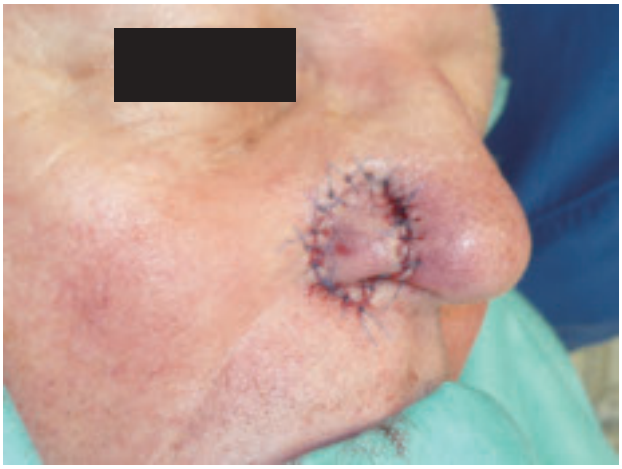


Fig. 9c : After mobilization and suturing of the flap, view from right lateral



Fig. 9d : 7 weeks postoperatively : view from caudal

Using a key stone flap the tissue on one side of the defect is incised completely through skin and fatty tissue in a trapezoid manner with a far wider circumference of the flap on the opposite side of the defect. Then the flap can be mobilized into the defect using the mobility of the fatty tissue. The donor site is closed with 2 VY−plasties on the defect opposite wide side of the flap [Fig. 12a–e]. Using perforator vessels the mobility of the flap can be extended wide area (Pelissier et al., 2007 ; Khouri et al., 2011). If the loss of tissue is very big two key stone flap can be raised on both

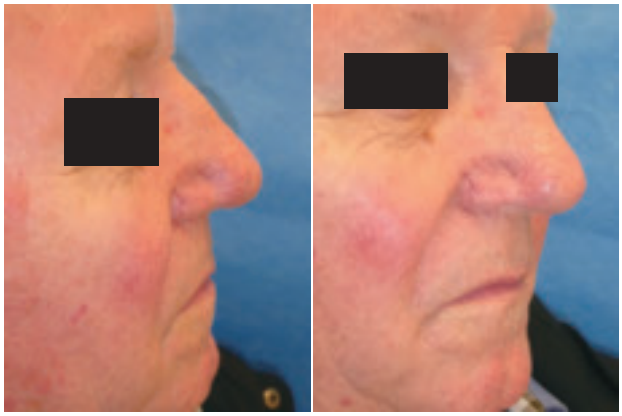


Fig. 9e : 1 year postoperatively : profile and half−lateral view

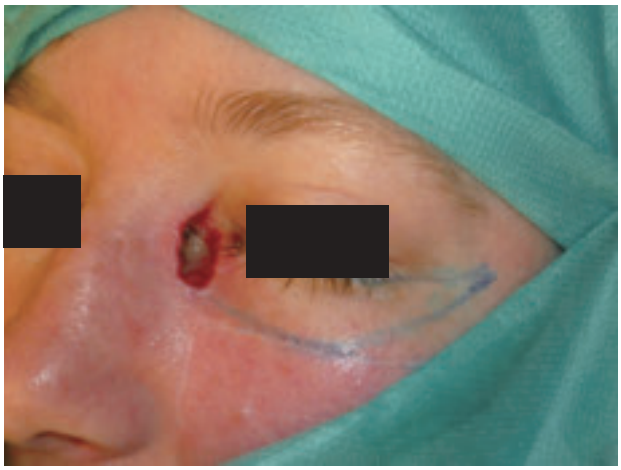


Fig. 10a : Plannig of a transverse VY−plasty after resection of a basal cell carcinoma

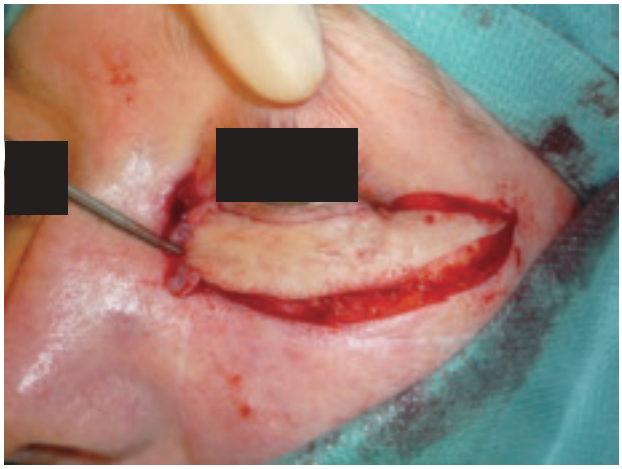


Fig. 10b : Mobilized V−like flap

sides of the defect (Behan, 2003 ; Pelissier et al., 2007).

Discussion

The VY−technique perfectly fulfils the requirement of Gillies and Millard to replace tissue with like tissue(Gillies & Millard, 1957). This means that lost tissue is substituted

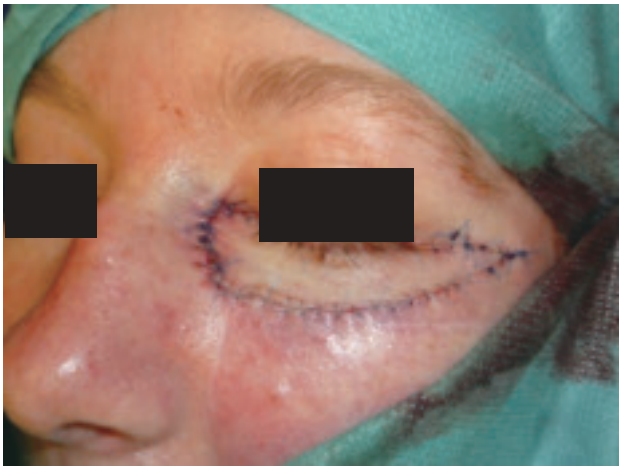


Fig. 10c : finished VY−plasty

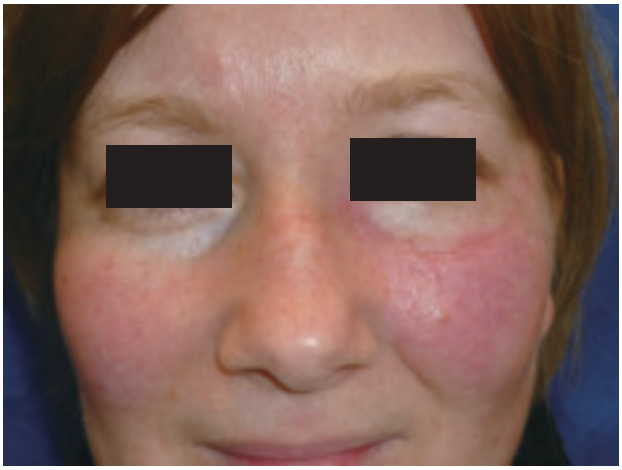


Fig. 10d : 5 months postoperatively : good functional and aesthetic result

by as far as possible similar tissue. Typically the neighboured tissue to the defect is most suited to comply this surgical axiom. The critical follow−up of the own patients showed strengths but also some disadvantages of the VY−plasty.

Using two opposite VY−plasties leads to a minimum of additional tissue lost on the on hand, on the other hand, however, the aesthetic result is not satisfying even 6 months after surgery [Fig. 8c]. Using in those cases a larger excision of tissues on both sides of the defect and mobilizing two flaps of dilated neighbouring tissues allows a primary closure of the defect (Soliman et al., 2011). Localizing the incisions sophisticated along the so called “relaxed skin tension lines” (Borges, 1984) leads to inconspicuous scars. This is especially true for older patients in whom the soft issue structures are more relaxed to a certain degree and the mobility is therefore increased. [Fig. 13a–c].

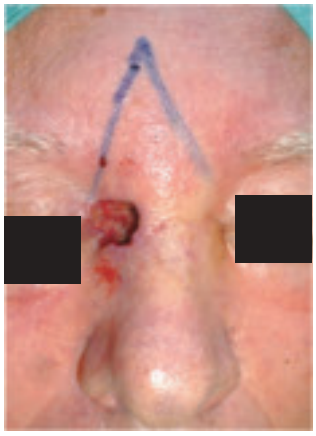


Fig. 11a : After basal carcinoma resection planning of a VY−plasty in the glabellar region



Fig. 11b : Mobilization of the V−like flap



Fig. 11c : Finishing the suturline in a Y−like fashion

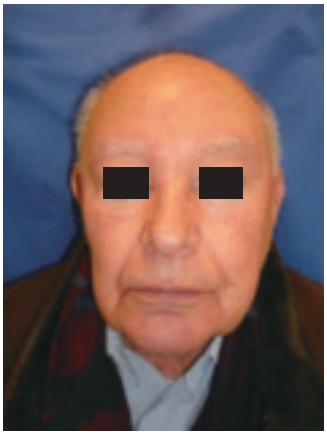


Fig. 11d : 5 months Monate inconspicuous scars



Fig. 12a : Defect shortly caudal to the head of the fibula after resection of a meanoma (Breslow : 0.4 mm invasion depth, Clark III, no distant metastases)



Fig. 12c : Mobilized flap



Fig. 12b : A keystone flap is designed

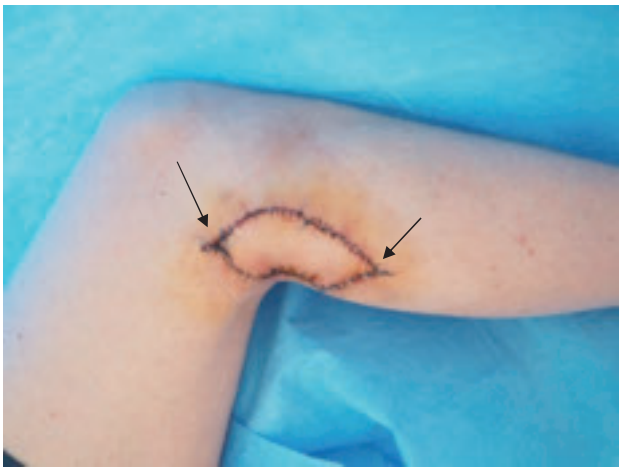


Fig. 12d : Undisturbed wound healing 5 days postoperatively, arrows are showing to the VY−principle

If a VY−plasty is used the so called "aesthetic units" should be taken into consideration (Burget & Menick, 1985). If the boundaries between different aesthetic units are passed by the mobilized tissues the aesthetic result is negatively influenced. In the patient of Fig.4 this surgical detail was followed. In the patient of Fig 14a–c the boundaries between the aesthetic units were not respected in order to improve the flap's vascularisation. The aesthetic result is re-



Fig. 12e : Primary healing, undisturbed function 3 months after surgery



Fig. 13c : 5 months after surgery nearly symmetrical position of the eye brows. Hardly visible scar in the near view



Fig. 13a : After resection of a basal cell carcinoma of the forehead the ecsion of addional triangular flaps neighbouring to the defect are designed

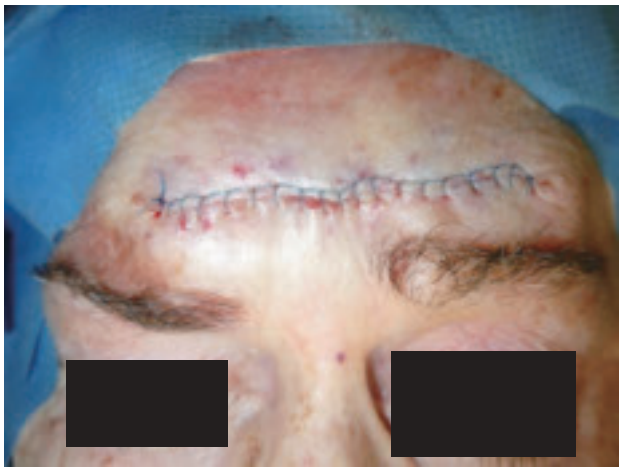


Fig. 13b : Primar wound closure after mobilizing two dilated flaps of the cranial and caudal wound edges. The left eye brow is positioned a little bit morde cranially at the end of the procedure.



Fig. 14a : After resection of a basal cell carcinoma a VY−plasty is planned, however, the aesthetic units are not respected.

duced.

Using perforator vessels this requirement to respect aesthetic units can be fulfilled much easier.

In the reconstruction of the nasal alar the alar rotation of the alar stump using the VY−plasty is of advantage in order to avoid notching at the free border of the alar. Fig.9 shows the inconspicuous result following this principle. Fig. 15 a–c in contrast a classical VY−plasty from the nasolabial fold was performed leading to an impaired aesthetic result.

In 2014, Carminati and Robotti proposed (Carminati & Robotti, 214) the use of some techniques of rhinoplasties like hump reduction or nasal tip defining sutures to optimize



Fig. 14b : The defect is covered. The boundary between the nose and the cheek is surpassed.

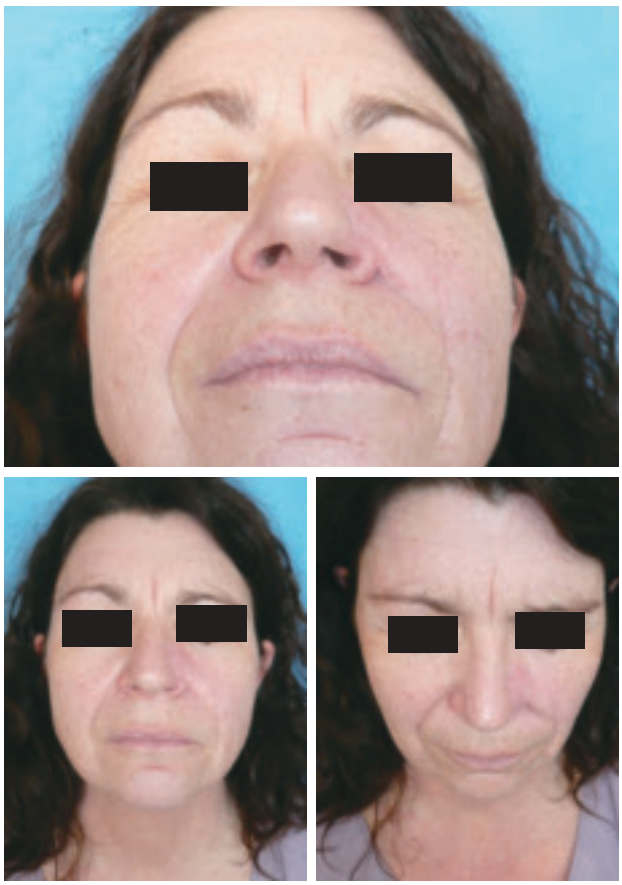


Fig. 14c : 17 months after reconstruction this aesthetic impairment is clearly visible.

the aesthetic results after tumor resection and reconstruction of the nose [Fig. 16].



Fig. 15a : Defect after resection of a basal cell carcinoma



Fig. 15b : Situation after coverage of the defect using a VY−plasty



Fig. 15c : Even 2 years after reconstruction irregularties at the nasal entrance visible. The patient did not wish a surgical correction.

Accepting all advantages of the different VY−plasties especially for reconstruction of the nasal tip the techniques described by Rintala and Asko−Seljavaara 1969 should not be

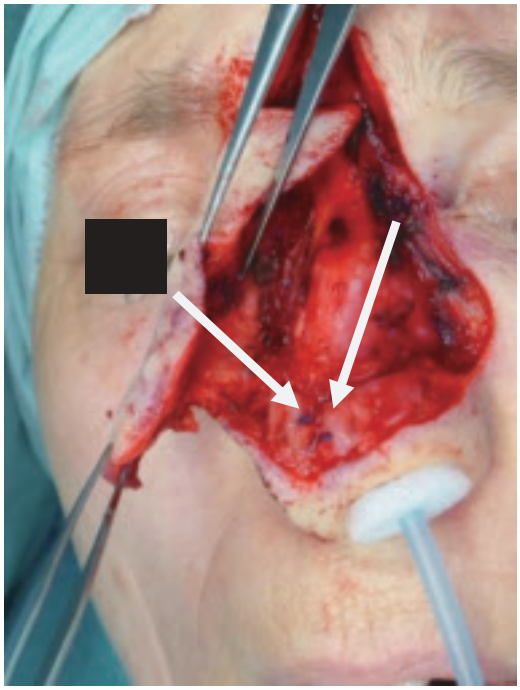


Fig. 16 : During a Rieger−plasty for nasal reconstruction after resection of a squamous cell carcinoma intra- and interdomal sutures were used (arrows) to define the nasal tip more exactly. Additionally a nasal hump was removed.

forgotten. The incisions in this techniques are located parallel to the nasal dorsum leading to scars situated in the shadow of the nasal dorsum producing a nice aesthetic result [Fig. 17a–c].

Conclusion

1. VY−plasties can be used in many situation to cover soft tissue defects using its different modifications. This technique is especially of advantage in the head and neck area.
2. Using perforator vessels allows an increase of mobility of the flap together with a thinner flap pedicle.
3. Especially mentioned is the rotation of the nasal alar stump using VY−plasty for nasal reconstruction.
4. The VY−plasty leads to very good functional and aesthetic results in the reconstruction of eye lids.

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Fig. 17a : Resection of a basal cell carcinoma at the tip of the nose. Design of a Rintala−plasty. Burow's triangle are resected near of both eye brows (Von Burow, 1855).



Fig. 17b : After finishing the procedure often an anaemia of the flap is observed.



Fig. 17c : Even 6 weeks after reconstruction a pleasant result is achieved

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