Defect closure after oral and pharyngeal tumor resection with the superiorly pedicled myocutaneous platysma flap: indications, technique, and complications

Michael Koch · Julian Künzel · Konstantinos Mantsopoulos · Johannes Zenk · Heinrich Iro

Abstract This study evaluated the myocutaneous platysma flap (MPF) as an alternative to free flaps for closing defects after head and neck tumor resection in selected cases. MPFs were used to close small to medium-sized full-thickness oral and pharyngeal defects after surgery for tumors staged cT1-3 (oral cavity 37.1%, oropharynx 24.3%, hypopharynx 38.6%) in 70 patients. Flap-related complications developed in 27% of cases (partial necrosis 7%, total necrosis 3%, salivary fistula 11.4%, bleeding/hematoma 5.7%) and donor-site complications in 10%. Defect closure was adequate in 97%; 62.5% of the patients required intraoperative tracheotomies (closed again in 72.5%). Postoperative swallowing was not significantly disturbed in 72% of the patients. The MPF allows closure of small to medium-sized defects in the head and neck region in selected patients, with acceptable aesthetic and functional outcomes. The success rate (>90%) is comparable with surgical alternatives associated with considerably greater surgical effort and risk.

Keywords Head and neck tumors · Myocutaneous platysma flap · Defect closure · Oral defects · Pharyngeal defects

Introduction

Several methods of reconstructing the oral cavity and pharyngeal wall after ablative cancer surgery have been described, including primary closure, skin grafting, tongue flaps, pedicled myocutaneous island flaps, and free flaps. During the past 20 years, free-tissue transfers with microvascular anastomoses, such as the radial forearm flap (RFF), anterolateral thigh flap (ALT), and fibula osteoseptocutaneous flap have been predominant both in the literature and in practice for head and neck reconstruction. However, pedicled flaps may be indicated in specific cases. Pedicled myocutaneous flaps have been described for more than 30 years, including the pectoralis major flap, sternocleidomastoid, trapezius, and latissimus dorsi flap. The myocutaneous platysma flap (MPF) was introduced by Futrell et al. [1]. Although various reports on the use of the MPF have been published, there is still some controversy over its advantages and disadvantages, as well as the specific indications for it [2–10]. The MPF is easy to harvest, thin, and pliable, and is also large enough to cover defects up to 70 cm^2 in size. Verschuur et al. [11] have also reported that the MPF is associated with virtually no functional or cosmetic morbidity at the donor site11.

A review of the literature shows that there are various indications for the MPF in reconstructing defects in the floor of the mouth, tongue, cheek, retromolar triangle, oropharynx, and hypopharynx [3–12]. Its uses generally range from external skin coverage in facial reconstruction to functional restoration with internal lining in the upper aerodigestive tract. Friedman et al. [13] described successful use of superiorly and inferiorly pedicled MPFs to repair hypopharyngeal strictures, and Ariyan and Cuono [2] used transverse-based MPFs to reconstruct facial skin defects, also with good results. However, there is still some hesitancy about using the MPF due to fears that it may be unreliable; flap-related complication rates in the range 10–45% have been reported [2–4, 9–11, 14–17]. Contraindications against the MPF have been recognized, such as

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prior radiotherapy or neoadjuvant chemotherapy, prior radical neck dissection, and bulky nodal disease with a need to sacrifice the facial vessels or external jugular vein [3, 5, 11].

Reports on the anatomy of the MPF and on the surgical technique and its influence on flap survival show that the arterial blood supply to the flap is mostly maintained by the submental branch of the facial artery, which appears to be crucial for flap survival [9, 18]. The issue of whether or not sacrificing the facial vessels is critical for the viability of the MPF is still a matter of debate [3, 11, 15]. Partial or total flap failure has been reported in approximately 40% of patients when the facial artery has to be sacrificed during neck dissection; Conley et al. [9] and Coleman et al. [10] recommend preserving the artery. Other authors, such as Ruark et al. [3], have stated that preserving the facial artery is not a prerequisite for the survival of the MPF [3, 15, 18].

To date, only a few reports, including 15–40 cases in the largest series, have evaluated the MPF [1–17]. The aim of the present study was to report on experience with the superiorly pedicled MPF with regard to surgical technique, postoperative complications, and success rates for closing defects in the upper aerodigestive tract, in addition to providing a review and discussion of the existing literature on the topic. The use of the MPF has been incorporated into the surgical approach used at our institution. Free-tissue transfer methods such as the RFF and ALT are performed routinely and are the first choice standard techniques in our department. Pedicled flaps such as the MPF or pectoralis major flap are regarded as valuable alternatives in selected cases.

Patients and methods

A total of 70 patients were treated using an MPF to cover defects in the head and neck region following tumor resection in the Department of Otorhinolaryngology, Head and Neck Surgery at the University of Erlangen–Nuremberg in the period between 1998 and 2009. The patients included 66 men (94.3%) and 4 women (5.7%), aged between 37 and 86 (mean 56.5 years). The MPF was indicated in small to medium-sized tumors that had deeply infiltrated the wall and were therefore no longer capable of being removed using transoral laser resection, and when primary wound closure was no longer possible. The tumors were located in the oral cavity (lateral border of the tongue, hypoglottis, floor of the mouth, intraoral cheek carcinoma), the oropharynx (lateral wall, posterior wall), and hypopharynx (lateral wall, posterior wall, and anterior wall including circumscribed infiltration of lateral laryngeal structures such as the lateral thyroid cartilage and aryepiglottic fold). Contraindications for the use of the MPF have been prior chemoradiation, prior radical neck dissection, large 3-dimensional defects and subtotal defects of the pharyngeal wall.

84.3% ($n = 59$) of all patients received an adjunctive therapy. In 47.5% ($n = 28$) a simultaneous chemoradiation (CRT), in 33.9% ($n = 20$) a external beam radiation (RT), and in 11.9% ($n = 7$) an interstitial brachytherapie (iRT) of the primary tumor region was carried out. In two patients (3.4%), a CRT was combined with a iRT-boost and one patient (1.7%) got a RT combined with iRT. The medium dose in RT was 61.2 Gy (50; 74) and for iRT 59.4 Gy (56; 60).

Surgical technique and perioperative management

The procedures were all carried out with the patient under endotracheal anesthesia. To begin with, a skin island (maximum 6×12 cm) was marked supraclavicularly, corresponding to the size of the defect (Fig. 1). This was done as far as possible into the distal area of the muscle, in order to obtain a sufficiently long flap pedicle. The neck skin above the platysma was dissected away while preserving a layer of subcutaneous tissue on the muscle in order to maintain the subdermal arterial vascular plexus (Fig. 2). The ramus mandibularis has always been carefully included in the neck skin during preparation of the MPF. Neural injury to the rami of the facial nerve has never been observed. In addition, care was taken to preserve a circular extension of the subcutaneous tissue layer around the skin island as peripherally as possible. This was intended to reduce the risk of ischemia in the border zone and thus avoid the development of a fistula as far as possible (Fig. 2). Whenever feasible, the flap pedicle covered the full width of the platysma muscle. Particular attention was given to preserving the compartment-like subplatysmal fatty tissue with its arterial and venous network, so as to

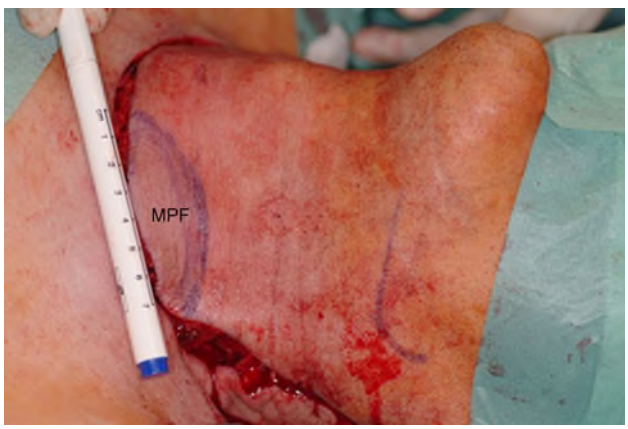

Fig. 1 The intraoperative site with the incision during raising of a cranially pedicled myocutaneous platysma flap, showing the location and marking of the flap size—9 × 5 cm in this case

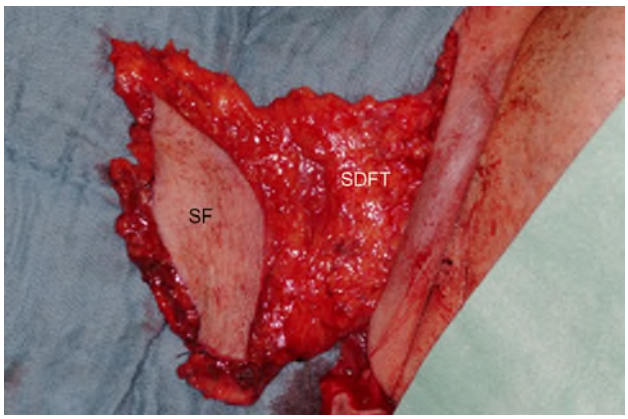

Fig. 2 The intraoperative site during raising of a cranially pedicled myocutaneous flap, with a view of the flap from anterior. The subdermal fatty layer on the platysma is seen, with preservation of the arterial vascular plexus from the facial artery and submental artery. *SF* skin flap

optimize the arterial supply and ensure adequate venous drainage, minimizing the risk of venous stasis (Fig. 3) [19–21]. The facial artery and submental artery, facial vein, and anterior jugular vein, as well as a wide bridge of soft tissue between the platysma and the mandible, were always preserved when possible (Fig. 3). The external jugular vein was released distally and raised with the flap, which also increases the mobility of the flap pedicle. During rotation of the flap into the defect, care was taken to avoid excessive stretching, compression, or twisting of the flap pedicle whenever possible. This included, for example, creating a sufficiently wide tunnel of at least two fingerbreadths under the mandible when covering defects in the area of the oral cavity and lateral wall of the oropharynx. The donor site was primarily closed using cervical and supraclavicular

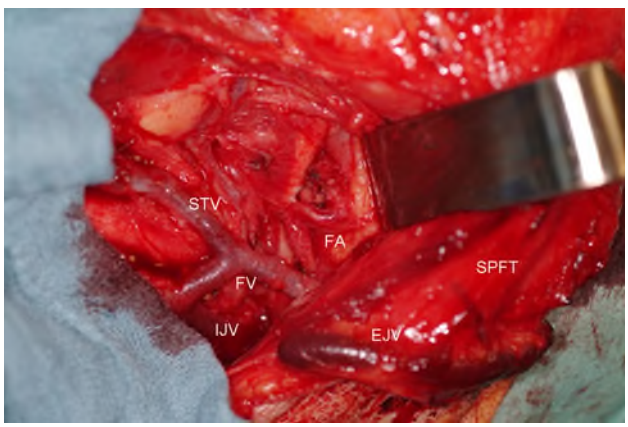

Fig. 3 The intraoperative site with a view of the flap from posterior. The subplatysmal fatty layer underneath the platysma is seen, with preservation of the facial vein and superior thyroid vein (STV). The external jugular vein was ligated distally and integrated into the flap with the subplatysmal fatty layer in order to optimize drainage via the anastomoses in the fatty layer

skin mobilization. When there was an increased risk of bleeding and/or a risk of postoperative aspiration, a tracheotomy was carried out. When postoperative dysphagia was expected, a percutaneous gastrostomy (PEG) was established.

Complications

Flap-specific complications were defined as partial and total flap necroses, as well as salivary fistulas and hematomas or postoperative hemorrhage. Partial flap necroses were defined as superficial epithelial necroses not exceeding 30% of the skin area with intact underlying muscle layer. Partial necrosis showed good secondary wound healing, without a need for a revision surgery. Other perioperative complications were wound healing disturbances such as wound seromas, wound infections, and chyle fistulas that were manageable with conservative wound care.

Donor-site complications were defined as the development of supraclavicular wound dehiscence and/or a narrow skin necrosis in the area of the sutured primary site at which the flap was raised. The development of a total flap necrosis with a need for surgical revision before the start of adjuvant treatment was regarded as representing a failure of defect coverage.

Statistical analysis was carried out using SPSS (IBM PASW Statistics, version 18.0.0). Group comparisons of target variables were performed using Pearson's chi-squared test and Fisher's exact test. The significance level was set at $P \leq 0.05$.

Results

Data on defect coverage and flap

The tumors consisted of carcinomas of the oral cavity in 37.1% of cases ($n = 26$), of the oropharynx in 24.3% ($n = 17$), and of the hypopharynx in 38.6% ($n = 27$). The histological findings showed that all of the lesions were squamous cell carcinomas. Overall, the lesions consisted of pT1 tumors in 27.1% of cases ($n = 19$), pT2 tumors in 48.6% ($n = 34$), pT3 tumors in 20% ($n = 14$), and pT4a tumors in 4.2% (carcinoma with selective infiltration of the mandible, $n = 1$; carcinomas of the lateral thyroid cartilage, $n = 2$). The mean operating time (incision to suture time), including waiting times for fresh frozen sections, was 460 min, with the raising of the flap requiring around 30 min. The flap size varied from 3 × 5 cm to 6 × 12 cm. In one patient, reconstruction was carried out in the area of the floor of the mouth using a bilateral MPF (Fig. 4). Tumor resection and raising of the MPF were carried out using a combined transoral–transcervical approach in

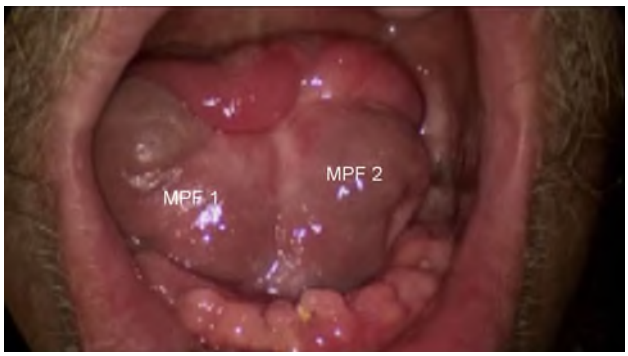

Fig. 4 The postoperative site in the oral cavity bilaterally 1 year after being covered with two myocutaneous platysma flaps. The findings show good mobility of the tongue, and the patient's swallowing function and ability to speak were not restricted

81.4% of cases ($n = 57$) and using a transcervical approach in 18.6% of cases ($n = 13$). Procedures in the mandible were carried out in nine patients, including temporary splitting of the mandible to allow better tumor exposure in three cases and continuity-preserving bone resections involving mandibular rim resection in five cases. In patients with hypopharyngeal carcinoma with infiltration of the aryepiglottic fold, circumscribed partial laryngeal resection was carried out, and partial resection of lateral thyroid cartilage was carried out when there was infiltration of the margin of the thyroid cartilage.

Neck dissection was carried out simultaneously in all patients, with bilateral neck dissection in 85.7% of cases. Level I lymph-node dissection was carried out on the side on which the flap was raised in 61.4% of cases ($n = 43$). A modified radical neck dissection, with resection of at least one of the relevant blood vessels, was necessary in 14.3% of cases ($n = 10$). The facial vein had to be ligated in 8.6% of cases ($n = 6$), the facial artery in 4.3%, and the external carotid artery in 1.4% ($n = 1$). There was no statistically significant association between resection of one or more of these flap-supplying cervical vessels and the frequency of any flap-specific complications ($P = 0.46$).

Flap-specific complications occurred in 27.1% of cases ($n = 19$) (Table 1). These involved hematoma or postoperative hemorrhage in the area of the flap in 5.7% of cases ($n = 4$; oral cavity: $n = 2$, with the patients in stages pT1 and pT2, respectively; hypopharynx: $n = 2$, with the patients in stages pT2 and pT3, respectively). A salivary fistula developed in 11.4% of cases (hypopharynx: $n = 7$, five patients in stage pT2, one patient each in stages pT3 or pT4a; oropharynx: $n = 1$, stage pT1).

Total flap necrosis developed immediately postoperatively in two patients (2.9%; oral cavity: $n = 1$, stage pT2; hypopharynx: $n = 1$, stage pT3). The total necrosis in the area of the oral cavity occurred after coverage of an intraoral cheek defect. The final defect coverage was carried out with an RFF in a revision operation. In the second case, the MPF was already reported to be very thin at the time it was raised, and in addition it was used to cover a defect on the contralateral side of the hypopharynx. A cervical salivary fistula subsequently developed, with erosion hemorrhage of the external carotid artery. In an emergency revision procedure, final defect coverage was achieved with a pectoralis major flap. In these two cases, the flap pedicle was too short, on the one hand, and was subject to excessive stretching and twisting on the other, leading to a compromised blood supply.

Another patient with an uncomplicated postoperative course and vital MPF developed total flap necrosis 3 months after completing the adjuvant interstitial brachytherapy in the oral cavity that was indicated. A revision operation and defect coverage with an RFF were carried out in this case as well. This necrosis has not been count as a failure due to surgical procedure or as a flap-specific complication but as a failure due to this kind of radiation therapy.

Partial flap necrosis occurred in 7.1% of cases ($n = 5$; oral cavity: $n = 2$, with one patient in stage pT1 and one in stage pT2; oropharynx: $n = 1$, stage pT2; hypopharynx: $n = 2$, both patients in stage pT2). In two of these cases, ligation of the facial vein had been carried out intraoperatively. One patient developed a partial flap necrosis and a

Table 1 Frequencies and locations of 19 flap-specific complications in $n = 14$ patients

	n	%	Oral cavity	Oro-pharynx	Hypo-pharynx	Management
Partial flap necrosis	5	7.1	2	1	2[b, c]	Conservative
Total flap necrosis	2	2.9	1	–	1[a]	Surgical
Fistula	8	11.4	–	1	7[a,b,c]	7 conservative 1 surgical
Hematoma/postoperative hemorrhage	4	5.7	2	–	2[a,b]	Surgical

[a] $n = 1$ with total flap necrosis and fistula and erosion hemorrhage → emergency revision procedure

[b] $n = 1$ with partial flap necrosis and fistula after surgical treatment of a postoperative hemorrhage; the partial necrosis and the fistula were treated conservatively

[c] $n = 1$ with partial flap necrosis and fistula showed timely wound healing due to conservative treatment

fistula after surgical treatment of a postoperative hemorrhage. In another case, a salivary fistula was associated with a partial flap necrosis after defect coverage in the hypopharynx. The fistula and the partial necrosis were treated conservatively in both cases and showed an uncomplicated course with timely wound healing within 1–2 weeks due to daily intensive wound care. In all cases, adequate defect coverage was achieved and no revision procedures were needed. The beginning of a postoperative adjuvant therapy was not delayed.

Perioperative complications that were not flap-specific occurred in 25.7% of cases ($n = 18$) in the area of the neck wound, such as superficial cervical wound healing disturbances and wound infections. A chyle fistula occurred in one case after resection of a hypopharyngeal carcinoma with bilateral neck dissection, and the fistula was revised surgically.

Wound dehiscence in the area of the supraclavicular donor site occurred in 10% of cases ($n = 7$), caused by a narrow skin necrosis on the margin in one case (1.4%). One triangular dehiscence measuring $4 \times 4 \times 4$ cm and one oval dehiscence measuring 5×9 cm had to be covered with full-skin transplants measuring 2×2 cm and 3×5 cm, respectively, following good wound contraction. Another dehiscence was closed with a secondary suture.

In summary, adequate coverage of the resulting defect was achieved with the MPF in 97.1% of the patients included in this study ($n = 68$) (Figs. 4, 5, 6, 7).

Tracheotomies were carried out intraoperatively in 62.5% of the patients ($n = 40$), and were closed again in 72.5% of these cases ($n = 29$; minimum postoperative follow-up period 2 months). PEGs were placed in 78.1% of cases ($n = 50$), but long-term nutrition exclusively via the PEG was necessary only in 7.8% ($n = 5$). Swallowing function was not significantly impaired in 71.9% of cases (minimum postoperative follow-up period 2 months).

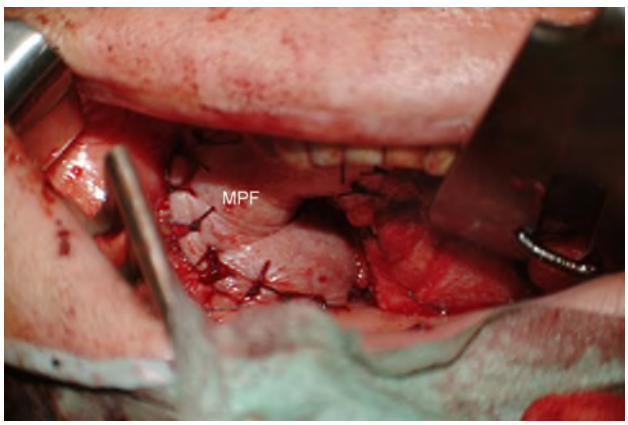

Fig. 5 Intraoperative site. Covering of a defect in the anterior and lateral floor of the mouth up to the base of the palatal arch on the left using a myocutaneous platysmal flap

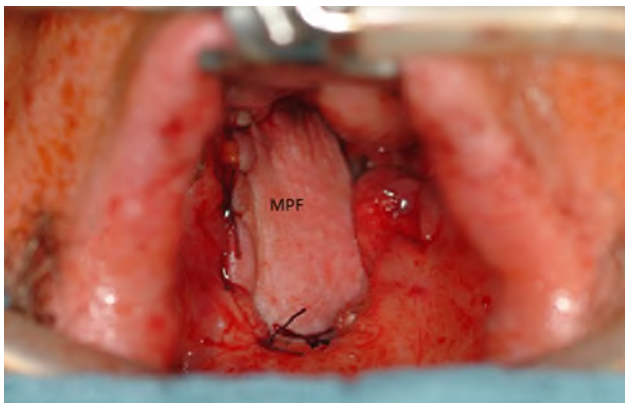

Fig. 6 The intraoperative site after coverage of a defect in the area of the tonsil bed, with the lateral oropharyngeal wall on the left with the myocutaneous platysma flap

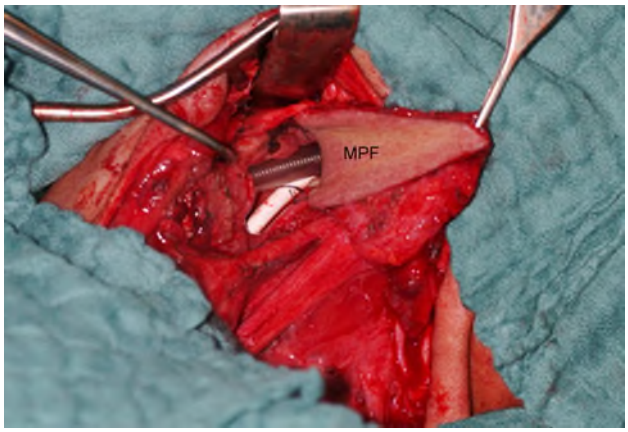

Fig. 7 The intraoperative site before suturing of the myocutaneous platysma flap to cover a defect in the lateral wall of the hypopharynx (*black arrow*) and bordering lateral laryngeal region (*white arrow*)

Discussion

The aim of reconstruction for defects in the swallowing tract following ablative tumor resection in head and neck surgery is to restore anatomic integrity, with good oncological results, a low procedural mortality rate, and rapid rehabilitation of the patient's swallowing and respiratory function. This can nowadays be achieved in a standardized fashion for every type of defect, using free-tissue transfer with microvascular pedicles [22–27]. For small to medium-sized tumors with deep infiltration into the wall, however, free flaps may involve a disproportionately high level of risk for the compromised patient as well as being an elaborate procedure for the therapist. In these cases,

covering a full-thickness defect using a locally pedicled flap such as the MPF represents a useful alternative.

However, there is controversy regarding the MPF in the literature. Disadvantages mentioned include anatomic limitations (particularly an inadequate pedicle length for specific tumor locations) and the uncertainty of the vascular supply. These factors are associated with uncertain postoperative perfusion and have been thought to be responsible for the increased flap-specific complication rate of up to 45% when the MPF is used [2–4, 9–11, 14–17]. However, several studies have also emphasized that success depends on careful preoperative patient selection and adequate surgical technique [3, 5, 8, 9, 11–13, 18, 28]. Predictable intraoperative situations, that are highly likely to be associated with compromised perfusion, such as an expected radical neck dissection in a cN3 situation, have to be included in the surgical planning [2–5, 9–11, 15–17]. A limited size for the skin island, with a maximum of 70 cm^2, also often excludes the use of the MPF for example for the reconstruction of larger 3-dimensional defects or subtotal defects of the pharyngeal wall. Despite this, Ruark et al. [3] do not in principle regard T3 and T4 tumors as contraindicating the use of the MPF3. To achieve adequate structural and functional coverage of the defect, flap shrinkage of up to 30–40% should be taken into account during planning [2–5, 7–11, 15–17]. In our view as well, the MPF should therefore only be used in selected cases in patients with T3 or T4 tumors [9, 16]. This includes patients with small to medium-sized tumors with circumscribed infiltration of laryngeal cartilage structures or the mandible, for example.

Taking these contraindications and limitations into account, the MPF can successfully be used as a very thin flap to cover small to medium-sized defects in the entire upper aerodigestive tract (Figs. 4, 5, 6, 7, 8) [3, 5, 8, 11, 13, 28].

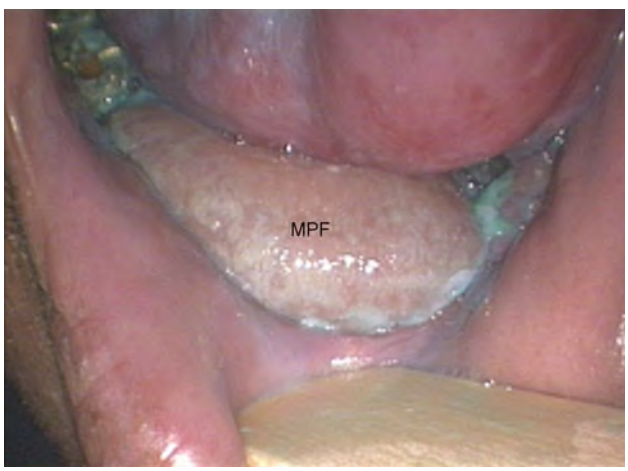

Fig. 8 The postoperative site 3 months after coverage of a defect in the floor of the mouth area on the right using a myocutaneous platysma flap. The mobility of the tongue is not restricted

This is particularly the case when primary closure is only just not possible, or at least only with a risk of significant functional limitation. The MPF can be planned as a primary procedure here, or it can be used as an "auxiliary flap", as it can be raised in the same session with only a minor modification of the surgical access route. Due to the small volume and good plasticity of the MPF, the risk of flap bulking is markedly reduced in comparison with many other types of flap. The MPF can also provide an almost anatomical equivalent to replace the pharyngeal wall or piriform sinus even in the longer term (Figs. 9, 10). As in

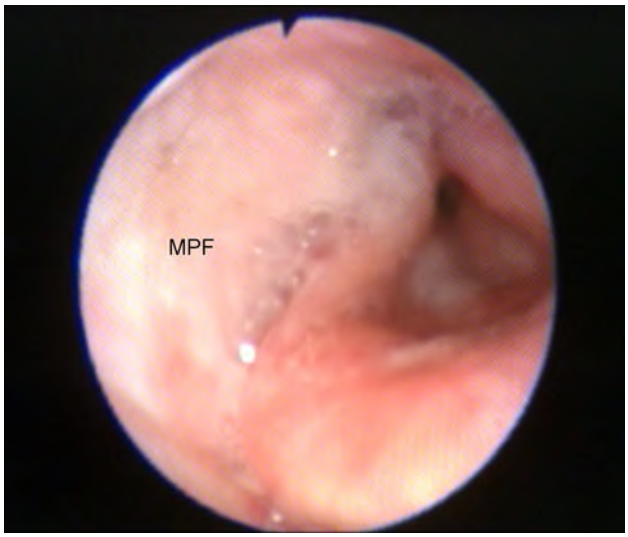

Fig. 9 The postoperative site 1 year after coverage of a defect in the area of the oropharynx and posterior wall of the hypopharynx with a myocutaneous platysma flap

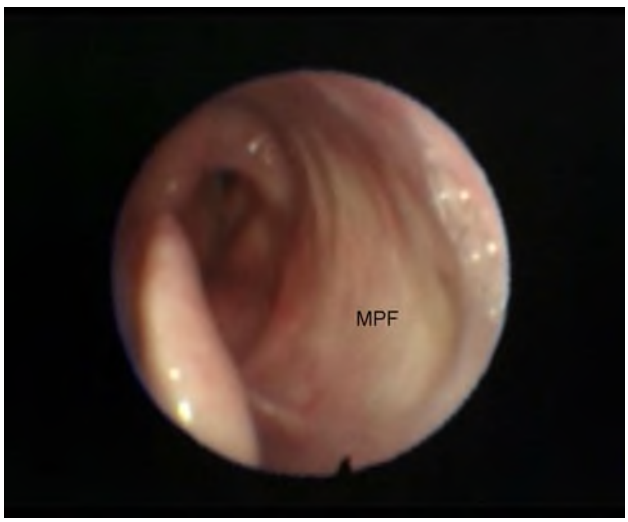

Fig. 10 The postoperative site 2 years after resection of the lateral posterior wall of the hypopharynx and lateral parts of the larynx, including the aryepiglottic fold, thyroid cartilage, and epiglottis, with coverage of the defect using a myocutaneous platysma flap

the reports by Julieron et al. [12] and Suárez Nieto et al. [29], hypopharyngeal carcinomas with or without infiltration of the lateral thyroid cartilage proved to be a very good indication in the present group of patients as well.

The rate of flap-specific complications in this series was 27% in the mid-range of the 10–45% complication rates reported in the literature [1, 3, 4, 9–11, 15–17]. A flap-specific complication rate of 33.7% was reported in a meta-analysis by Szudek and Taylor [4] including 190 patients from 16 published reports. Julieron et al. [12] reported a 27% rate of total flap necroses when using the MPF after resection for hypopharyngeal carcinoma. Verschuur et al. [11] and Szudek and Taylor [4] report failure rates—i.e., total flap necroses with a need for flap revision—of 2.5–5.0%, comparable with the 3% rate in the present study. Verschuur et al. [11] and Ruark et al. [3] report partial flap necroses (involving a maximum of 50% of the skin area) in up to 30% of cases. As in the present study, in which partial flap necroses (not exceeding 30% of the flap area) occurred in 7% of cases, all of the patients treated in the reports cited showed secondary reepithelialization after daily wound care. Rejection of parts of the most superficial epithelial layer of the MPF is not in principle regarded as a failure in the literature if the underlying muscle is preserved and there is adequate defect coverage [8, 11, 19]. The presence of partial necroses and epidermolysis also appears to be liable to subjective assessment on the part of the examiner [5]. Agarwal et al. [19] and Mazzola and Bennazzo [30] noted that the epidermolysis of the MPF observed in 15–30% of cases must not be regarded solely as a sequela of arterial underperfusion and instead appears to be caused more by venous stasis. Hurwitz et al. [18] and other authors point out that a dissection technique involving attention to the specific vascular supply of the MPF can avoid complications following use of this type of flap [3, 6, 9, 11, 15, 18–20]. To achieve reliable and adequate perfusion, the subdermal fatty tissue with its arterial vascular plexus and the subplatysmal fatty tissue with the arterial and venous network that it contains should remain adherent to anastomoses on the platysma (Figs. 1, 2, 3). In the present study, this provided protection for the relevant arteries and veins (the facial artery, submental artery, facial vein, external jugular vein, and anterior jugular vein) in 85.7% of the cases. In addition, any form of torsion, stretching, or crushing of the flap pedicle during dissection of a sufficiently wide tunnel must be strictly avoided. This is made clear by the fact that three of the patients in the present study who had partial necroses following defect coverage in the oral cavity or lateral wall of the oropharynx showed signs of venous stasis. In addition, the MPF has proved to be unsuitable for covering defects outside the range of the pedicle, particularly on the contralateral side. Using the MPF outside of the above indications was also the cause of all cases of total flap necrosis during the immediate postoperative period that occurred in the present series. We would agree with authors such as Ruark et al. [3], Verschuur et al. [11], and Agarwal et al. [19] that the external jugular vein should be ligated far distally whenever possible and should be routinely included in the flap pedicle. According to Saito et al. [31], this procedure leads to a significantly higher likelihood that the MPF will survive. In addition, there are reports in the literature that ligation of the facial vein appears to be associated with a greater risk of inadequate perfusion of the MPF [6, 21]. Partial flap necrosis was also observed in the present study in 33% of cases after ligation of the facial vein. Particular care should therefore be taken to ensure that venous drainage is provided by preserving other veins, particularly the external and anterior jugular veins [18, 31].

There is controversy in the literature on whether ligation of the facial artery represents a contraindication or a risk factor for the survival of the MPF. At the same time, most studies do not provide precise details of the site at which the facial artery is ligated. Ruark et al. [3] and McGuirt et al. [15], as well as other authors, regard ligation of the facial artery as not absolutely contraindicating the use of the MPF if the dissection technique is otherwise adequate [3, 7, 8, 15, 16, 18]. Hurwitz et al. [18] describe in detail the way in which the extensive network of ipsilateral and contralateral arterial anastomoses in the submental artery may explain flap survival following ligation of the facial artery. The facial artery or submental artery should always be preserved if possible, as the primary axial blood supply for the MPF is otherwise becomes adventitious [9]. According to the observations reported by Verschuur et al. [11] and Conley et al. [9], routine ligation of the facial artery appears to be associated with a potential risk to the vitality of the flap. However, the data from the present study show that ligating the facial artery distal to the submental artery (done in 4.3% of cases in this series) does not necessarily lead to tissue damage. Since perfusion of the MPF is also in principle possible from the contralateral side, the ligation of the external carotid artery that was carried out in one case in this study did not lead to substantial damage to the flap—in contrast to the findings reported by Grützenmacher et al. [7]. Overall, resection of important vessels such as the facial artery, facial vein, and external carotid artery did not show any statistically significant association with the frequency of flap-specific complications ($P = 0.46$).

Total flap necrosis developed in one patient in the present study after the completion of postoperative interstitial brachytherapy ($n = 10$). This suggests that interstitial radiotherapy also represents a risk factor for substantial tissue damage with the MPF, in the same way as has been

reported for free flaps [32]. In contrast, percutaneous adjuvant radiotherapy does not appear to have any negative effects on the survival of the MPF, which were also not observed in any patients in the present study [9, 16, 33].

Szudek and Taylor [4] report the development of salivary fistulas in 9% of cases after using the MPF4. The rate of salivary fistulas in the present study was 11.4% ($n = 8$), with seven of the fistulas developing after defect coverage in the hypopharynx. All but one of the fistulas were managed with conservative treatment. Salivary fistulas developed in a total of 26% of defects in the hypopharynx that were covered using the MPF. This is in good agreement with the fistula rates reported by Suárez et al. [29] and Julieron et al. [12] of 25–33% following reconstruction of the posterior hypopharyngeal wall with an MPF. In contrast, the rate of oropharyngeal fistulas in the present study was 6%. Overall, these results indicate a higher rate of salivary fistulas after defect coverage in the hypopharynx in comparison with the oropharynx. Koch [5] attempted to explain this as a result of the lack of support for the MPF from surrounding anatomic structures in the hypopharynx5. Possible border-zone ischemia in the MPF may therefore influence fistula development in the hypopharynx in particular. Dissecting a subcutaneous extension around the skin island might therefore be able to reduce the risk of fistula.

Donor-site complications, most of which can be managed conservatively, are reported in the literature to occur at a rate 6–12% [3, 5, 7]. The rate of 10% in the present study is thus well comparable with other findings and underlines the low donor-site morbidity rate reported by Verschuur et al. [11].

Overall, the present results show that sufficient coverage of the defect using the MPF was possible in 97% of cases. In their review, Szudek and Taylor [4] report a comparable success rate of 95% in 190 patients4. Success rates with free flaps of 91–99% are reported by various centers [23–27]. Despite their advantages, free flaps also not infrequently have limited application due to the length of the vascular pedicle, and perfusion disturbances associated with the microvascular surgical technique used are observed in 5–25% of cases as well [23–27]. In summary, these results suggest that after careful patient selection and with appropriate surgical technique, the MPF can be used in selected cases with a success rate that is comparable with that of other types of flap plasty. In contrast, the reduced technical effort involved and the ability to raise the MPF with low morbidity at the donor site represent an acceptable solution also in patients with high preoperative morbidity. In addition, the MPF can be raised in the same session using a slight modification of the planned surgical access route if defect coverage that was not preoperatively planned proves to be necessary.

Conclusions

In the light of free-tissue transfer, being now a days the first choice standard technique in the closure of defects after head and neck surgery, a thin flap like the MPF is maybe a valuable alternative for covering defects in the oral cavity, oropharynx, and hypopharynx, and also particularly in the border area of the laryngeal orifice. Small to medium-sized defects can be covered with a high success rate and also with good functional results, due to the small volume of the flap. It is important to use an adequate dissection technique, to observe the indications and contraindications, and to carry out careful patient selection. When these prerequisites are met, the MPF is a useful alternative in the context of balanced defect coverage in the head and neck region and should form part of the repertoire of every head and neck surgeon involved in oncological care.

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