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Original Articles

Planned Simultaneous Cervical Skin Reconstruction for Salvage Total Pharyngolaryngectomy

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Background: Salvage surgery after definitive radiotherapy with or without chemotherapy is still controversial, especially in cases of hypopharyngeal cancer because of the poor prognosis and surgical complications. Irradiation of the skin results in loss of flexibility of the skin and impairment of the normal healing processes, thereby increasing the risk of wound infections, which could be potentially life-threatening. In an attempt to diminish the risk of major complications, we performed planned cervical skin replacement with salvage total pharyngolaryngectomy (TPL).
Methods: From 2005 to 2006, six patients underwent salvage TPL and cervical reconstruction with a deltopectoral flap at our hospital. The cervical skin replacement was determined pre-operatively and not according to the intraoperative status.
Results: There were no major post-operative complications. Both the prolongation of the operation time and of the duration of hospitalization were within acceptable limits.
Conclusion: Planned cervical skin reconstruction appears to be an appropriate and acceptable procedure with salvage pharyngolaryngectomy to avoid major complications.

Key words: hypopharyngeal cancer – reconstruction – chemoradiotherapy – salvage surgery – complication

INTRODUCTION

Remarkable improvements have been achieved in the treatment of head and neck squamous cell carcinoma (HNSCC) in recent years, owing to the advances in the radio- and chemoradiotherapeutic techniques employed. In the case of hypopharyngeal cancer, concurrent chemoradiotherapy has been shown to yield good complete response rates (1) and radiation combined with induction chemotherapy has been reported to be equivalent in therapeutic effect to surgery-based therapy which causes loss of voice (2,3). As organ preservation is very important for patients, more and more patients have begun to prefer radiation-based treatments. Unfortunately, in cases with locoregional control failure, surgical intervention is often considered as a salvage measure. However, the rationale of salvage surgery for locally recurrent hypopharyngeal cancer is still controversial in view of the high incidence of post-operative complications and the poor prognosis (4). Irradiation may cause radiodermatitis and fibrosis, with the resultant scarring producing loss of flexibility of the cervical skin and subcutaneous soft tissues, which poses surgical difficulties during subsequent salvage surgery. In addition to the intraoperative difficulties, the risk of post-operative complications, some of which can be life-threatening, e.g. carotid artery rupture, is also significantly increased (4–6). Wound healing is delayed and the normal processes of healing are impaired, which increase the risk of dehiscence and the chances of bacterial infection (7). Therefore, we were prompted to attempt replacement of the irradiated cervical skin with non-irradiated skin during salvage surgery. In this study, we report the usefulness of

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Table 1. Patient characteristics

Patient	Age	Sex	Primary disease[a]	Primary treatment	Time to salvage	rTNM
1	63	Male	HPC(PS) T2N0M0	HART 72Gy	5 months	rT2N0M0
2	62	Male	HPC(PC) T1N2bM0	cCRT 70Gy	9 months	rT2N0M0
3	54	Male	CeEso TxN2bM0	cCRT 60Gy	2 months	rT3N2bM0
4	63	Male	HPC(PS) T3N2bM0	RT 70Gy with ICT	1 y 1 month	rT2N0M0
5	60	Male	HPC(PS) T3N0M0	cCRT 70Gy	2 y 6 months	rT3N0M0
6	64	Male	HPC(PS) T2N0M0	HART 72Gy with ICT	1 y 4 months	rT2N0M0

The TNM classification of cervical esophageal cancer was applied as that of hypopharyngeal cancer. HPC, hypopharyngeal cancer; CeEso, cervical esophageal cancer; PS, pyriform sinus; PC, post-cricoid; HART, hybrid accelerated radiotherapy; cCRT, concurrent chemoradiotherapy; RT, radiotherapy; ICT, induction chemotherapy; rTNM, TNM stage at recurrence.
[a]TNM (UICC 2002).

'preoperatively planned' cervical skin reconstruction with a deltopectoral (DP) flap in cases undergoing salvage total pharyngolaryngectomy (TPL) after intensive radiotherapy or concurrent chemoradiotherapy, for the prevention of major post-operative complications.

PATIENTS AND METHODS

From February 2005 to December 2006, a total of six Japanese patients underwent salvage TPL and planned cervical reconstruction with a DP flap at the University of Tokyo Hospital, Tokyo, Japan. All patients were males, with a mean age of 61 years (range 54–64 years). Of the six patients, five had hypopharyngeal cancer and one had cervical esophageal cancer. Pathologically, the primary lesion was squamous cell carcinoma in all the cases. The patients had previously received radiation therapy or concurrent chemoradiotherapy, as described in Table 1, however, local recurrence necessitated salvage surgery. The chemotherapeutic regimen for concurrent chemoradiotherapy was intravenous cisplatin, pirarubicin hydrochloride and fluorouracil, administered either singly or in combination. The mean interval from the primary therapy to the salvage surgery for local recurrence was 12.5 months (range 2–30 months). The TNM stages at recurrence (rTNM) are also shown in Table 1.

All patients gave informed consent for the surgical procedure after obtaining a thorough understanding of the risks of the salvage surgery. TPL with pharyngeal tube reconstruction using a free jejunal flap was performed for locally recurrent disease in all cases, and neck dissection was also undertaken where possible. Simultaneous cervical skin reconstruction with a DP flap, after sacrificing the irradiated anterior cervical skin, was performed with epidermization of the donor site of the flap with a graft from the femoral area (Fig. 1). Prophylactic antibiotics (cefotiam hydrochloride or cefazolin sodium) were given to all patients for 4–6 post-operative days. This procedure was determined pre-operatively in all the cases of this series according to the comprehensive physical condition of the irradiated cervical skin, i.e. its flexibility, color and the thickness of the subcutaneous fat tissue. The peri- and post-operative courses of all the cases were evaluated retrospectively to determine the incidence of complications and the prognoses. The severity of the complications was classified according to the scheme proposed by Weber et al (8).

Figure 1. Intraoperative view of the procedure. Irradiated anterior cervical skin is sacrificed and replaced with a flexible deltopectoral (DP) flap.

RESULTS

The surgical procedure was as mentioned above, and a schema is shown in Table 2. Bilateral level II–IV neck dissection was also performed in the majority of the cases. Neck dissection was omitted in one case due to the strong inflammatory adhesions that had developed following the development of a cervical abscess, and unilateral dissection was performed in another case due to previous neck dissection on the opposite side. The mean operation time was 12 h 13 min (range 10 h 15 min–14 h 3 min). The mean intraoperative hemorrhage volume was 398 ml (range 250–500 ml). Two cases required intraoperative blood transfusion. The mean time to oral intake after the operation was 12.5 days (range 10–15 days). The mean duration of hospitalization after operation was 28 days (range 22–40 days).

Table 2. Surgical data and prognosis

Patient	Surgical procedure	Operation time	Hemorrhage (ml)	Blood transfusion	Prognosis
1	TPL + FJT + DP	12 h	445	−	DOD after 12 months
2	TPL + bil.ND + FJT + DP	13 h 5 min	500	−	NED after 31 months
3	TPL + bil.ND + FJT + DP	14 h 3 min	510	+	DOC after 7 months
4	TPL + bil.ND + FJT + DP	12 h 25 min	250	+	DOD after 6 months
5	TPL + bil ND + FJT + DP	11 h 30 min	280	−	NED after 15 months
6	TPL + lt.ND + FJT + DP	10 h 15 min	400	−	NED after 14 months

TPL, total pharyngolaryngectomy; FJT, free jejunal transfer; DP, skin reconstruction with a deltopectoral flap; ND, neck dissection; DOD, died of the disease; NED, no evidence of disease; DOC = died of other cause.

None of the cases developed any major acute post-operative local complications, such as flap necrosis, salivary fistula formation and life-threatening major vessel crisis, or systemic complications. Therefore, during hospitalization, no further surgical procedures were necessitated in any of the cases and there were no surgery-related mortalities. In two cases, wound infection (peri-tracheostoma infection) occurred as an acute minor post-operative complication, which was treated by intravenous antibiotic administration. In two cases, stenosis of the tracheostoma was observed because of the coverage of the stoma by the sagging DP flap; this was treated by tube insertion or pulling up of the sagging skin with a tape after hospitalization (Fig. 2). During the follow-up period, two of the six patients died of the disease: one died due to recurrence in the parapharyngeal space and skin metastasis 6 months after the surgery, and another due to recurrence in the supraclavicular region 12 months after the surgery (Table 2). One patient died of other causes 7 months after the surgery, although he had lung metastasis at that time. The remaining three patients are alive at the time of writing, without evidence of disease recurrence (follow-up period range 14–31 months).

DISCUSSION

Intensive radiotherapy and concurrent chemoradiotherapy are becoming increasingly preferred strategies for the treatment of HNSCC. Previous studies have reported better survival rates with altered fractionated radiotherapy, including hyperfractionated and accelerated radiotherapy, than with conventional radiotherapy (9,10). Also, concurrent chemoradiation methods are now commonly chosen for advanced-stage head and neck cancers based on the equivalent or superior survival, locoregional control and organ preservation rates (1,11). Soo et al. (12) reported that there was no significant difference in the survival rate between advanced HNSCC patients treated by surgery and those treated by concurrent chemoradiotherapy. Recently, hyperfractionated or accelerated hyperfractionated concurrent chemoradiotherapy has also been evaluated for very advanced HNSCC (13,14). In cases of hypopharyngeal cancer, radiotherapy combined with induction chemotherapy has been reported to yield equivalent outcomes to surgery combined with post-operative radiation (2,3). As organ preservation, especially laryngeal preservation, may be expected to improve the quality of life, the aforementioned treatments have come to be increasingly preferred as compared to conventional surgery combined with post-operative radiation in patients with HNSCC (15).

On the other hand, in those cases with failure of organ preservation therapy, surgical procedures often need to be considered for salvage. The usefulness of salvage surgery is still controversial and such a surgery is regarded as a 'high stake' surgery, because of the poor prognosis, high risk of complications and also even the low cost–benefit ratio of the treatment (4–6,16). The disease-specific 5-year survival rate

Figure 2. Stenosis of the tracheostoma was seen in two cases. (A) Due to sagging of the DP flap (arrows in A); tube insertion (B) or pulling up of the flap with a tape (arrows in C) was conducted after hospitalization.

of salvage surgery has been reported to be only 20%, especially in cases of hypopharyngeal cancer, and it has, therefore, been suggested that in these cases, salvage surgery should be performed only in very carefully selected cases (4). Not only minor complications, but also major ones, such as fistula formation and flap necrosis, are often reported in cases undergoing salvage surgery, which can sometimes directly lead to life-threatening carotid artery rupture (4–6). Although Proctor et al. (17) reported that patients treated by chemoradiation did not seem to be any significantly increased risk of acute post-salvage surgery complications, they did not include cases undergoing free tissue transfer in their study series. Meticulous attention should be paid to the operative procedure during salvage TPL, because the carotid arteries of both sides are exposed during the surgery. We, however, believe that salvage surgery should not be unduly restricted, except in unresectable cases and high-risk surgical cases because of poor general conditions, as better survival would be expected in cases with a favorable TNM stage at recurrence and a negative tumor resection margin (18); furthermore, even if the prognosis is poor, successful surgery without any major complications might still prolong the patients' time spent at home.

From January 2003 to 2005, we treated eight cases of salvage TPL with free jejunal transfer at our hospital, in none of which we performed skin reconstruction. We encountered major post-operative complications in four out of the eight cases, including one case of anastomotic leak that necessitated a second operation and three cases of carotid rupture. Therefore, the incidence rate of major complications was as high as 50%. Retrospective analysis of these cases has revealed that in the cases with the carotid rupture, the complication had developed consequent to wound infection caused by skin flap necrosis or seroma caused by poor vascularization and loss of flexibility of the irradiated skin, even in the absence of salivary fistula formation or jejunal flap necrosis. Irradiation damages the skin and subcutaneous tissue in terms of impairing wound healing (7). Impairment of fibroblast function by irradiation effects atrophy, contraction and fibrosis, leading to impaired wound healing (7), and surgeons often encounter surgical difficulties while operating on the irradiated tissue (6). It is recommended that all possible dead spaces be filled and that wounds be drained well and closed without tension to avoid the formation of seromas or hematomas which could cause wound infection (7,19). The effect of irradiation on wound healing is clearly dependent on the radiation dose (20) and organ damage occurs more frequently in patients undergoing concurrent chemoradiotherapy than in those undergoing radiotherapy alone (21). It has also been reported that surgery after induction chemotherapy was associated with a higher risk of post-operative complications in patients with HNSCC (22). Therefore, in this report, we have suggested a new surgical procedure, namely 'preoperatively planned' reconstruction of cervical skin with salvage TPL after radio- or chemoradiotherapy using non-irradiated, flexible and well-vascularized DP flaps. We have performed this procedure in cases needing salvage TPL at our hospital since February 2005, and have noted that the complication rate is indeed lower than that in the cases in which skin reconstruction is not undertaken after radio- or chemoradiotherapy. Reconstruction with flexible skin allows easy drainage and wound healing, reducing the risk of infections following the formation of seromas or hematomas. While there are some reports which suggest a high complication rate with the use of DP flaps and sacrifice of donor site, such as conspicuous scar deformity in the upper chest region (23), the DP flap remains a major useful candidate for neck reconstruction, especially as a salvage option (24), and indeed, we did not encounter any major complications in our series. The vascularization of the DP flaps, which we used only for covering the anterior neck region in this series, was maintained well, when the several perforators of the internal thoracic artery were preserved appropriately. Although superselective or selective neck dissection in salvage surgery and no elective neck dissection in recurrent N0 cases have been advocated (25,26), we suppose that replacement of cervical skin makes performance of neck dissection combined with TPL safer and also improves locoregional control. Although we have not yet determined definite criteria for this procedure, we think that it is especially valid for cases treated by concurrent chemoradiotherapy or altered fractioned radiotherapy, because the cervical skin in these cases seems calloused and poorly vascularized. During the same period, we encountered only two cases of salvage TPL without skin reconstruction which resulted in just a minor anastomotic leak and in no post-operative trouble, respectively, but they were cases of failure of conventional radiotherapy alone.

In this series, the operation time, time to oral intake and the duration of hospitalization all tended to be longer than those after TPL with a free jejunal flap reconstruction performed as first-line treatment at our hospital, although the data were not strictly comparable. The prolongation of the operation time was attributed to the surgical difficulties encountered during the manipulations in the irradiated area and the extra time required for elevation of the DP flap and epidermization at the donor site. Furthermore, the prolongation of hospitalization was attributed to the extreme caution required in monitoring the wound condition and hesitation against early start of oral intake post-operatively because of anxiety about salivary fistula formation, which was reported to occur in about 20% of cases undergoing salvage surgery in a previous study (5), and the long time required for epithelialization at the donor site of the DP flap and the skin grafting. We do not believe that these are too problematic, and also from the medical economics point of view, this procedure might prove to be more cost-beneficial than managing potential major complications following surgery which might necessitate other expensive medical interventions. As minor complications, we encountered stenosis of the tracheostoma in two cases, which did not deteriorate the quality of life of the patients. In this report,

although we have presented only a small number of trial cases, the results suggest that the survival prognosis might be as poor as that reported previously (4), because half of the cases died within the very short follow-up period. On the other hand, all of the patients could be discharged from the hospital without major complications and could spend their last days at home without any medical intervention, with a good locoregional control rate. Recently, Fung et al. (27) reported a new surgical technique to avoid major wound complications, involving the use of a free vascularized flap placed at the pharyngeal closure at the time of salvage laryngectomy after chemoradiotherapy. They report that the technique 'converts' major wound complications into minor ones. Although we also do, of course, believe that salvage TPL is not a very safe surgical procedure and that the indications should be considered very carefully after obtaining informed consent, the procedure described in this report, even though the number of cases in which it was tried was small, could reduce the risk of major complications as suggested by Fung et al (27), and appears to be acceptable. A greater number of cases should be accumulated and followed up for complications to validate the usefulness of this preventative procedure for salvage surgery, to establish definite criteria for the procedure and to develop even safer surgical techniques.

Conflict of interest statement

None declared.

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Combination of Costal Cartilage Graft and Rib-Latissimus Dorsi Flap: A New Strategy for Secondary Reconstruction of the Maxilla

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In secondary reconstruction of the maxilla, skeletal reconstruction as well as soft tissue augmentation is required to obtain a good contour. We present a new strategy for combining a costal cartilage graft with a rib-latissimus dorsi flap. We used this method to treat a 39-year-old man who had previously undergone total maxillectomy. First, a vascularized rib, elevated together with a latissimus dorsi flap, was fixed between the middle of the maxilla and the edge of the zygomatic arch. The small defects that could not be reconstructed with the rib only were reconstructed with a costal cartilage graft. The patient did not develop any postoperative infection or flap necrosis. Thirteen months after the secondary reconstruction, he presented with a good contour of the cheek. Our method was effective for the reconstruction of a complex skeletal defect of the maxilla.

Key Words: Reconstruction of maxilla, costal cartilage graft, rib-latissimus dorsi flap

Secondary reconstruction of the maxilla remains a challenging problem for reconstructive surgeons. In this type of reconstruction, skeletal reconstruction as well as soft tissue augmentation is required to obtain a good contour. Various methods, primarily those using a vascularized bone, have been reported.[1–9] However, it remains difficult to reconstruct a complex skeletal defect using only a single vascularized bone. Here, we describe a new strategy for secondary reconstruction of the maxilla that combines a costal cartilage graft with a rib-latissimus dorsi flap.

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Clinical Report

A 39-year-old man was referred to our institution for secondary reconstruction of the maxilla. Three years before, the patient had undergone total maxillectomy for squamous cell carcinoma of the maxilla, and the orbital contents had been preserved. At that time, immediate reconstruction was performed with a titanium mesh plate for the orbital floor and a free rectus abdominis musculocutaneous flap for the soft tissue defect. After surgery, the patient sustained a contour deformity of the left cheek, including a posterior deviation of the alar base and oral commissure (Fig 1). Preoperative three-dimensional computed tomography scan showed a large bony defect of the maxilla, with the exception of the orbital floor, which had been reconstructed with the titanium mesh plate (Fig 2). To reconstruct the skeletal defect, a vascularized rib was to be elevated together with a latissimus dorsi flap. The small defects that could not be reconstructed with the rib alone were to be reconstructed using a costal cartilage graft.

A subcutaneous pocket beneath the left cheek was created through a scar from the previous surgery. To reduce the risk of infection, care was taken not to open the nasal and oral side, which had been reconstructed with a rectus abdominis musculocutaneous flap. Another small incision was made, and the right facial vessels were exposed as recipient vessels because the left facial vessels had been used in the previous operation. The seventh costal cartilage was also harvested at the time of the procedure described here. Then, a free latissimus dorsi musculocutaneous flap (15 × 6 cm) was elevated together with the ninth rib (length, 10 cm). The rib was vascularized by a perforator between the

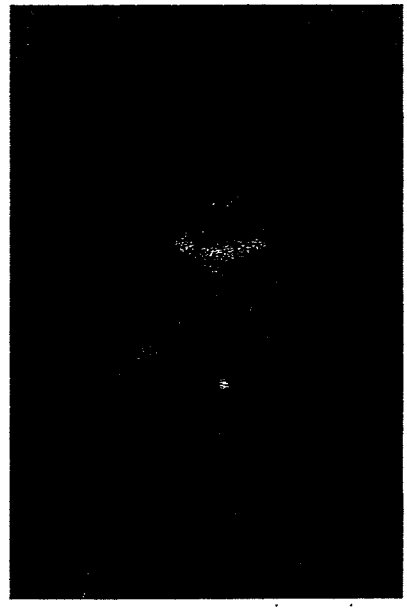

Fig 1 Preoperative view.

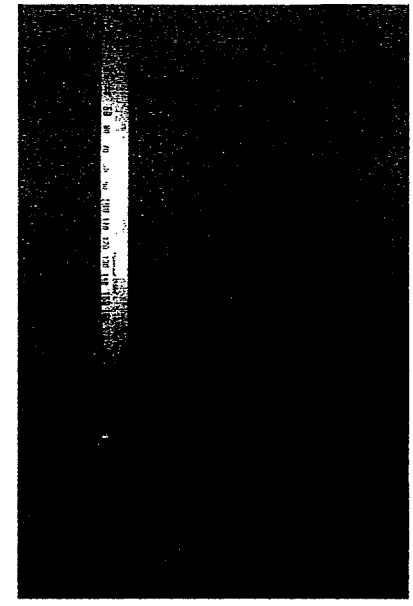

Fig 3 Rib-latissimus dorsi flap. Arrow shows a perforator.

latissimus branch of the thoracodorsal vessels and the intercostal vessels (Fig 3). The rib was fixed between the middle of the maxilla and the edge of the zygomatic arch. The piriform aperture and the alveolar ridge, neither of which could be reconstructed with the rib alone, were reconstructed with a costal cartilage graft. The harvested seventh costal cartilage was divided into two pieces. Each of these two pieces was trimmed to the shape of the defect and was then fixed to the defect (Fig 4). The grafted cartilage was covered with a de-epithelized latissimus dorsi flap. The thoracodorsal vessels were anastomosed to the right facial vessels.

The patient did not develop any postoperative infection or flap necrosis. Ten months after the secondary reconstruction, he underwent revision

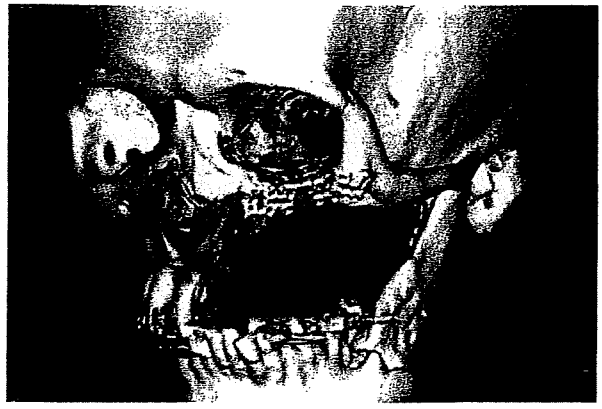

Fig 2 Preoperative three-dimensional computed tomography.

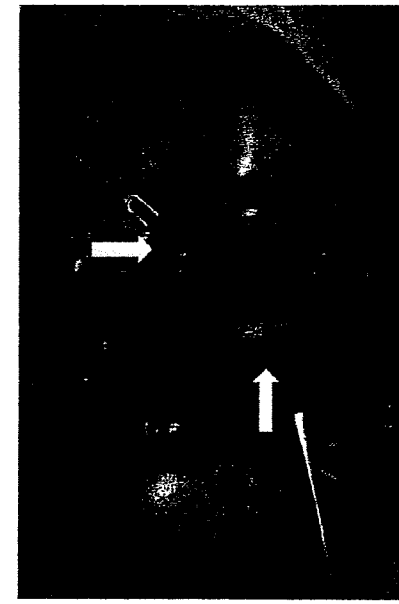

Fig 4 Intraoperative view. Arrows show a costal cartilage graft.

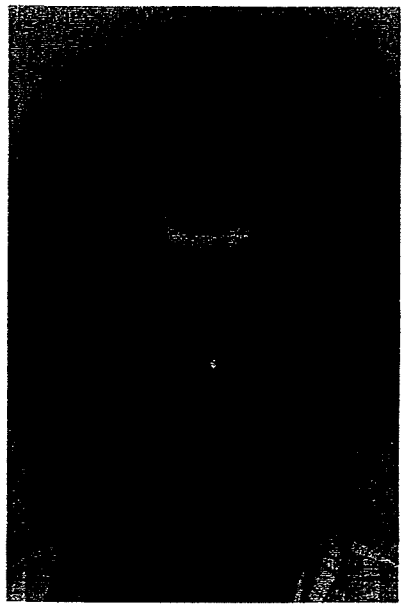

Fig 5 Thirteen month postoperative view.

surgery for contracture of the upper lip. Thirteen months after the secondary reconstruction, he presented with a good contour of the left cheek (Fig 5). Postoperative three-dimensional computed tomography scan showed a well-reconstructed maxilla (Fig 6).

DISCUSSION

Reconstruction of the maxilla should be performed on the basis of the classification of the defect.[10] In cases involving total maxillectomy with preservation of the orbital contents, immediate reconstruction of both the orbital floor and the soft tissue defect is required. With the immediate reconstruction, most patients obtain good functional recovery. However, because of the remaining skeletal defect, patients tend to exhibit a contour deformity of the cheek, as was the case with the patient described here. Yamamoto et al[11,12] have described the effects of buttress reconstruction in the treatment of zygomaticomaxillary skeletal defects. We believe that the concept of buttress reconstruction is also important to consider in the context of secondary reconstruction (i.e., when good cosmetic results are desired). Our patient presented with a contour deformity of the left cheek, which included a posterior deviation of the alar base and oral commissure. To ameliorate the deformity, not only soft tissue augmentation but also complete skeletal reconstruction was required.

Various procedures involving osteocutaneous free flaps have been reported for reconstruction of the maxilla.[1–3,5,7,9] Reconstructions using a rectus abdominis musculocutaneous flap combined with a vascularized rib or costal cartilage have also been reported.[4,6,8] Each method has demonstrated advantages, and each can be of potential benefit in cases with a partial bony defect of the maxilla. However, in cases involving large defects, it remains almost impossible to completely reconstruct the maxilla using only a single vascularized bone because of the very complex structure of the maxilla. Some reports have described a method using two vascularized bones;[7,11,12] however, such approaches require a significant amount of operative time. It is also quite difficult to trim each vascularized bone to match the shape of the defect. Here, we combined a costal cartilage graft with a vascularized bone. Costal cartilage is relatively easy to harvest and is sufficiently strong for skeletal reconstruction. Most importantly, it is easy to trim harvested cartilage to match the shape of the defect. In the present case, we used a costal cartilage graft to reconstruct the piriform aperture and the alveolar ridge. Such small skeletal defects would be difficult to reconstruct with a vascularized bone. Grafted costal cartilage itself is not vascularized, which can potentially lead to infection or resorption of the graft, as some authors have previously pointed out.[6,11,12] To prevent such complications, it is important not to open the nasal and oral side at secondary reconstruction. It is also important to cover the graft with well-vascularized soft tissue. In our case, the grafted cartilage was covered with a de-epithelized latissimus dorsi flap.

In the context of using an osteocutaneous free flap combined with a costal cartilage graft, we prefer

Fig 6 Postoperative three-dimensional computed tomography.

a rib-latissimus dorsi flap. There are vascular perforators located between the latissimus branch of the thoracodorsal vessels and the intercostal vessels.[13] Thus, a vascularized rib can be elevated together with a latissimus dorsi flap. As Nagasao et al[14] have noted, the use of a rib-latissimus dorsi flap has certain advantages in terms of reconstruction of the maxilla. This flap provides ample soft tissue as well as a long bone, and each component can be positioned in an unrestricted manner. Moreover, a long pedicle is available; in our case, this feature enabled anastomosis to the facial vessels on the contralateral side.

Certain disadvantages of our method should be mentioned in this context. One such drawback would be the risk of pneumothorax when harvesting a costal cartilage and a rib. In addition, the costal cartilage and rib might be found inadequate for osseointegrated implants.

In conclusion, our method of combining a costal cartilage graft with a rib-latissimus dorsi flap was effectively used for reconstructing a complex skeletal defect of the maxilla. Although more clinical experience and long-term follow-up studies are still needed, this novel approach may become useful in cases involving secondary reconstruction of the maxilla.

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特集 上顎癌切除後の再建と形態の回復

上顎癌切除後の二次変形の治療

—再建材の選択—

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Key words：上顎癌　二次再建　遊離皮弁

はじめに

上顎癌切除後の二次変形は，骨欠損と軟部組織欠損の状態や瘢痕拘縮の程度，先行する放射線照射や化学療法の影響などが症例によって異なるため，非常に再建の難度が高い分野である。

通常は遊離植皮術のみでは対応できず皮弁による再建を必要とするが，骨欠損の状態によっては硬組織による再建を組み合わせなければ良好な結果は得られない。DP皮弁などの有茎皮弁では，再建が口蓋，鼻腔，義眼床や顔面皮膚など複数に及ぶ場合や，硬組織再建を合わせて行う場合には制限が大きい。したがって，移植床血管が存在する限り，遊離組織移植による再建が第1選択であると考えられる。上顎癌の一次再建については各種の再建材料が報告され[1)~7)]，二次再建においても骨付き皮弁をはじめ各種の報告があるが[8)~12)]，どの方法もそれぞれに利点と欠点を有し，症例に応じた再建材料の選択が必要である。一次再建に有用な再建材料であっても，二次再建に適するとは限らない場合もある。

この稿では遊離組織移植による上顎二次再建について，再建術式を選択する際に留意すべき点を中心に述べる。

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I 上顎変形の欠損様式の評価について

初回手術における上顎の切除方法は，medial maxillectomy や inferior maxillectomy などの上顎部分切除術（partial maxillectomy），上顎全摘術（total maxillectomy）または亜全摘術（subtotal maxillectomy），眼窩内容を含んだ拡大上顎全摘術（extended total maxillectomy）に大別される。しかし骨の切除範囲については，個々の症例における癌の進展状況や施設によって差がある。骨欠損で特に術後の顔貌の変形に大きく関わってくるのは，鼻骨から眼窩内側，眼窩下縁，頬骨突起に至る，いわゆる upper horizontal plane もしくは zygomaticomaxillary buttress と呼ばれる部位の欠損である。また，lower horizontal plane もしくは pterygomaxillary buttress と呼ばれる上歯列と口蓋部の骨欠損も顔貌を大きく左右する。垂直方向では鼻腔外側壁に沿った nasomaxillary buttress（nasofrontal buttress，medial maxillary buttress）に骨欠損がある場合，鼻翼基部の支えがないために鼻変形が顕著となる。これら上顎骨の骨組みともいうべきラインを再建する考え方は Le Fort 型骨折の治療において導入され[13)14)]，上顎骨欠損に対しても応用されている[15)~17)]。われわれは，これらのうち最低限 upper hori-

zontal plane（zygomaticomaxillary buttress）については何らかの硬性再建を行う必要があると考えている。術前に骨欠損の状態を把握するためには3D-CTが極めて有用である。

骨欠損とともに軟部組織欠損や残存する器官の状態も把握する必要がある。拡大上顎全摘で眼球も摘出されていれば，義眼床を形成するために眼瞼や残存結膜がどこまで利用できるかを考慮する必要がある[18]。眼球が温存されてかつ眼窩下壁の骨欠損があると，多くは眼位が低下し，複視を伴う症例もある。最近はチタンメッシュなどによって眼位低下を防止した一次再建が行われている場合もある[19]。顔面皮膚再建の必要があるかどうか，皮膚が残存しても表情筋が切除されている場合もあり，顔面神経の残存機能を把握すること，などの検討も必要である。

そして何より必要なのが条件のよい移植床血管の存在である。初回手術で頸部郭清術を行っていなければ，顔面動静脈を顎下部に求めて吻合するのが一般的である。動注化学療法に使用されていなければ浅側頭動脈も移植床血管の候補ではあるが，上顎の欠損部位とは意外と離れており皮下ポケットを作製し難いこと，皮下にあるため攣縮を起こしやすいことなどからあまり推奨できない。頸部では，時として頸部郭清術後の瘢痕形成によって血管の剝離が非常に困難になる。特にN1以上の頸部郭清術後で高線量の放射線照射も行われている症例では同側頸部の血管は使用しない方が無難である。内頸静脈については，郭清術中に温存されていてもその後の経過で閉塞している場合もあるので，術前のCTで確認しておくべきである。やむを得ず対側の血管を使用する場合，対側下顎部における顔面動静脈，あるいは対側頸部での上甲状腺動脈と内頸静脈が選択肢となる。

II 欠損様式に対する再建術式と再建材の選択

術前の評価と患者の希望を参考にし，何をどこまで再建するか，という術式の方針を決定する。まずupper horizontal planeについては前述のように，眼位の低下を修正し，頬骨突起部を形成して上顎骨欠損による変形を改善するために，何らかの硬組織による再建が必要である。Lower horizontal planeについては，口蓋の欠損を閉鎖することで患部を直視下に観察できなくても問題ないかどうか，初回手術の担当医と連絡をとって判断すべきであるが，上顎癌の術後生存率から考えると術後2年以降は低下があまりみられない。したがって，約3年経過すれば欠損を充填しても問題なく，その後はCTなどで再発については経過観察可能であろうとわれわれは考えている。一次再建においては口蓋を再建せず，プロテーゼ装着を前提とした再建を行う考え方[20]もあるが，二次再建ではプロテーゼで口腔鼻腔の遮断が不完全な症例，あるいは装着に満足しない症例が対象となるので，たとえ硬組織でなく皮弁のみであっても口蓋を再建し，lower horizontal planeを形成することは機能形態の両面から必要であると考えられる。垂直方向のbuttressについては，鼻翼基部の支えとして鼻腔外側の再建を行う必要がある。ただLe Fort型骨折の場合と異なり，上顎癌による上顎骨欠損は通常片側性で同側の咬合力は問題とならないので，厳密に支柱として硬組織で支える再建は必要とせず，口蓋と同様に十分な厚みをもつ皮弁のみで再建してもよいとわれわれは考えている。

再建材は，欠損の状態，硬組織再建の方法，および使用できる移植床血管によって選択がしぼられる（表1）。移植床血管は欠損部位と離れているので，血管茎の長い移植組織が使用しやすい。血管茎が短い場合には，吻合箇

表1　上顎二次再建に用いられる再建材料

硬組織再建材料	軟部組織再建材料
自家遊離組織：遊離腸骨，遊離肋軟骨 人工物：人工骨，チタンメッシュ 骨付き皮弁：肩甲骨付き皮弁 腓骨付き皮弁（同側の移植床血管，場合により橈骨動静脈移植を併用） 肋骨付き広背筋皮弁 肋軟骨付き腹直筋皮弁（対側の移植床血管へも到達可能）	遊離皮弁・筋皮弁：腹直筋皮弁（皮下組織のボリューム調整が容易） 広背筋皮弁 前腕皮弁 大腿皮弁

所が増えても橈骨動静脈移植などを併用する方法が安全である。西川ら[8]は外頸動脈，内頸静脈を頭側に追って下顎の裏側で血管吻合を行っているが，二次再建の場合は瘢痕形成が強いため，血管束を間置する方が容易であると考える。

以上の観点から，軟部組織再建の材料としては腹直筋皮弁が最も適しているといえよう[9]。ただし，筋体は術後の萎縮の程度が大きいため少な目に採取し，皮下脂肪の厚みを調整することで必要な皮弁量を調節する方がよい。ほかに，血管茎の長い筋皮弁として広背筋皮弁も候補となるが，筋体量の調節には腹直筋皮弁よりも手間がかかる。大腿皮弁や前腕皮弁は薄いため，皮弁を欠損部位に縫合する操作は行いやすいが，欠損を充填するのに十分であるかどうか，慎重に検討して用いるべきである。

硬組織の再建材料としては血管柄付き骨移植，遊離骨・軟骨移植，人工物がある。血行のある血管柄付き骨移植が最も安全な方法と考えられ，特に肩甲骨付き皮弁は骨弁と皮弁の自由度が高く，皮弁部分の量の調節も行いやすいので，上顎再建に広く用いられている。しかし，体位変換などで手術時間が長くかかり，また，angular branchを血管茎としてもその長さは十分であるとはいえず，二次再建においては多くの場合橈骨動静脈移植との併用を必要とする[9]。腓骨を用いた上顎再建の報告[2)3)]もあるが，必要な骨の長さが長くなればその分血管茎が短くなるため，やはり血管茎の長さは十分とはいえない。一方，肋骨付き広背筋皮弁は対側顎下部まで届く血管茎の長さをもち，採取できる肋骨も15 cm以上と，upper horizontal planeを再建するには十分である[21)]。また，皮弁と骨弁の自由度も高く，体位変換は必要であるが骨付き皮弁としての有用性は高い。これに対して，肋軟骨付き腹直筋皮弁[5)6)]は体位変換を必要とせず，かつ血管茎が長いという特徴をもつが，軟骨への血行を重視すると腹直筋筋体を多めに付着させざるを得ず，軟部組織量の調節が容易でないという欠点もある。

上顎の硬性再建においては，大きな外力に対抗するほどの強さは必要ないと考えられる。したがって，遊離骨移植や軟骨移植であっても，周囲が血行のよい組織で覆われていれば目的を果たすことは可能で，Cordeiroら[16)]は基本的に遊離骨移植を用いている。われわれは骨よりも軟骨の方が本来遊離移植に適しており，かつ上顎の硬性再建部が周囲の顔面骨と骨癒合を果たす必要はないと考えており，肋軟骨移植を他の筋皮弁と組み合わせる方法[11)12)]を好んで用いている。いずれの場合でも，移植骨または軟骨は，鼻腔や口腔から遮断された状態で固定することが重要である。

ハイドロキシアパタイトやチタンメッシュなどの人工物で硬性再建を行う方法も，場合によっては有効である。しかし，これらの人

工物は露出や感染などの合併症を起こす可能性が常にあることを念頭に置く必要がある。したがって，血行のよい遊離組織移植で周囲を被覆することと，口腔や鼻腔とは完全に遮断した状態で固定することが特に重要である。また，大きな人工物ほど露出や感染の可能性が高く，ミニプレートなど小さなものではそれらの合併症の可能性は小さくなる。その意味から，現在われわれは眼窩底のみの再建ならチタンメッシュも有効であるが，頬骨突起自体を再建する場合には人工物を使用しない方が安全であると考えている。

III 再建術中および術後の注意すべきポイント

切除の段階での皮膚切開線はWeber切開と呼ばれる，口腔前庭から上口唇正中，鼻孔縁から鼻翼基部を回って上行し，下眼瞼に至る切開が一般的である。再建においても通常はこの切開線を利用して展開し，口腔および鼻腔の瘢痕拘縮を解除することになる。拘縮部の粘膜を切除する際に，顔面皮膚側では表情筋や顔面神経を損傷しないよう注意しながら，十分に瘢痕拘縮を解除する。底部では上顎動脈やその分枝，翼突筋周囲の静脈叢があり，出血すると止血に難渋する場合がある。底部の瘢痕拘縮自体は顔貌に大きく影響するものではないので，粘膜を薄く切除するに留め，組織充填すべき空間と皮弁の縫いしろを作製することに主眼を置くようにする。

移植床血管を露出する場合，瘢痕形成が高度なため剝離操作自体で血管内膜損傷を来たすことがあり，慎重な操作を要する。内頸静脈や外頸動脈本幹を移植床血管とする場合には必ず全周性にある程度の長さの剝離を行い，不意の損傷で出血してもコントロール可能な状態にしておくことが重要である。血管吻合部と上顎欠損部の間の皮下ポケットは下顎骨の裏面を通せば経路が短いと考えがちであるが，下顎骨の上をまたぐ経路で作製する方が頸部郭清の影響もなく容易に広いポケットを作製しやすく，血管柄のねじれがないようにセッティングしやすい。また，術後の出血や浮腫によって血管柄が圧迫される心配も少ないため，二次再建の場合は特に皮下ポケットを浅い層で十分に広く作製するよう心がける。血管吻合に関して，半周を縫合してから血管クリップを反転させる通常の吻合が行いにくい場合は，肝動脈吻合に用いる両端針付きマイクロ縫合糸[22]を用いて後壁から先に縫合するのがよい。

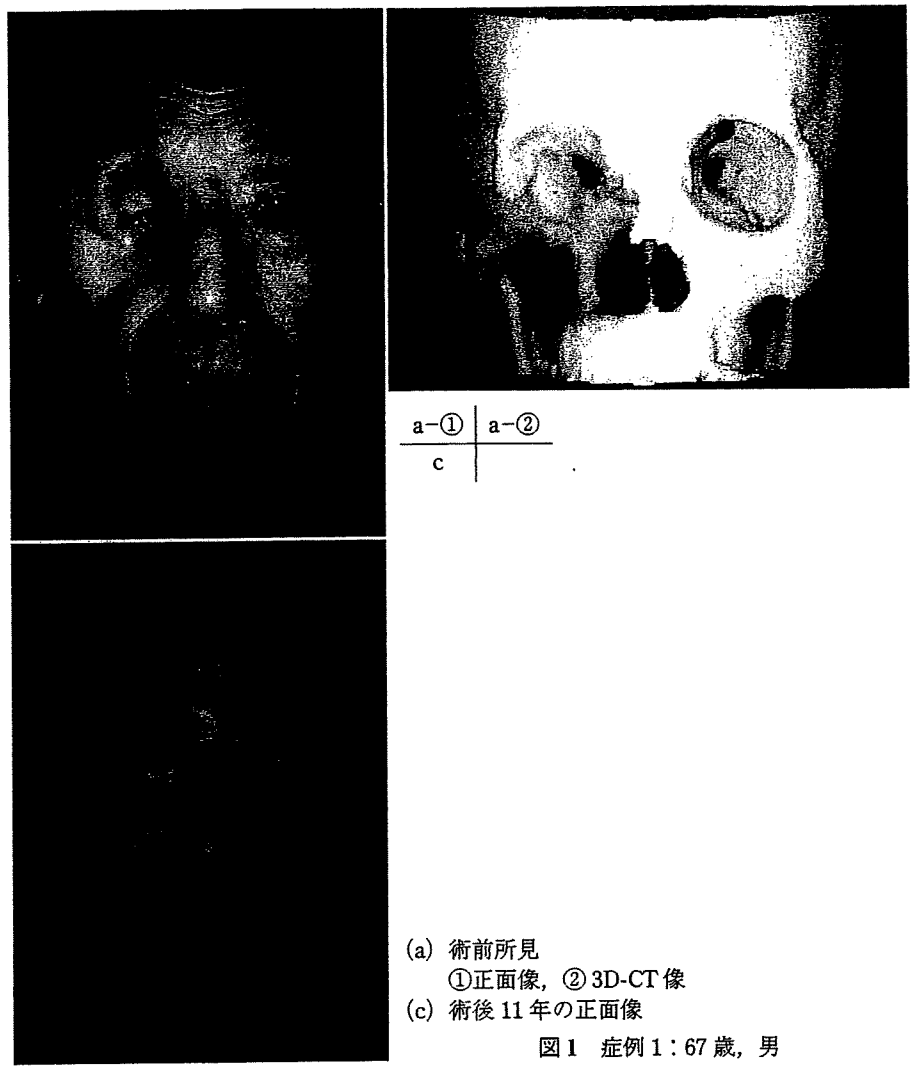
頸部郭清術後の頸部の血管を吻合に用いた二次再建の場合，頸部の剝離範囲が狭く血管茎の自由度が少ないため，術後の局所の安静に特に注意を要する。吻合後の血管茎のねじれや，首の動きにより血管茎に緊張がかからないか，閉創前に肩枕をとって頸部の体位を変えながら確認しておくことが重要である。われわれは同様の症例において，術後に患者が不穏状態に陥り吻合血管が破綻して出血を起こした経験がある。術後も安定剤の使用や，3日程度は砂嚢などを置いて首の動きを制限する方がよいと思われる。

IV 症　例

【症例1】67歳，男

右上顎洞の扁平上皮癌（T3N0M0）の診断により，他病院で浅側頭動脈からの動注化学療法と放射線照射を受けた後に，右上顎亜全摘および眼球摘出，頸部郭清術を施行された。再発を認めず術後3年経過し，当科に紹介された。初診時，右上顎眼窩部は著明に陥凹し，開放された眼窩部と鼻腔が直接交通していた。一方，口蓋は温存されており，食物や飲料の鼻腔への逆流は認めなかった（図1-a）。

手術では腫瘍切除時の皮膚切開線から鼻腔に達し，鼻腔外側の拘縮を十分に解除しながら眼窩の内・外側壁，頬骨弓の骨断端を露出



(a) 術前所見
①正面像，②3D-CT像
(c) 術後11年の正面像

図1　症例1：67歳，男

した。頸部で上甲状腺動脈と顔面静脈を移植床血管として準備し，上顎の欠損部との間に皮下トンネルを作製した。腹部より2皮島の腹直筋皮弁を採取し，遠位の皮島を義眼床として眼窩部へ，近位の皮島を鼻腔外側壁の被覆用として移植し，血管茎は皮下を通して頸部で血管吻合を行った。眼窩下縁の硬性再建として，眼窩内壁と頬骨弓断端の間にミニプレートとハイドロキシアパタイトのブロックを橋渡しして固定し，閉創した（図1-b）。

術後経過は良好で皮弁は完全生着した。しかし長期経過中に人工物の感染を生じ，洗浄などの保存的処置では沈静しなかったため，ブロックの部分的抜去を繰り返し，結局初回再建手術後2年8カ月には眼窩下縁の再建に用いたすべての人工物を抜去して感染は沈静化した。その後に義眼床や眼瞼の修正術を行い，義眼が装着できるようになった。現在初回再建術後11年経過しているが，顔面の形態は満足できる状態となっている（図1-c）。

【症例2】 39歳，男

他病院で左上歯肉の扁平上皮癌（T4N0M0）の診断により上顎部分切除術を受けたが再発し，左上顎全摘術および頸部郭清術，眼窩底へのチタンメッシュと腹直筋皮弁移植による再建を施行された。術後60 Gyの放射線照射

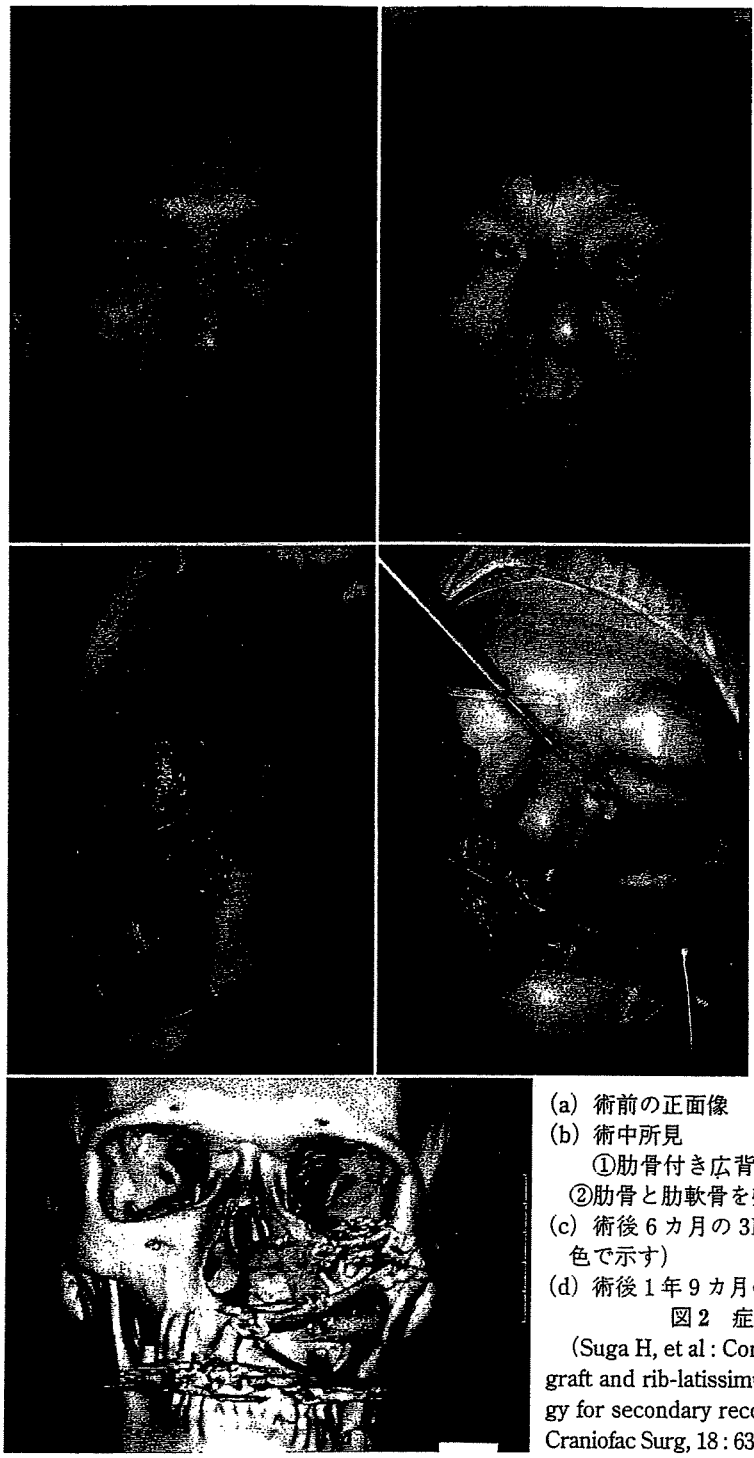
b-①|b-②
b-③|b-④

(b) 術中所見
①瘢痕拘縮を解除したところ，②2皮島腹直筋皮弁のデザイン，③皮弁を充填し，人工骨で眼窩下縁を形成したところ，④人工骨で眼窩下縁を形成したところ

図1　症例1

を受けている。2年6カ月の経過観察の後，当科を紹介され受診した。初診時，口蓋と鼻腔は腹直筋皮弁により再建されていたが，骨欠損が大きいために高度の上顎部変形を来たしていた。眼位の下方への偏位はほとんどなく，チタンメッシュによる硬性再建の効果が認められた。メッシュの感染兆候は見られなかった（図2-a）。

手術は前回の皮膚切開線に沿って切開し，拘縮部を解除しながら展開した。この際，前回再建されている口蓋と鼻腔外側壁の部分は温存し，口腔，鼻腔と今回の再建部位が交通しないように注意して展開を行った。また，前回の再建と頸部郭清，放射線照射により同側の血管は使用できないと判断し，対側の顔面動静脈を移植床血管として準備した。左側胸部より約10 cmの第9肋骨を付けた広背筋皮弁を採取し，肋骨で上顎正中の歯槽突起部



a	d
b-①	b-②
c	

(a) 術前の正面像
(b) 術中所見
①肋骨付き広背筋皮弁を挙上したところ，
②肋骨と肋軟骨を頬部に固定したところ
(c) 術後6カ月の3D-CT像（移植肋軟骨を黄色で示す）
(d) 術後1年9カ月の正面像

図2　症例2：39歳，男

(Suga H, et al : Combination of costal cartilage graft and rib-latissimus dorsi flap ; A new strategy for secondary reconstruction of the maxilla. J Craniofac Surg, 18 : 639–642, 2007 より改変引用)

から頬骨弓まで橋渡しを行ってプレート固定，さらに右第7肋軟骨を採取して2つのブロックを作成し，鼻腔外側壁と口蓋の歯槽部欠損に沿った形にして移植肋骨にワイヤーで固定した。採取した広背筋皮弁は表皮を切除して真皮脂肪弁とし，これと広背筋の筋体で肋軟骨を被覆した後，血管茎は対側への皮下トンネルを経由して右顔面動静脈と血管吻合

を行った（図2-b）。

術後経過は順調で皮弁は完全生着した。術後6カ月のCTでは移植骨，肋軟骨とも固定状態は良好であり（図2-c），その後上口唇の修正や真皮脂肪移植，眼窩外側皮弁の下眼瞼への移行などの修正手術を行った。現在術後1年9カ月が経過し，顔面の形態は良好に保たれている（図2-d）。

まとめ

上顎二次再建において満足すべき結果を得るためには，欠損状態の的確な把握，使用できる移植床血管の選定，これらを踏まえた再建の方針と再建材料の決定が重要である。特にupper horizontal planeは硬組織による再建を必要とする。鼻腔や口腔との遮断が確実に行えるなら，硬組織の再建材料として自家肋軟骨移植や人工物を，軟部組織再建材料の腹直筋皮弁と組み合わせて使用する方法が簡便である。骨付き皮弁による再建を行う場合は，肋骨付き広背筋皮弁が血管茎も長く使用しやすい。

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ABSTRACT

Secondary Reconstruction of the Deformity Due to Resection of Maxillary Cancer ; The Selection of Reconstructive Materials

Hirotaka Asato, MD[1], Yasutoshi Suzuki, MD*[1], Hirotaka Suga, MD*[2], Mutsumi Okazaki, MD*[3], Akihiko Takushima, MD*[3] and Kiyonori Harii, MD*[3]*

To obtain satisfactory results for secondary mid-face reconstruction due to resection of maxillary carcinoma, an adequate reconstructive procedure must be selected and free flap transfer is recommended. To decide the strategy for reconstruction, preoperative assessment of the bony defect and soft tissue deformity utilizing 3DCT, and the estimation of which vessels are applicable for microanastomoses, and the selection of a flap that has long vascular pedicles, should be carefully considered. The upper horizontal plane, which consists of a zygomatic process and the rim of the orbital floor, is very important for obtaining a good facial contour and should be reconstructed using hard tissue. Artificial bone, free bone or cartilage grafts are available for this purpose, but they should be covered with a well vascularized soft tissue flap such as the rectus abdominis musculocutaneous flap, to avoid complications such as exposure or infection. The osteocutaneous flap is another good option, and the rib-latissimus dorsi musculocutaneous flap, which has a long vascular pedicle to reach contralateral recipient vessels, is very useful for midface reconstruction.

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Three-dimensional Reconstruction of Supraglottic Structures after Partial Pharyngolaryngectomy for Hypopharyngeal Cancer

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Objective: Larynx-preserving surgery is frequently performed for advanced hypopharyngeal cancer involving the larynx. However, reconstruction after partial pharyngolaryngectomy (PPL) remains a challenging problem because of the high risk of postoperative aspiration. In this report, we describe our new three-dimensional method for reconstructing supraglottic structures with a radial forearm flap. This is a retrospective analysis of 20 patients who underwent PPL for having hypopharyngeal cancer involving the larynx at our institution from 1996 to 2005.

Methods: The resulting pharyngolaryngeal defects were reconstructed with radial forearm flaps in all patients. Three-dimensional structures were reconstructed with a single nylon suture, which was used to hoist the flap and ensures that the arytenoids and the aryepiglottic fold were of appropriate height.

Results: Radial forearm flaps were transferred successfully in all but one case. Swallowing function was satisfactory in all patients, and decannulation could be performed in all but one patient. Postoperative conversational function in all patients was rated as excellent with Hirose's scoring system.

Conclusions: Free jejunum transfer is the method of first choice for reconstruction of a defect after partial hypopharyngectomy. However, the complex supraglottic structures of the larynx are difficult to reconstruct with a free jejunal graft after PPL. In such cases, we perform three-dimensional reconstruction of the pharyngolaryngeal defect with a radial forearm flap and have achieved satisfactory postoperative function. We believe that our new procedure is a useful method for functional reconstruction after PPL.

Key words: hypopharyngeal cancer partial pharyngolaryngectomy hypopharyngeal reconstruction radial forearm flap head and neck reconstruction

INTRODUCTION

Total pharyngolaryngectomy has historically been the treatment of first choice for advanced hypopharyngeal cancer. However, preserving the voice is a major concern when cancer of the head and neck is resected. Recently, partial resection of the hypopharynx has become possible, even when the tumor involves the laryngeal structures. In such cases, partial pharyngolaryngectomy (PPL), in which parts of the hypopharynx and the supraglottic structures are resected simultaneously, can be performed. However, reconstruction after PPL is often complicated by postoperative aspiration. The free jejunal patch graft is a good choice for reconstruction after simple partial resection of the hypopharyngeal wall, but when the larynx has also been partially resected, reconstructing the complex supraglottic structures with a free jejunal patch graft is difficult. In the present report, we describe our method of three-dimensional

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