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Lipofilling in Post-Treatment Oral Dysfunction in Head and Neck Cancer Patients

Marise Neijman, R.T. Karsten, L. van der Molen, O. Lapid and M.W.M. van den Brekel

Abstract

Lipofilling is a new treatment option for head- and neck cancer patients who suffer from chronic and severe (chemo-) radiation or surgery-related swallowing problems. Lipofilling is a technique of autologous grafting in which living fat cells are transplanted from one location to another in the same patient. In the case of head and neck cancer patients, volume loss or muscle atrophy of the tongue or pharyngeal musculature caused by the treatment may result in oropharyngeal dysfunction. Firstly, intensive swallowing therapy will be given, but if that offers no further improvement and the functional problems persist, lipofilling can be considered. By transplantation of autologous adipose tissue, the functional outcomes might improve by compensating the existing tissue defects or tissue loss. Only a few studies have been published which evaluated the effectiveness of this new treatment option. The results of those studies show that the lipofilling technique seems safe and of potential value for improving swallowing function in some of the included patients with chronic and severe dysphagia after surgery and/or (chemo-) radiation therapy for head and neck cancer. The lipofilling procedure will be described in detail as well as the clinical implications.

Keywords: lipofilling, head and neck neoplasms, dysphagia, deglutition, deglutition disorders, fat transfer, autologous fat injection, adipose tissue, quality of life

1. Introduction

Head and Neck Cancer (HNC) is the seventh most common type of cancer worldwide [1]. The regions of HNC include cancers of the nasal cavity, oral cavity, nasopharynx, oropharynx, hypopharynx, larynx, and paranasal sinuses (see **Figure 1**). Risk factors are tobacco use, alcohol consumption [2], and viral infections with the Human Papilloma Virus (HPV) (for oropharyngeal cancers) [3] and Epstein-Barr Virus (EBV) (for nasopharyngeal cancers) [4].

1.1 TNM classification

HNC tumors can be classified using the TNM stage classification published by the American Joint Committee on Cancer and International Union for Cancer

Figure 1.
Regions of head and neck cancer, source: <https://www.intechopen.com/chapters/67124>

Committee (AJCC/UICC) [5]. This classification is based on the anatomic tumor extent and includes three different aspects. Firstly, the size of the primary tumor (T), secondly the presence or absence and extent of involved regional lymph nodes (N), and lastly the presence or absence of distant metastasis (M). With the TNM classification, it is possible to give an estimate on cancer prognosis and it is helpful for treatment selection and proper communication. An example of a TNM classified advanced oropharynx carcinoma with one lymph node involved and diagnosed with no distant metastasis is T3N1M0.

1.2 Head and neck cancer treatment

Patients with HNC can be treated with (a combination of) surgery, radiotherapy, chemotherapy, proton therapy, immunotherapy, or photodynamic therapy (PDT). The choice of treatment depends on the location and the size of the tumor (TNM classification). Despite improved radiotherapy techniques, the anatomical structures, including muscles and tissue around the primary tumor, can still be damaged by the tumor itself or the treatment [6–8]. Well-known (negative) side effects of the HNC treatment are xerostomia, sticky saliva, mucositis, altered taste, weight loss, pain, trismus and tissue loss due to fibrosis. Long-term functional problems such as swallowing problems (dysphagia), voice or speech problems, and trismus can harm patients' quality of life [9].

2. Dysphagia in HNC patients

One of the most critical and potentially life-threatening functional problems in patients who are treated for advanced HNC is acute and chronic dysphagia. One of the causes of dysphagia after HNC treatment might be a reduced tongue strength, insufficient contact between the base of tongue and pharyngeal wall, reduced hyolaryngeal elevation, and reduced opening of the upper esophageal sphincter. Due to this altered physiology, the food bolus is swallowed less powerfully, leading to stagnation of food ('residue'), with a high risk of laryngeal penetration or even (silent) laryngeal aspiration of the residue into the trachea. The swallowing problems may worsen when the swallowing musculature is no longer actively used, and the so-called 'non-use' atrophy occurs, causing further deterioration of the swallowing function [10]. Dysphagia (chronic) can lead to reduced body weight, long-term and even lifelong feeding tube dependency, depression, reduced quality of life, aspiration pneumonia and can even lead to death [6, 11, 12].

3. Treatment options of HNC related dysphagia

In the next paragraph, the treatment options of HNC-related dysphagia will be described. Firstly, the importance of interdisciplinary head and neck rehabilitation will be described, secondly (preventive) swallowing protocols and finally, surgical options.

3.1 Interdisciplinary head and neck rehabilitation

The treatment of dysphagia, and the treatment of HNC patients in general, involves a high level of variety and complexity of problems. Therefore, it is recommended to have a specialized multidisciplinary team of medical specialists and allied health professionals, specialized in head and neck oncology [13]. Rehabilitative care aims primarily at reducing and/or preventing negative effects of head and neck cancer treatment, and thereby improving daily functioning. The effectiveness of head and neck rehabilitation program have been proven [13, 14].

3.2 (Preventive) swallowing protocols

Over the last years, the prevention of dysphagia has become a major focus point in HNC research. The assumed disadvantages of (prophylactic) feeding tube placement to prevent weight loss and with that effectively immobilizing the swallowing musculature, have led to the so-called 'eat or exercise' principle [10]. This means that oral intake should be maintained as long as possible, and that preventive swallowing rehabilitation programs should keep the swallowing musculature 'active' as much as possible before and during treatment. Studies on preventive rehabilitation in the Netherlands and elsewhere have shown that preventive swallowing protocols (in particular in the short-term) are associated with better post-treatment functional outcomes and quality of life, and are cost-effective, compared to standard care [10, 15–22].

There are several (swallowing) exercises that have proven their value in the treatment of dysphagia. Those exercises are used in standard swallowing protocols, but also within preventive rehabilitation protocols. Most frequently used exercises include a range of motion or resistance exercises (with or without medical devices

such as the TheraBite® device), compensatory techniques (postural changes, diet/bolus modifications), behavioral swallow exercises such as the (super-)supraglottic swallow [23, 24], the effortful swallow [25], the Mendelsohn maneuver [26], and the Masako (tongue-holding) maneuver [27], and non-swallow exercises such as the Shaker (head-raising) exercise [28]. Also, devices, such as the Swallow Exercise Aid (SEA) have been developed to be able to perform multiple exercises more efficiently. The SEA device allows adaptation to individual subjects' capacity, and thus the application of progressive overload during the training program, and has shown to activate important swallowing structures [29–31]. Nevertheless, in some cases severe, therapy-refractory dysphagia may still exist.

3.3 Surgical procedures

Surgical treatment of functional impairment may be considered when rehabilitative measures, such as those described above, are insufficient to help ensure safe and efficient oral intake. The primary goals of surgery are to reduce the risk of aspiration, improve bolus transfer, and prevent malnutrition and/or dehydration. What the best surgical technique will depend on the etiology of the dysphagia. If there is less relaxation of the upper esophageal sphincter this can result in a less efficient movement of the bolus into the esophagus. This impaired relaxation can sometimes be remedied by reducing the tonus of the musculature of the pharynx. Cricopharyngeal myotomy, either endoscopically using a CO₂ laser or by an open surgical procedure, can be helpful [32, 33]. Myotomy of the cricopharyngeal muscle results in lower resistance of the upper esophageal sphincter. Due to this lower resistance, the bolus can be more easily be transported through the upper esophageal sphincter and enter the esophagus.

Other surgical techniques that can widen the cricopharyngeal muscle are dilatation (in case of fibrosis) or botulinum toxin (botox) injection in case of spasm. Several studies have reported promising results in patients with upper esophageal sphincter dysfunction caused by muscle spasm or hypertonicity [34, 35].

If dysphagia is caused by a serious limitation in laryngeal elevation, an invasive surgical technique called hyolaryngeal suspension can be performed. In this procedure, the hyoid bone is suspended and the thyroid-cricoid complex is fixated to the anterior mandible. This results in a permanent more cranial position of the larynx [36]. This procedure can be very effective in the restore a full oral intake without aspiration. However, it is also reported that previous treatment with (chemo) radiotherapy will negatively influence the outcome [37].

Finally, in some cases, none of the abovementioned treatment options are suitable or effective. If the larynx has severe functional impairments and there is no reasonable likelihood of functional recovery as a 'last refuge', a functional total laryngectomy can be considered. In the case of a total laryngectomy, the airway is surgically separated from the digestive tract by sacrificing the larynx.

Surgery procedures as described above, however, can have serious complication risks. Myotomy (especially open) can cause infections and even pharyngocutaneous fistulas or (retropharyngeal) infection [34, 37]. Besides, studies have shown that the improvement rate is much higher for neurologic dysphagia and idiopathic dysfunction than in patients with swallowing problems due to HNC treatment [32].

4. New treatment option: lipofilling

Since 2013, the Netherlands Cancer Institute has been using lipofilling as an alternative treatment option. Lipofilling has the advantage of being less radical, less invasive and presenting less of a burden for the patients [38].

Lipofilling is a technique in which autologous fat is transplanted to a site that lacks volume. In 1893, fat was transplanted for the first time with variable success [39]. Since the 1980s with the advent of modern liposuction, the technique of lipofilling has become a standard modality for esthetic as well as reconstructive purposes; however, it is rarely used in HNC patients.

4.1 Physiology of fat grafting

Of all tissues in the human body, fat possesses the highest percentage of adipose-derived stem cells with more than 5,000 of these per gram of fat. Adipose-derived stem cells are present in the mesenchyme, and are a type of multipotent stem cells. This means that these stem cells can differentiate into multiple cell types including osteoblasts, endothelial cells, myocytes, neuronal type cells, adipocytes and chondrocytes [40, 41].

A microscopic view shows that fat consists of a complex matrix of adipocytes mixed with collagen, endothelial cells, adipose-derived stem cells, and fibroblasts. All these adipocytes play an important role in the physiological processes, such as angiogenesis, metabolism, lipid storage and endocrine functions [40]. There is evidence that stem cells may even contribute to the reduction in fibrosis, and the restoration of tissue vascularization and organ function [42, 43].

4.2 Evaluation tools to check patient eligibility

Lipofilling might be a suitable treatment option for specific patients with chronic dysphagia after HNC treatment. Patients might benefit from lipofilling when part of the etiology of the dysphagia consists of lack of volume, for instance, of the tongue or pharyngeal wall. There are different examination tools to analyze the severity and etiology of dysphagia. Before considering if lipofilling is suitable for a patient, it is recommended to perform objective assessments such as Fiberoptic Endoscopic Evaluation of Swallowing (FEES) or a Video Fluoroscopic Swallow Study (VFSS) and a Magnetic Resonance Imaging (MRI) assessment.

FEES, in which a flexible endoscope is inserted via the nose and the patient is asked to swallow different consistencies, visualizes directly the anatomy and function of the pharyngeal swallowing phase. Also, the sensory and motor components of swallowing can be assessed [44]. On the other hand, VFSS (also known as Modified Barium Swallow) provides information about the oral and oropharyngeal phases of the swallow, including dynamics of the swallowing process. With VFSS, it is possible to analyze the contact between the tongue base and posterior pharyngeal wall and it is more suitable for diagnosing aspiration during swallowing. VFSS is also more informative for detecting problems below the upper esophageal sphincter [45]. Preferably a VFSS is performed, to select eligible patients, but the choice of examination also depends upon clinical presentation, available instruments and clinician's preferences.

To visualize the potential injection sites in the oral cavity and pharynx the most crucial examination of the pre-lipofilling work-up is the Magnetic Resonance Imaging (MRI) [38]. Besides, with the MRI it is possible to evaluate the volume of the tongue and pharyngeal wall. In **Figure 2**, an MRI assessment pre- and post-lipofilling treatment is presented.

In addition to the objective assessments, it might also be helpful to explore patient-reported experiences. The MD Anderson Dysphagia Inventory (MDADI) [46] and the Swallowing Quality of Life questionnaire (SWAL-QOL) [47] are often used in HNC patients to analyze patients' reported swallowing-related quality of life.

Figure 2.

MRI assessment pre- and post-lipofilling treatment. On the left side, the loss of tissue in the base of tongue is visible. On the right side, the base of tongue is larger and is filled up with fat.

4.3 Lipofilling procedure

Different techniques exist for lipofilling injection [41]. There are many preparation techniques for adipose tissue. There is no universally accepted standard method. The Coleman technique, which was described in the early 1990s, is the most frequently used method. This technique aims to prevent damage to the fragile adipose cells as much as possible during transplantation and thus promote tissue survival [48]. The technique involves three steps and is described by Hsu et al. [41]. The first step consists of the harvest of fatty tissue from the upper abdominal wall or inner thigh using large- or small-volume liposuction (see **Figure 3a**). The upper abdominal wall or lateral thigh is very useful as donor sites because of the high amount of local fat cells. The donor site can be infiltrated with tumescence fluid (for instance, ringers lactate, adrenaline and lidocaine) just before the liposuction, but this can also be done after the suction. After liposuction, the second step involves the preparation of the adipose tissue. During the preparation phase, the fat sample is transferred in a 10 cc syringe for centrifugation (see **Figure 3b**). The syringe is centrifuged for 2–3 minutes at 3000 rounds per minute (800 g) to separate out oils, debris, water (including lidocaine or adrenaline, saline and blood) and a layer of cell pellets/residue from the cellular fraction. In the syringe, three layers will be visible: the oil layer at the top, cellular fraction in the middle, and cellular debris and red blood cells at the bottom (see **Figure 3c**). The segregated cellular fraction, composed of adipocytes and stromal vascular cells, is transferred to a small 1 cc syringe. The third and last step consists of the injection into the predetermined spots in the base of the tongue. Using a needle, the side of the tongue is perforated, and the injection cannula is introduced. The dominant hand is used, or the injection is performed on cannula retraction in a three-dimensional “fan pattern.” The aim is to transfer small aliquots of fat with multiple passes at different depths. The non-dominant fingers can be placed behind the tongue to control the process. It is helpful if the assistant pulls on the tongue (see **Figure 3d**). The same procedure is usually performed separately on both sides of the tongue. In general, we inject 10–15 cc of fat per session.

The lipofilling procedure can be carried out under local anesthesia or general anesthesia. Because 30–50% of the injected fat might be resorbed, and not too much fat can be injected at the same time, it is recommended to repeat the assessments,

Figure 3.
The procedure of a lipofilling injection. (a) Fat harvest from the abdomen, (b) fat substance, (c) syringe with fat after centrifugation, (d) injecting fat into the base of tongue.

approximately 2–3 times. Preferably, between every injection procedure there is a period of 3 months to wait for the (positive) effect of the injection.

5. Short-term outcomes

In the last few years, different studies, primarily case reports, have been published about the use of lipofilling in patients with chronic dysphagia due to HNC (treatment) [38, 49, 50]. Navach et al. [49] reported about a 58-year-old patient with impaired swallowing after treatment for a nasopharyngeal carcinoma. This patient complained about dysphagia, the loss of body weight, aspiration pneumonia, and frequent episodes of bronchitis. A VFSS was conducted where a lack of bolus compression, asymmetry of the lingual movements, stagnation in the valleculae, lack of projection of the base of tongue, and more were visualized. The patient received 7 months of speech and language therapy to improve mobilization and strengthening of the swallowing muscles. The treatment improved the preparation and presentation of the bolus, although it was not sufficient enough. After 6 weeks, another VFSS showed a worsened bolus stagnation in the valleculae and at the base of tongue. This patient received a lipofilling injection in the base of tongue, which was performed following Coleman's procedure. In total, 5 cc of fat was injected into both sides of the base of tongue. After surgery, the patient experienced an improvement in swallowing, and minimal post-operative swelling was reported. A new VFSS was

made 1 month after surgery, showing an improved swallowing mechanism due to greater elevation of the base of tongue, the effective elevation of the larynx, and an improved closure of the larynx. After 3 months, the swallowing function was still stable, and the patient gained body weight.

In our institute, a study was performed by Kraaijenga et al., to investigate the feasibility and potential value of lipofilling in HNC patients with post-treatment oropharyngeal dysfunction [38]. This case series included seven patients. One patient dropped out of the study because of progression and therefore, he chooses a total laryngectomy procedure. Pre-assessment of the six remaining patients included VFSS, MRI, and the SWAL-QOL measurements. VFSS showed penetration and/or aspiration in all but one patient. Reduced or absent contact between the base of the tongue and pharyngeal wall was seen in all six patients. This reduced or absent contact resulted in residue above and below the hyoid bone. MRI showed volume loss or atrophy of the tongue in five patients. Two patients had reduced tissue of the tonsillar in the right tonsillar arch. The lipofilling session was performed using the Coleman technique. Patients received two to three injection sessions at 3-month intervals. In total, 20–35 cc adipose tissue was transplanted in all patients. No complications, such as necrosis, infection, swelling, or edema, were observed. The follow-up took place 1–3 months post-surgery. VFSS showed that four patients had improved swallowing function, and two of them were no longer feeding tube dependent. The MRI showed increased tongue volume with the injected fat spread out at the base of tongue. The SWAL-QOL showed improved quality of life in almost all patients.

Recently, Ottaviani et al. [50] published a case report about a 76-year-old patient with severe chronic dysphagia who had undergone a horizontal supraglottic laryngectomy and adjuvant radiotherapy. FEES showed a mobile right arytenoid and tissue loss in the base of tongue. VFSS demonstrated constant intra-swallowing aspiration and moderate pooling of food at the base of tongue with post-swallowing penetration and aspiration. The patient received 6 months of speech therapy focused on muscle strengthening and postural compensation techniques. The intervention turned out insufficient, and therefore, lipofilling injection was offered as a treatment option. The surgery was performed following the Coleman technique, and 5 cc was injected into the base of tongue. Intraoperatively, FEES was performed and demonstrated an improved swallowing function. However, trace aspiration for liquid textures and minimal residue was seen. After 1 week, FEES demonstrated only aspiration for liquids. After 1 month, the VFSS showed mild to moderate dysphagia. These results were also stable at 6 months post-surgery.

These three studies showed that lipofilling might be an effective treatment for HNC patients with chronic dysphagia. No complications were reported, and therefore, lipofilling seems safe [38, 49, 50]. Many patients showed improved objective and subjective swallowing function after lipofilling. Nevertheless, it remains difficult to predict how much fat will be resorbed and thus how long a therapeutic effect will persist. With the Coleman technique, absorption of fat seems to be reduced to some extent [32, 33]. In general, after 20–30 cc injections (in 2–3 procedures), positive effects are seen. However, sometimes repeated injections might be needed to achieve and hold a therapeutic effect. Hopefully, the injected tissue may also become less fibrotic, and no further injections are needed. Until now, there is no large data available yet, supporting this hypothesis.

6. Case reports

To give a better insight into lipofilling and how it can be used in post-treatment swallowing problems in HNC patients, three cases will be described in detail (see

Case	Sex	Age	Tumor		Treatment	Lipofilling injections		
			Site	TNM		Site	No.	Amount (cc)
1	M	66	Oral cavity	T3N2c	Surgery + RT (1997)	Base of tongue	3	32.0
2	F	59	Base of tongue	T3N2c	CRT (2004)	Base of tongue	3	34.5
3	M	73	Hypo-pharynx	T2N1	CRT (1984)	Base of tongue	1	20.0

Abbreviations: M = male, F = female; TNM = classification of Malignant Tumors; RT = radiotherapy; CRT = chemo radiotherapy; No. = number of injections.

Table 1.
Characteristics of the three selected case reports.

Table 1). Patients’ pre lipofilling objective and subjective swallowing function are analyzed and compared with the swallowing function after the last lipofilling (short-term results) and between 2.5 years and 5.8 years after the last lipofilling treatment (long-term results).

6.1 Case 1

A 67-year-old male, had been treated in 1997 for a T3N2c carcinoma of the floor of the mouth. His treatment consisted of local resection, partial mandibulectomy with free fibula reconstruction, and post-operative radiotherapy which resulted in complete remission. In 2013, 16 years after treatment, he visited the outpatient clinic with increasing swallowing difficulties, with particularly solid foods getting stuck in his throat, requiring placement of a PRG feeding tube to maintain adequate nutritional intake.

6.1.1 VFSS

VFSS assessments showed severe dysphagia with the occurrence of penetration and a high amount of oropharyngeal contrast residue due to insufficient contact between the base of tongue and posterior pharyngeal wall.

6.1.2 MRI

An MRI was made to rule out a new tumor. Since standard swallowing exercises for more than 1 year did not improve the persisting swallowing problems, and other surgical options were unlikely to improve the swallowing function. In **Figure 3**, the pre-lipofilling MRI scan can be found on the right.

6.1.3 Number of injections

This patient underwent three lipofilling sessions (3 times 8–12 cc) into the base of the tongue at 3-months intervals. After the second procedure, the patient noticed an improvement in swallowing function. He resumed oral intake following the third injection and his feeding tube could be removed.

6.1.4 Short-term results

A VFSS assessment showed improved scores for thick liquids (lower penetration and aspiration (PAS), see **Table 2**). This patient also reported notable improvement in subjective swallowing function, with substantially less effort and less choking. In **Figure 3**, the short-term post-lipofilling MRI scan is shown in the middle.

Case	Amount (cc)		FOIS	VFSS (PAS)			TL
				Thin	Thick	Solid	
1	32.0	Pre	3	4	4	3	No
		Post short*	6	4	2	3	
		Post long**	5	8	1	1	
2	34.5	Pre	1	NA	NA	NA	No
		Post short*	6	7	6	NA	
		Post long**	6	8	8	8	
3	20.0	Pre	1	7	5	NA	Yes
		Post	1	X	X	X	

Abbreviations: FOIS = functional oral intake scale: range 1–7, whereas 1 is ‘no oral intake’ and 7 means ‘normal oral intake’; VFSS = video fluoroscopic swallowing study; PAS = penetration aspiration scale: range 1–8, lower scores mean better/safer swallowing function; TL = total laryngectomy; X = missing data; NA = not applicable (i.e., no transport possible); Post short* = 1–3 months after lipofilling treatment; Post long** = up to 4 years after lipofilling treatment.

Table 2.
Pre- and post-treatment outcomes after the lipofilling session.

6.1.5 Long-term results

However, 2.5 years later the SWAL-QOL subscale scores deteriorated (see **Table 3**). Until 2020, this patient was able to maintain oral intake without a PRG. Swallowing was not easy, but he managed to have a full oral intake with additional diet modifications. He died in 2020 due to urosepsis. In **Figure 4**, the long-term post-lipofilling MRI scan is shown on the right.

Figure 4.
MRI assessment of case 1 over time. On the left, pre-lipofilling injection. In the middle, short-term MRI (1-month post-treatment). On the right, long-term MRI (4 years post-treatment).

6.2 Case 2

A 59-year-old female, was diagnosed with a T3N2c base of tongue tumor in 2004. Organ-preservation treatment with concurrent chemo radiotherapy resulted in a complete remission. In the post-treatment period, however, the patient developed severe dysphagia and dysarthria due to oropharyngeal scarring and base of tongue atrophy. Despite intensive swallowing rehabilitation with strengthening exercises, several esophageal dilatations, and a customized intraoral prosthesis lowering the

hard palate to also improve speech, the patient remained completely feeding tube dependent due to persistent oropharyngeal dysfunction/stagnation of food.

6.2.1 VFSS

VFSS evaluation demonstrated minimal contact between the base of tongue and the pharyngeal wall during swallowing, with large amounts of a residue located at the piriform sinus, and occurrence of aspiration, even at a 1 cc swallow administered with a pipet to improve bolus transport.

6.2.2 MRI

MRI showed an atrophic tongue, sagged posteriorly (see **Figure 5**). Since intensive swallowing exercises offered no solution, in 2014 the patient opted for lipofilling into the base of tongue.

6.2.3 Number of injections

Three lipofilling sessions were needed at 3-months intervals with 10–12 cc filled per session.

6.2.4 Short-term results

The post-operative MRI showed several fat depositions at the right base of the tongue (see **Figure 5**), and the patient was able to eat and drink again for the first time in 10 years. However, although the patient was very satisfied with being able to swallow again, the VFSS evaluation still showed aspiration. Four months later the patient presented with aspiration pneumonia, and a nasogastric feeding tube was indicated. However, although being aware of the possible risks, she chose to resume her per oral intake. At 8 months post-lipofilling (short-term results), she remained happy with the procedure resulting in good SWAL-QOL scores.

6.2.5 Long-term results

However, after 4 years of the last lipofilling this patient experienced more swallowing problems. Her subjective swallowing outcomes deteriorated (see Appendix, **Table 3** for her long-term SWAL-QOL scores) and she decided to have another lipofilling session. Nevertheless, even with that extra lipofilling (17 cc at the left and 17 cc at the right base of tongue) the SWAL-QOL scores increased meaning worse swallowing-related quality of life (see **Table 3** in the Appendix). In addition, the repeated VFSS showed worsening swallowing function (severe dysphagia). Since she was familiar with developing aspiration pneumonias, and weight loss, we decided to place a PRG and stop any oral intake. In **Figure 5**, the long-term MRI scan can be found on the right.

6.3 Case 3

A 73-year-old male, who had been diagnosed with a T2N1 hypopharynx carcinoma in 1984. He was treated with radiotherapy, which resulted in complete remission. This patient also had a history of esophageal carcinoma in 1964 for which he needed several dilatations in 1990/1991. Since 2009, he suffered from severe swallowing problems (several aspiration pneumonias) caused by a dysfunctional larynx and he needed a PRG.

Figure 5. MRI assessment of case 2 over time. On the left, pre-lipofilling injection. In the middle, short-term (after 3 months) MRI. On the right, long-term MRI (after 4 years).

6.3.1 VFSS

A VFSS showed a severe swallowing problem. All food consistencies were (silently) aspirated, the epiglottis was rigid, and the laryngeal elevation was limited. This patient started with intensive swallowing rehabilitation since he had had no swallowing exercises before. However, the rehabilitation did not improve the swallowing function enough to increase oral intake or to remove the PRG. In 2017, the patient opted for a lipofilling injection in the base of tongue.

6.3.2 Number of injections

In total 20 cc was injected, 10 cc on the left and 10 cc on the right.

6.3.3 Short-term results

After this first injection, the patient was still not able to swallow anything. He continued to develop pneumonias for which he used antibiotics daily. Because of the serious health risks related to the recurrent pneumonias, and his low swallowing related quality of life as measured by the SWAL-QOL (see **Table 3**), this patient decided to undergo a functional total laryngectomy in 2018.

7. Clinical implications

In our institute, the Netherlands Cancer Institute, lipofilling is considered as a safe procedure. Therefore, this procedure is embedded as standard care for specific swallowing therapy to refractory patients. When a patient visits the hospital with swallowing complaints, the first step is to start swallowing rehabilitation under the guidance of a specialized speech and language pathologist. If the swallowing exercises do not give a satisfactory result, lipofilling can be considered. Patients are eligible if they have severe dysphagia caused by volume loss or muscle atrophy of the tongue or pharyngeal musculature due to HNC treatment. Patients may be eligible if they have no history of major oral surgery.

In the past 5 years, 20 patients have been treated with lipofilling injections at our institute. The procedure is preferably performed in collaboration with the plastic surgeon and under complete anesthesia. We prefer general anesthesia because, in

our experience, especially injecting the fat into the tongue felt uncomfortable. General anesthesia makes the injection less stressful for the patient. In general, we inject 10–15 cc of fat, and on average, two to three sessions are needed. No severe complications have been developed since we started performing this procedure.

8. Conclusions

This chapter describes the possible role of lipofilling in patients with chronic dysphagia after HNC treatment. Lipofilling is a technique for transplanting fat cells within one individual. This procedure has the potential to increase tissue volume and increase oropharyngeal function. Based on published results, the lipofilling technique seems to be safe and—in selected cases—of potential value for improving swallowing function in therapy-refractory HNC patients. For this reason, lipofilling should be considered as a treatment option for chronic dysphagia after HNC treatment.

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Conflict of interest

The authors declare no conflict of interest.

Appendix

SWAL-QOL									
	Case 1			Case 2			Case 3		
	Pre	Short	Long	Pre	Short	Long	Pre	Short	Long
General burden	88.0	25.0	100.0	13.0	0.0	25.0	50.0	75.0	X
Food selection	75.0	38.0	75.0	13.0	0.0	0.0	50.0	50.0	X
Eating duration	88.0	88.0	100.0	50.0	0.0	25.0	50.0	50.0	X
Eating desire	50.0	25.0	100.0	42.0	17.0	17.0	50.0	50.0	X
Fear of eating	56.0	63.0	56.0	38.0	0.0	44.0	56.0	63.0	X
Sleep	25.0	25.0	13.0	0.0	0.0	0.0	0.0	0.0	X
Fatigue	58.0	67.0	67.0	83.0	42.0	X	8.0	17.0	X
Communication	100.0	50.0	100.0	25.0	0.0	25.0	75.0	75.0	X
Mental health	45.0	35.0	30.0	40.0	0.0	X	50.0	50.0	X
Social function	55.0	55.0	75.0	30.0	20.0	X	35.0	60.0	X
Symptom scale	61.0	48.0	57.0	52.0	11.0	X	39.0	46.0	X

Abbreviations: SWAL-QOL = swallowing quality of life questionnaire: range 0–100; lower scores mean better subjective swallowing function. A difference score of 12 points or more was used to demonstrate improvement (+), deterioration (–), or equality (=). X = missing data.

Table 3.
SWAL-QOL scores pre and post (last) lipofilling of the three selected case reports.

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Author details

Marise Neijman, R.T. Karsten, L. van der Molen, O. Lapid²
and M.W.M. van den Brekel^{1,3*}

1 Netherlands Cancer Institute, Amsterdam, The Netherlands

2 Amsterdam University Medical Centre, University of Amsterdam,
The Netherlands

3 University of Amsterdam, The Netherlands

*Address all correspondence to: m.vd.brekel@nki.nl

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