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HEAD AND NECK

Lipofilling after total parotidectomy: a useful option to prevent functional and aesthetic sequelae

Il lipofilling dopo parotidectomia totale: valida tecnica per prevenire sequele estetiche e funzionali

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SUMMARY

Objective. Parotidectomy is the main treatment for parotid tumours, but its functional and aesthetic sequelae can be very disturbing for patients.

Methods. 15 patients underwent total conservative parotidectomy, harvesting of a superficial musculoaponeurotic system (SMAS) flap and lipofilling between May 2014 and June 2020 for a benign parotid tumour. Aesthetic, functional sequelae and cosmetic results were assessed with the House-Brackmann scale, Luna-Ortiz's classification and a semiquantitative questionnaire. Lipofilling resorption was analysed by maxillofacial and neck MRI imaging at 2 years after surgery. The results were compared to a group of 21 patients who underwent total parotidectomy without harvesting a SMAS flap and lipofilling.

Results. No complications were observed. No facial defects were seen during follow-up. Post-operative MRI showed fat resorption was less than 20% in 12 patients and from 20 to 30% in 3 patients. Cosmetic satisfaction was 100% in all cases. Only 1 patient (6%) complained of Frey's syndrome.

Conclusions. Lipofilling is an excellent solution considering its efficacy, safety, simplicity, duration over time and economic costs. Donor site invasiveness is minimal, and reintervention is always possible. Face-lift incision and SMAS flap can improve aesthetic results and minimise the disfiguring impact of the surgical scar.

KEY WORDS: parotidectomy, lipofilling, Frey's syndrome, parotid gland tumours

RIASSUNTO

Obiettivo. *La parotidectomia è il trattamento di scelta per i tumori parotidei; tuttavia, può associarsi a disturbi funzionali ed estetici per il paziente.*

Metodi. *15 pazienti sono stati sottoposti a parotidectomia totale conservativa per tumore parotideo, con allestimento di lembo di SMAS e lipofilling, nel periodo tra maggio 2014 e giugno 2020. I risultati estetici e funzionali sono stati valutati mediante la scala di House-Brackmann, la classificazione di Luna-Ortiz e questionari semiquantitativi. Il riassorbimento del lipofilling è stato valutato mediante una RM del massiccio facciale a 2 anni dall'intervento.*

Risultati. *Non vi sono state complicanze intra e post-operatorie. Nessun paziente ha presentato deficit del nervo faciale. La RM post-operatoria ha mostrato un riassorbimento di tessuto adiposo < 20% in 12 pazienti e tra 20-30% in 3 pazienti. Solo un paziente ha presentato la syndrome di Frey. Il 100% dei pazienti è stato soddisfatto del risultato estetico.*

Conclusioni. *Il lipofilling è una tecnica valida, efficace, semplice, sicura e durevole. Presenta minima invasività sul sito donatore ed è ripetibile. Un'incisione tipo lifting, combinata con l'allestimento del lembo di SMAS, può migliorare i risultati estetici e minimizzare l'impatto della ferita chirurgica.*

PAROLE CHIAVE: *parotidectomia, lipofilling, sindrome di Frey, tumore parotideo*

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Introduction

Parotidectomy is the mainstay of treatment for benign and malignant parotid gland tumours. At present, many surgical options exist for parotid tumours and include (following the European Salivary Gland Society classification from the least to the greatest volume resected): parotidectomy (I or II, tumour arising in the boundaries of the superficial lobe), complete superficial parotidectomy (I-II, tumour involving the entire superficial lobe) and total conservative parotidectomy (I-IV, tumour involving both the superficial and deep lobe or arising in the deep lobe) [1]. Radical removal, avoiding rupture of the tumour capsule and preservation of the facial nerve, are the main goals of parotid surgery. Minor importance is paid on prevention of Frey's syndrome (or auriculotemporal syndrome) [2] and minimising aesthetic defects (concave deformities, facial contour deformity, prominent scar), that may result from parotidectomy. Several approaches have been developed to prevent or secondarily treat neurological syndromes and cosmetic facial depression including flaps (sternocleidomastoid flap, temporoparietal fascial flap, superficial musculoaponeurotic system [SMAS] flap), autologous tissue grafts, implants, allogenic dermis, dermal fat grafts and free fat grafts [3], in addition to topical therapies (anticholinergics) [4] and multiple intracutaneous botulinum toxin A injections [5]. Lipofilling has been described as an efficient, quick, safe, and inexpensive surgical procedure. Based on the injection of autologous semiliquid fat graft, the technique is widely used in cosmetic surgery.

The main aim of this study is to present the outcomes following harvesting of SMAS flap and lipofilling after total conservative parotidectomy in patients treated for a benign parotid tumour.

Materials and methods

Study population

A retrospective study was carried out on the use of lipofilling after total conservative parotidectomy and harvesting SMAS flap. The study cohort (Group A) included 15 consecutive patients treated between May 2014 and June 2020 for a benign parotid tumour (mostly arising in the deep parotid lobe). All patients underwent total conservative parotidectomy, SMAS flap harvesting and lipofilling. The control group (Group B) included 21 consecutive patients treated between January 2007 and December 2013 who underwent parotidectomy without harvesting SMAS flap and lipofilling.

All patients underwent the same clinical assessment during the 3 weeks before surgery including clinical examination, salivary gland ultrasound, fine needle biopsy (FNAB) with pathological examination and maxillofacial and neck MRI/CT scan.

Inclusion criteria was a fine-needle aspiration (FNAB)-proven benignant neoplasm not involving the parotid capsule demonstrated by pre-operative imaging. Exclusion criteria was a FNAB-proven tumour involving the parotid capsule demonstrated by pre-operative imaging.

Surgical procedure

All patients in Group A underwent total parotidectomy (I → IV) with preservation of the facial nerve, followed by lipofilling. A face-lift skin incision was made and the SMAS plane was dissected off the glandular capsule and preserved as a flap in continuity with the platysma, deep to the subcutaneous layer (Fig. 1). The SMAS flap was isolated on both sides to then reposition and stretch it at the end of the resection in order to allow for lipofilling even superficially to it. The posterior branch of the great auricular nerve was mobilised and preserved whenever possible.

Simultaneously, a second surgical team harvested the fat graft from the sub-umbilical abdominal region using Coleman's technique [6]. The donor site was infiltrated through a 3 mm horizontal incision with a 1:400,000 solution of epinephrine in Ringer's lactate. Fat was aspirated by exerting a low negative pressure using a 10 ml Luer-Lok syringe attached to a blunt tip cannula to minimise mechanical trauma to adipocytes. The material was centrifuged for 3 minutes at 3,000 rpm and the semi-liquid phase containing vital adipose tissue was stored. After total conservative parotidectomy, the SMAS flap was approximated and sutured to the tragal plane (Fig. 2A-B). Lipofilling was performed using multi-layer injections under and over the SMAS flap, obtaining approximately 30% overcorrection of the anatomical deficit by observing the convexity of the

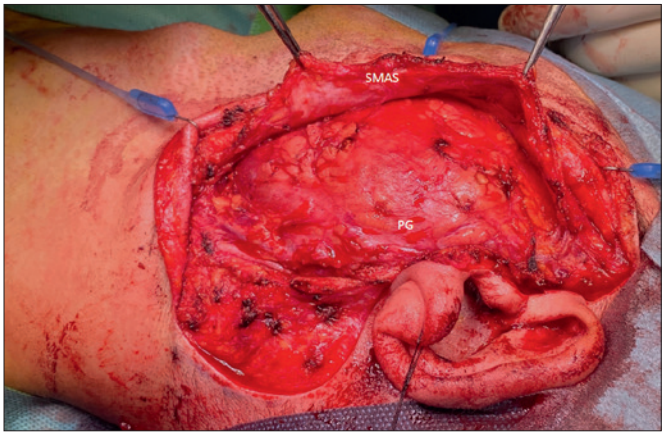

Figure 1. Face-lift skin incision and SMAS flap harvesting (PG: parotid gland).

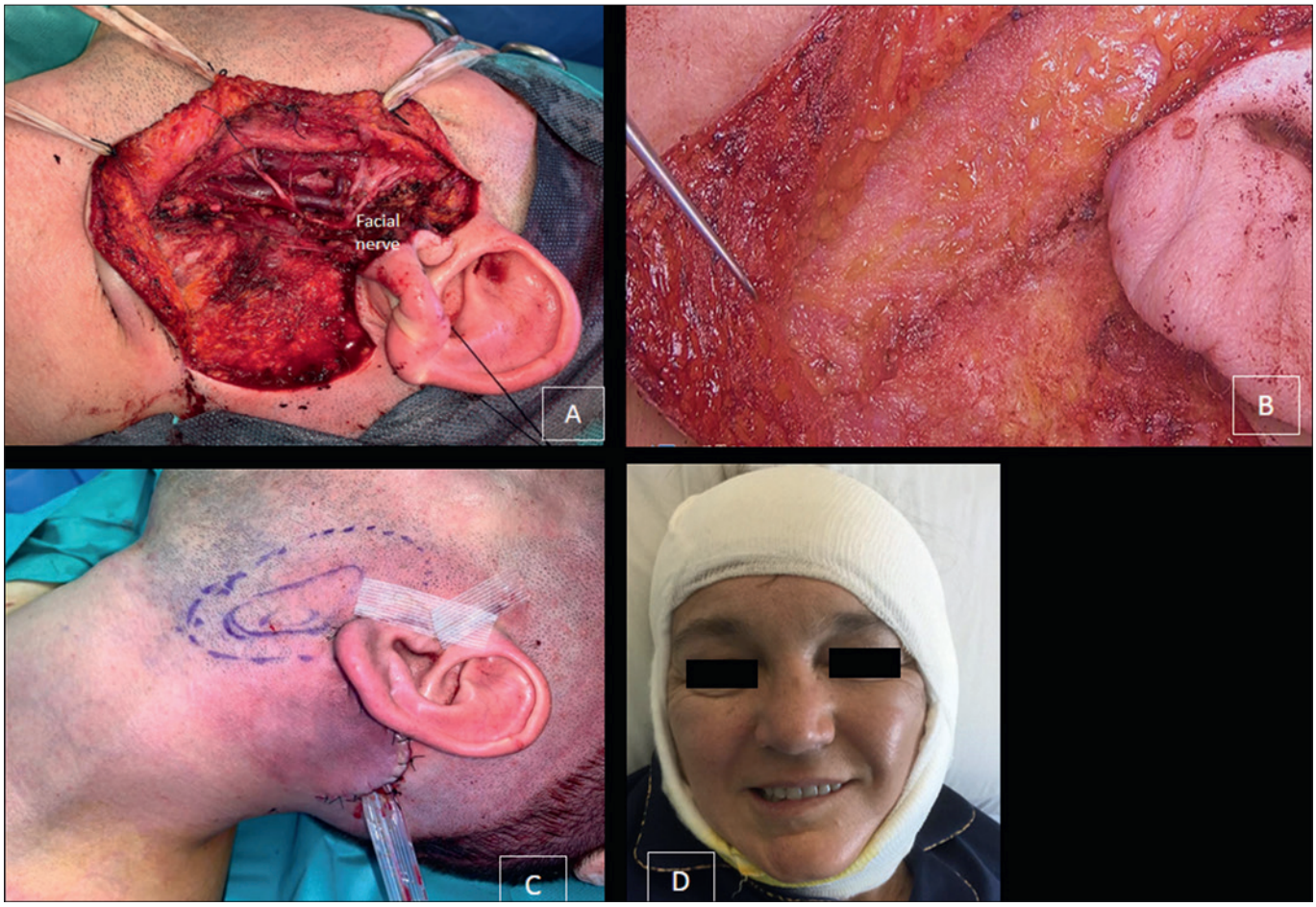

Figure 2. (**A**) Total conservative parotidectomy. (**B**) Approximation of the SMAS flap and suture to the tragal plane. (**C**) Precise marking of the injected area on the skin of the patient to avoid dressing compression at that site. (**D**) Post-operative compressive dressing: a head bandage is wrapped over the top of the head and brought down in front of the ear, under the chin and around the neck.

skin flap after its closure, facial contour and by comparison with the contralateral side. No suction drainages were used, but a soft drain was inserted to prevent the build-up of fluid without draining the lipofilling that was injected. The injected area was precisely marked on the skin to avoid dressing compression at that site (Fig. 2C). A head bandage was wrapped over the top of the head and brought down in front of the ear (on the opposite side of the wound), under the chin and up over the dressing and around the neck. This compressive dressing was held in place for 7 days to allow the fat injection to settle (Fig. 2D).

All patients in Group B underwent total parotidectomy (I → IV) with preservation of the facial nerve, without the use of SMAS flap and lipofilling, using a face-lift skin incision.

All patients were included in regular follow-up programme (salivary gland assessment by ultrasound and clinical examination every 12 months).

To assess the degree of resorption of the lipofilling, patients in Group A underwent maxillofacial and neck MRI at 2 years after surgery, asking the radiologist to evaluate the symmetry of facial contour before and after the operation, grading fat resorption as less than 20%, between 20 and 30% or more than 30%.

MRI was performed with a 1.5 T scanner (Siemens Symphony TIM; Siemens, Enlargen, Germany and Philips Achieva, Philips Healthcare, Best, The Netherlands). The imaging protocol included T1-weighted images in three orthogonal planes, T2-weighted images with fat suppression in axial and coronal planes, contrast-enhanced T1-weighted images with fat suppression in axial and coronal planes and axial diffusion-weighted images. T1-weighted images were used for volume measurements of the fat graft, since the fat tissue is best observed with this sequence.

The severity of Frey's syndrome was evaluated using Luna-Ortiz's classification [7]: mild (total score 1-3) or severe (total score ≥ 4) on the basis of subjective (clinical manifestation,

excessive focal sweating and unpleasant smelling sweat) and objective manifestations (extent of the affected area revealed by Minor's iodine starch test) [8]. Facial nerve defects were evaluated with the House-Brackmann scale [9]. Patients were asked to evaluate postoperative cosmetic results with a semiquantitative questionnaire, focusing on symmetric appearance and change of cosmesis during follow-up. Satisfaction was graded on a scale of 1 (strongly unsatisfied) to 5 (strongly satisfied).

Statistical analysis

Means and standard deviations were used to report continuous variables and frequencies and proportions for categorical variables. The following parameters were evaluated with nonparametric Mann-Whitney and Fisher Tests: intraoperative time, length of hospitalisation, complication rates, facial nerve deficit, grade of lipofilling resorption (Group A), cosmetic satisfaction and Frey's syndrome.

Results

Group A

A total of 15 patients were treated. Demographic data for patients in Group A are summarised in Table I. The median age was 45 years (range 16-72 years). Fourteen patients were affected by pleomorphic adenoma, and one patient had a multilocular lymphangioma. The mean intraoperative time was 140 minutes (range 85-260 minutes). The mean length of hospitalisation was 3 days (range 2-4 days). The results in this group are summarised in Table II.

No intra-operative or post-operative complications were observed. The first follow-up was performed after 9-14 months and the second after 18-24 months. The late timing of the first follow-up was intentional in order to allow sufficient time for nerve regeneration.

Maxillo-facial and neck MRI, performed at 2 years after surgery, showed fat resorption of < 20% in 12 patients (80%), while 3 patients (20%) had 20-30% fat resorption.

Table I. Demographic data of Group A.

Characteristics	No. of patients N = 15
Age, yo	
Mean, n	45
Range	16-72
Sex, n (%)	
Male	4 (27)
Female	11 (73)
Histology, n (%)	
Pleomorphic adenoma	14 (87)
Multilocular lymphangioma	1 (6)

Table II. Intraoperative and postoperative results.

Characteristic	Group A (N = 15)	Group B (N = 21)
Intraoperative time (minutes)		
Mean	140	120
Range	85-260	80-170
Hospitalisation length (days)		
Mean	3	3
Range	2-4	2-4
Intraoperative complications		
No	15 (100%)	21 (100%)
Yes	0 (0%)	0 (0%)
Postoperative complications		
No	15 (100%)	21 (100%)
Yes	0 (0%)	0 (0%)
Sequelae		
No	14 (93%)	17 (81%)
Frey's syndrome	1 (6%)	4 (19%)
Aesthetic satisfaction	15 (100%)	20 (95.2%)
Grade I postoperative facial nerve function*	0 (0%)	0 (0%)
Grade II postoperative facial nerve function	0 (0%)	1 (4.8%)
Radiological evaluation of fat resorption		
≤ 20%	12 (80%)	Not applicable
20-30%	3 (20%)	Not applicable
≥ 30%	0 (0%)	Not applicable

**Grades 1 to 6 on the House-Brackmann Scale.*

Radiologist-evaluated fat resorption more than 30% was not seen in any patient.

When evaluated with the House-Brackmann scale, no facial defects were seen during follow-up. All patients expressed the highest level of cosmetic satisfaction (5/5, strongly satisfied) (Figs. 3-5). Only one patient (6%) complained of Frey's syndrome and had a positive Minor test during follow-up (7.5 cm^2 of skin involved after 12 months postoperative and 12.5 cm^2 of skin after 36 months postoperative; Tab. III).

Group B

A total of 21 patients (15 females and 6 males) were included in Group B. Demographic data are summarised in Table IV. The median age was 49 years (range 22-65 years). Twenty patients were affected by pleomorphic adenoma, and one patient had an oncocytoma. The mean intraoperative time was 120 minutes (range 80-173 minutes). The mean length of hospitalisation was 3 days (range 2-4 days). The results in this group are summarised in Table II.

No intraoperative or postoperative complications were observed. The first follow-up was performed after 9-14 months and the second after 18-24 months. The late timing of the first follow-up was intentional to allow sufficient time for nerve regeneration.

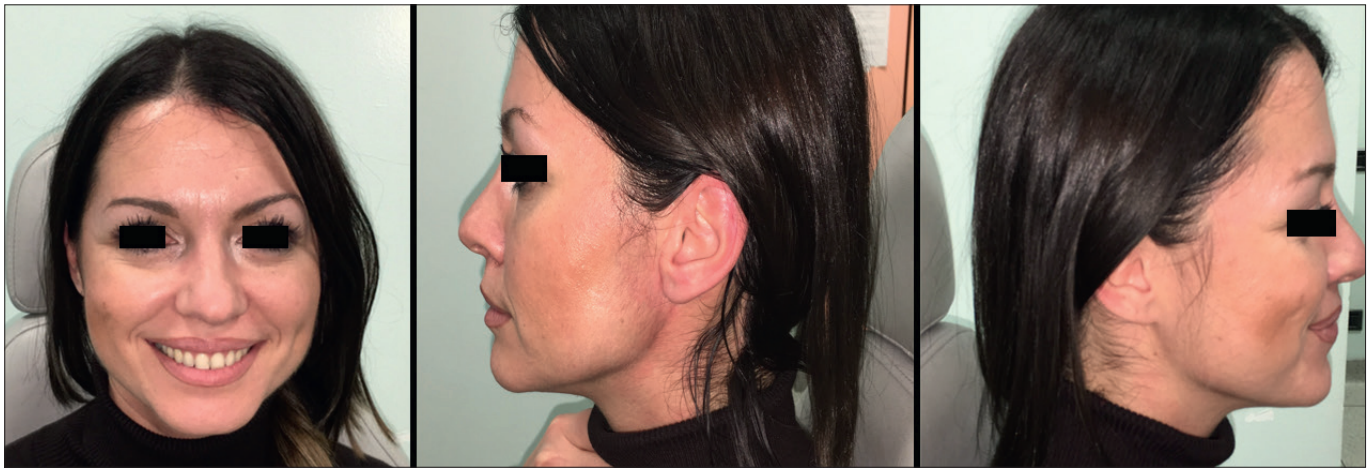

Figure 3. Aesthetic outcomes in a 39-year-old woman.

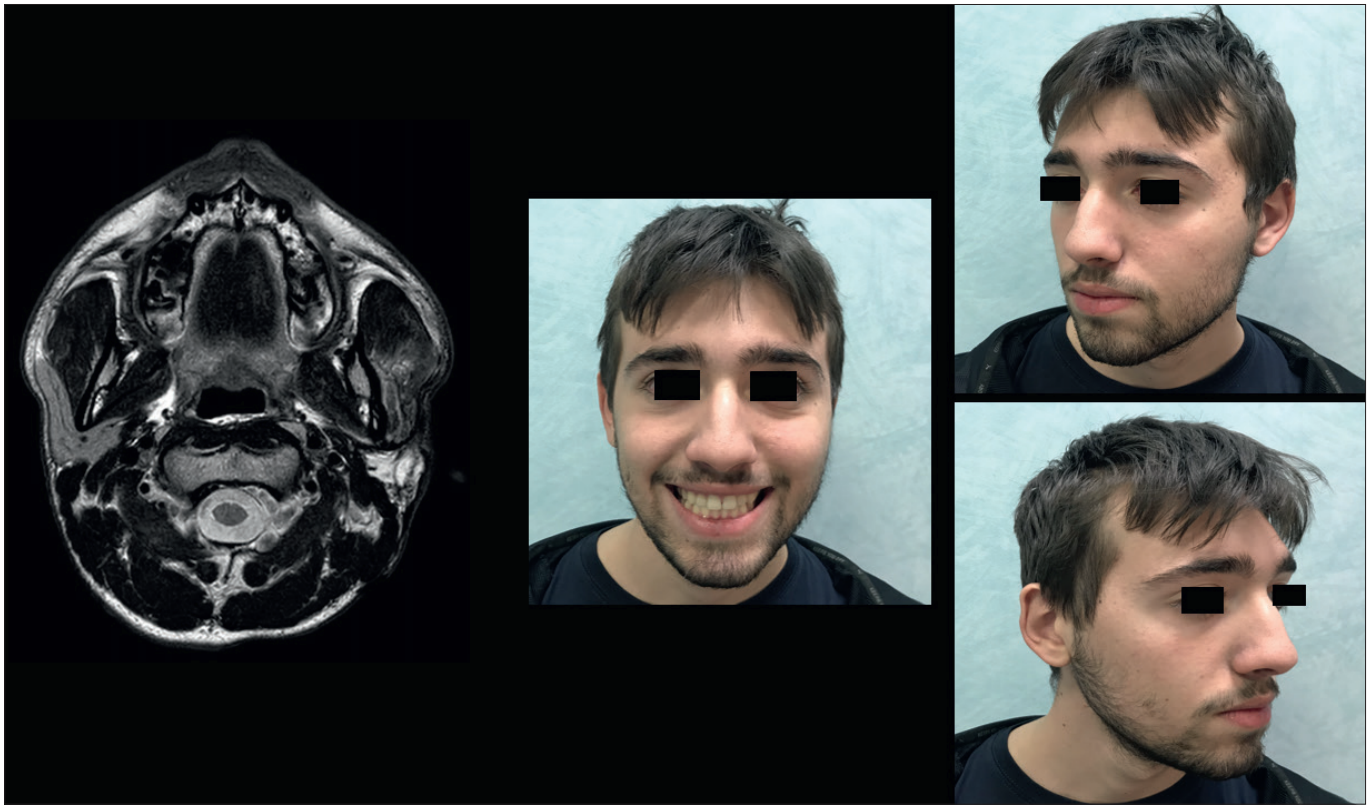

Figure 4. Neck MRI (T2) at 2 years postoperative and aesthetic outcomes in 16-year-old male.

Table III. Characteristics of Frey's syndrome in Group A.

	First follow-up visit (range 9-14 months) N = 15, n (%)	Second follow-up visit (range 18-24 months) N = 15, n (%)
Symptomatic Frey's syndrome	1 (6%)	1 (6%)
Positive Minor starch-iodine test	1 (6%)	1 (6%)
Iodine-positive surface area, cm^2	7.5 cm^2	12.5 cm^2

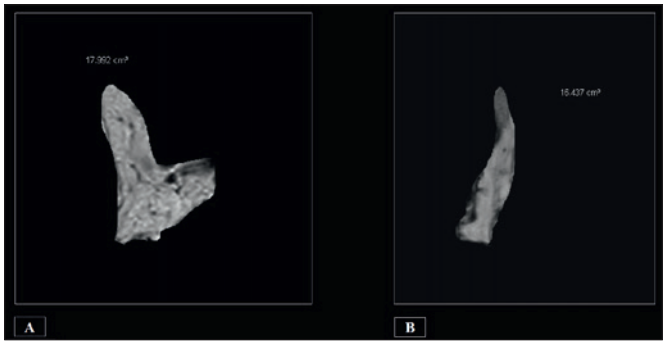

Figure 5. Volumetric comparison of the contents of the parotid region at 2 years after surgery: (**A**) non-operated side; (**B**) following total parotidectomy and immediate lipofilling.

Table IV. Demographic data of Group B.

Characteristics	No. of patients N = 21
Age, yo	
Mean, n	49
Range	22-65
Sex, n (%)	
Male	6 (28.6)
Female	15 (71.4)
Histology, n (%)	
Pleomorphic adenoma	20 (95.2)
Oncocytoma	1 (4.8)

Using the House-Brackmann scale, no facial defect was seen in 20 patients (95.2%) during follow-up. One patient (4.8%) complained of a grade II House-Brackmann facial nerve defect. Fifteen patients (71.4%) expressed the highest level of cosmetic satisfaction (5/5, strongly satisfied), while 3 patients (14.3%) were moderately satisfied (4/5) and 3 (14.3%) were satisfied (3/5). Four patients (19%) complained of Frey's syndrome and had a positive Minor test during follow-up (Tab. V).

Discussion

Parotidectomy is the treatment of choice for benign parotid gland neoplasms. When total conservative parotidectomy is necessary (I-IV), Frey's syndrome and aesthetic defects can frequently occur [10]. The aesthetic defect is due to the surgical scar and to a remarkable depressed area in the parotid region, resulting in asymmetry of facial contour. Almost all patients who undergo parotidectomy I-IV show a variable degree of aesthetic defects [10]. Frey's syndrome, which consists of sweating, flushing and erythema of the parotid region, is triggered by mastication and other salivation stimuli and has uncertain aetiology. It seems to be caused by an aberrant process of reinnervation, producing atypical synapsis between parasympathetic and sympathetic fibres. The rate of Frey's syndrome following parotidectomy is very heterogeneous in the literature (reported in 10-40% of cases) and reflects discrepancies in reporting and diagnosis [3]. The variability may also be related to the surgical technique used, diagnostic method and length of follow-up. However, up to 90% of patients have been reported to have a positive starch iodine test (Minor's test) [3,4,7,11].

By filling the anatomic defect caused by surgery both aesthetic defects and Frey's syndrome can be prevented. Reconstructive techniques can restore normal face contour and symmetry, creating a physical barrier to a pathological reinnervation process [3,8,9,11-13]. Moreover, the use of a facelift incision minimises the disfiguring impact of the surgical scar [12-14].

Many reconstructive techniques are now available. Reconstruction using SMAS flap has shown to be effective in preventing Frey's syndrome. However, due to its thinness it is not suitable to correct deep anatomic defects. A temporoparietal fascia flap allows good aesthetic results, but requires an extended temporal incision, and has an increased risk of alopecia and nerve lesions [15]. The effectiveness of a sternocleidomastoid muscle flap is still debated. Overall, the use of flaps has drawbacks such as an increase in surgical time, limited availability of tissue and the limited rotation angle. Graft and non-autologous implants (possibly synthetic) such as acellular dermal matrix, human lyophilised dura, PTFE patches and polyglactin 910 mesh are possible alternatives that ensure a high rate of aesthetic satisfaction. Even if these materials could be an ideally limitless source and are quick and easy to use, their high costs represent a limitation for a large-scale use. Furthermore, the non-

Table V. Characteristics of Frey's syndrome in Group B.

	First follow-up visit (range 9-14 months) N = 21, n (%)	Second follow-up visit (range 18-24 months) N = 21, n (%)
Symptomatic Frey's syndrome	4 (19%)	4 (19%)
Positive Minor starch-iodine test	4 (19%)	4 (19%)
Iodine-positive surface area, cm^2 (median)	8 cm^2	13 cm^2

negligible risk of infection, rejection and extrusion reduces their safety [16]. Good aesthetic results and effectiveness in preventing Frey's syndrome have been described using dermal or dermal-fat grafts (autologous or allogenic) and FAT (Free Abdominal Fat Transfer, a solid fat graft). Though these options represent a good compromise in terms of costs, rapidity and simplicity, the surgical invasiveness on the donor site is still a limitation since it can cause further complications and aesthetic defects [3,14,15]. In some cases, the techniques listed above have been combined or applied in a second step to treat but not prevent aesthetic issues and Frey's syndrome.

Cosmetic surgery has employed lipofilling for decades and is associated with excellent safety. The procedures for fat grafting and applying a semi-liquid fat graft have been described in detail [6].

The main debates regarding the use of lipofilling to correct the aesthetic defect after parotidectomy concern physiological resorption of the graft and its long-term efficacy. Volume loss and graft resorption remain a major challenge in the long-term that can lead to unpredictable results. The volume of fat transferred in the parotidectomy region has not been clearly identified. Moreover, the percentage of fat graft resorption in parotid bed reconstruction is unknown, and most studies have been based on the rates of fat graft resorption at other sites of the face or body [17].

Generally, fat resorption occurs during the first three months after lipofilling [18]. In the literature, it has been described that the resorption phenomenon is more prominent (around 50%) if the harvested fat is very oily (the proportion of oil in the centrifugated fat is high) [18]. Once stabilised in situ, the fat tissue permanently remains in the recipient bed. Eto et al. [19] noted that some adipocytes die immediately after surgery during the immediate, post-lipofilling ischaemic period. However, other cells survive due to the process of plasmatic imbibition. This biological phenomenon precedes the growth of neo-capillaries that will nourish the fat, establishing a long-term homeostatic equilibrium. Both the fat and the surgical recipient bed contribute to the process of revascularisation [20].

In 2013, Vico et al. described their experience in the use of lipofilling after parotidectomy I-IV to treat benign parotid neoplasms and reported that the procedure was associated with good long-term efficacy [21].

In the literature, the incidence of facial nerve dysfunction after surgery is variable, and the diverse populations studied, and type of surgical procedures used makes it difficult to compare different studies. Postoperative facial nerve dysfunction also depends upon the surgeon's experience, surgical technique employed, size and site of the tumour, histopathological type, comorbid inflammatory conditions, and the patient's age. Long-term dysfunction has been reported in 0 to 19% of patients [22,23].

In this study, none of the patients in Group A presented facial nerve deficit during follow-up (12 months after surgery); with the House-Brackmann grading scale, all patients had a score of I (100%), or normal facial nerve function. In Group B, only 1 patient had a grade II House-Brackmann facial nerve deficit during follow-up.

These excellent outcomes regarding facial nerve dysfunction may in part be justified by lipofilling that encases the facial nerve in fatty tissue. Mature adipocytes account for approximately 20-30% of all adipocytes. The remainder are the so-called DFAT cells (de-differentiated fat cells), which are characterized by a high proliferative potential and pluripotency. DFAT cells can differentiate into various types of cells (adipocytes, smooth muscle cells, cardiomyocytes, osteoblasts, chondrocytes) and significantly improve nerve-regeneration capability since they release large amounts of VEGF. Moreover, immunohistochemical studies show that neural stem cell markers, such as nestin and SOX2, are found in DFAT cells, suggesting that these cells can differentiate into peripheral nerve cells (Schwann cells); they thus appear to play a central role in nerve regeneration by releasing nerve growth factor and by forming myelin, which is important for axonal structure [24,25].

For these reasons, it is important to underline that lipofilling is contraindicated in patients with a malignant parotid tumour. Nevertheless, the presence of fat in the parotid region after lipofilling does not affect the need for revision surgery for recurrent pleomorphic adenoma or the need for adjuvant treatments (radiotherapy, chemoradiotherapy) in the case of an unexpected malignant tumour at the final histopathological report.

The results of this study are significant in terms of clinical and economic performance. The combination of face-lift skin incision, SMAS flap harvesting and lipofilling was shown to be effective in limiting aesthetic defects after parotidectomy I-IV and to reduce the rate of Frey's syndrome. All patients in group A expressed the maximum cosmetic satisfaction score, while only 71.4% of patients were highly satisfied in group B, demonstrating that lipofilling is not inferior in efficacy to any of the other employable options. Rigorous application of Coleman's technique and overcorrection (of about 30%) allowed maintaining long-term success without deterioration during follow-up.

Although the number of patients was small overall, the incidence of Frey's syndrome in Group A was low. Only one patient (6.6%) had a positive Minor's test during follow-up (12.5 cm^2 of skin involved), suggesting that the technique is also effective in preventing Frey's syndrome. In group

B, four patients (19%) complained of Frey's syndrome and had a positive Minor test.

The absence of intra- or post-operative complications or sequelae, in both the donor and the recipient sites, demonstrates that the methods are associated with an excellent safety profile. Intraoperative surgical time is not substantially increased (140 minutes in group A *vs* 120 minutes of group B), since the simultaneous work of two surgical teams allows harvesting the graft while tumour removal is ongoing. At the end of the resection, graft application can be easily performed in 10-15 minutes. Additionally, the technical skills required, and extra costs are negligible. Moreover, in the case of a poor aesthetic result in the long-term, reintervention is always possible. Excellent outcomes can be achieved with local anaesthesia and using a small incision at the donor and recipient sites.

Conclusions

Total conservative parotidectomy for benign parotid tumours is frequently followed by Frey's syndrome and aesthetic defects. The present study appears to suggest that the combination of face-lift skin incision, SMAS flap harvesting and multilayer lipofilling can reduce the incidence of Frey's syndrome and consistently improve postoperative cosmetic results, in the absence of significant morbidities. Nevertheless, larger case series are needed to confirm these encouraging results. In the future, new digital systems may be able to pre-operatively analyse the possible volumetric defect of the parotid region after total conservative parotidectomy in order to tailor the lipofilling and customise the reconstruction.

Conflict of interest statement

The authors declare no conflict of interest.

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Author contributions

EC: conception and design of the study, surgeon, and drafting the manuscript; GA: acquisition of data, drafting of the manuscript; MF: acquisition of data, editing the manuscript; GF: radiologist, acquisition of data; DM: surgeon, conception of the study; RC: surgeon, conception of the study; GS: conception and design of the study, surgeon, editing the manuscript, final approval. All Authors contributed to the article and approved the submitted version.

Ethical consideration

All procedures were considered to be conventional in terms of technique and indications, in accordance with current guidelines, the ethical standards of the institutional and/or National Research Committee and the 1964 Helsinki declaration and its later amendments. Ethical review and approval were not required for this study in accordance with national and local institutional requirements. Before surgery, all patients signed a consent form for disclosure of anonymised data for scientific purposes. Written informed consent was obtained from all patients.

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