

Complications Associated with Facial Autologous Fat Grafting for Aesthetic Purposes: A Systematic Review of the Literature

Davide Brucato, MD*
 Ismail I. Ülgür, DMD, MD*†
 Andrea Alberti, MD*
 Andrea Weinzierl, MD‡
 Yves Harder, MD*§

Background: With the increasing demand for aesthetic procedures, autologous fat grafting (AFG) seems to be an attractive option for facial volumization and rejuvenation. The aim of this study was to assess the type and severity of associated complications after facial AFG for aesthetic purposes.

Methods: The entire PubMed/Medline and Cochrane databases were screened to identify studies describing complications that occurred after the injection of autologous fat into the face. These complications have been reviewed and analyzed according to their occurrence and severity in the different anatomical regions of the face.

Results: Twenty-two articles including 38 patients reported on a total of 58 complications. Thirty-two complications have been classified as severe or permanent, including hemiplegia (n = 11), loss of vision (n = 7), or skin necrosis (n = 3). The other 26 complications were classified as mild or transient, such as lipogranuloma (n = 12) or mycobacterial abscess (n = 2). The majority of complications were reported after injection to the forehead (n = 26) and the temporal region (n = 21). Interestingly, this location seems to be the area at risk because 53% of all severe complications occurred in this anatomical region.

Conclusions: AFG to the face is associated with a low incidence of complications, but if they occur, they can be dramatic, particularly in the forehead and temporal region. Nevertheless, AFG can be used to correct age-related changes of the face and volume loss and may represent an alternative to synthetic fillers. Therefore, AFG to the face should be performed by qualified doctors under careful consideration of risks and facial anatomy. (*Plast Reconstr Surg Glob Open* 2024; 12:e5538; doi: 10.1097/GOX.0000000000005538; Published online 22 January 2024.)

INTRODUCTION

Lipofilling or autologous fat grafting (AFG) is the harvesting and transfer of a patient's fat or adipose tissue from a donor site to an area of the body, ie, recipient site where augmentation and/or rejuvenation is desired. This

has been described as a well-accepted approach for facial rejuvenation¹ to counteract the changes of the aging face, and demand for this procedure is increasing under the ever growing social pressure to remain youthful.^{2,3} In fact, according to the statistics of the International Society of Plastic and Aesthetic Surgery (ISAPS) 2021, 4.6% of all surgical procedures performed by plastic surgeons worldwide accounted for autologous fat grafts to the face. AFG seems to be the "ideal" filler because it has a permanent effect and large volumes can be injected without the risk of an allergic reaction.^{4,5} Thanks to its long-lasting effect, there is less need for repeated procedures than with other techniques for aesthetic facial augmentation. Moreover, regenerative effects due to the contained adipose derived stem cells and the stimulation of the surrounding tissue have been described.⁶ Although the harvesting of adipose

*From the *Department of Plastic, Reconstructive and Aesthetic Surgery EOC, Ospedale Regionale di Lugano, Ente Ospedaliero Cantonale (EOC), Lugano, Switzerland; †Cfc Hirslanden-Cranio Facial Center, Aarau, Switzerland; ‡Department of Plastic Surgery and Hand Surgery, University Hospital Zurich, Zurich, Switzerland; and §Faculty of Biomedical Sciences, Università della Svizzera Italiana, Lugano, Switzerland.*

Received for publication July 29, 2023; accepted November 17, 2023.

Drs. Brucato and Ülgür contributed equally to this work.

Copyright © 2024 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons. This is an open-access article distributed under the terms of the [Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 \(CCBY-NC-ND\)](https://creativecommons.org/licenses/by-nc-nd/4.0/), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

DOI: 10.1097/GOX.0000000000005538

Disclosure statements are at the end of this article, following the correspondence information.

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

tissue is associated with few surgical risks and almost no donor site morbidity, additional cost and the need for an operation may deter patients from undergoing the procedure. Furthermore, the highly variable rate of graft reabsorption needs to be discussed with the patient.⁷ Because of the above-mentioned drawbacks, the application of nonpermanent fillers for facial volumization, including hyaluronic acids (HA) and calcium-hydroxyapatite (CaHa)-based fillers remains a popular option. Because facial injections using HA or CaHa are associated with certain drawbacks, it remains doubtful whether the ease of application of nonpermanent fillers can rival the durability and long-term beneficial effects of facial AFG.

With the present review, the authors summarize the existing reports on complications following procedures using AFG to the face for aesthetic purposes to further define its role in facial rejuvenation and volumization.

MATERIALS AND METHODS

According to the PRISMA criteria (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), the authors reviewed the currently existing literature using the PubMed/Medline and Cochrane Library databases. The review has not been recorded in any review registry.

The following search algorithm has been applied: ((Lipofilling) OR (Fat Grafting) OR (Fat Modelling) AND (Facial) AND (Complications)). The research included publications from January 1989 to December 2022. Clinical studies of all types have been included, such as clinical trials, prospective case series, retrospective reviews, and case reports with a full text available in English language. Two independent investigators (D.B. and I.I.Ü.) manually screened and selected all articles on complications that occurred after an AFG procedure for facial rejuvenation in otherwise healthy patients. A third reviewer (Y.H.) was involved in case of discrepancy while interpreting the literature.

After initial selection, the authors excluded articles describing the use of synthetic fillers for the same purposes, the applications of lipofilling for congenital or acquired contour deformity, treatment of scars, and patients with preexisting diseases or gender re-assignment. As these patients usually have an indication to reconstruct the face to regain contour and symmetry, like before the disease, the injury, or the surgery, they were not included in this review to avoid any bias of the results (Fig. 1).

Each identified article has been listed as follows: name of the first author, year of publication, geographic origin of the study (location), study design, number of patients including gender, age, characteristics of the fat, area of injection, onset of the complication after the injection, type of complication, treatment of the complication (medical/surgical), outcome and level of evidence (LoE) of the article according to the Oxford level of evidence scale (See table, Supplemental Digital Content 1, which displays the summary of studies with complications after facial autologous fat grafting. <http://links.lww.com/PRSGO/D21>). Complications were further categorized as mild (or temporary) and severe (or permanent) as previously described by Oranges et al.⁸ For this literature review, an ethical committee approval was not required.

Takeaways

Question: Assess the type and severity of complications after facial lipofilling for aesthetic purposes to assess its role in cosmetic surgery.

Findings: Facial lipofilling is associated with a relatively low complication rate. However, severe complications can occur, primarily in the forehead and temporal regions. When comparing this technique with the use of fillers, it is challenging to determine which treatment is safer due to numerous biases.

Meaning: Surgeons should choose the technique for facial augmentation on a patient-by-patient basis, considering all individual variables.

RESULTS

A total of 1322 articles were identified in the PubMed/Medline and Cochrane Library databases and assessed for eligibility, out of which 22 articles were included in the present study. The LoE of these articles was mostly 5. The included articles reported a total of 38 patients respectively 58 complications after the injection of autologous fat into the face. The percentage of female patients was 97% (n = 37) with only one male patient (3%) reported in this review. The mean age of the patients was 34.7 years (range 22–65). A total of 26 (45%) complications were identified as mild or transient and 32 (55%) as severe or permanent, as shown in Tables 1–3.

Most of the complications occurred in the forehead region [45% (n = 26)]. Nineteen of them were classified as mild, such as lipogranuloma of the upper eyelids,⁹ which showed full resolution after surgical excision, or multiple abscesses as described by Kim et al.¹⁰ The latter were treated by incision, drainage, and antibiotic therapy, and full recovery was reported for all cases at latest after 11 months. The remaining seven complications in the forehead region were described as severe (22% of all severe complications), including one case of immediate postprocedural unilateral vision loss described by Dreizen et al¹¹ in 1989, where at 2.5 months follow-up there was still no light perception in the homolateral eye of the treated region.

A total of 36% of all complications were reported after the application of autologous fat in the temporal region in 21 patients. In this region, the highest percentage (53%) of severe complications occurred, as, for example, one case of right-sided hemiplegia that had to be treated by emergency decompressive craniectomy with resection of necrotic brain tissue.¹² Furthermore, Quian et al reported one case of massive cerebral infarction needing the same urgent procedure described by Quian et al due to a complete occlusion of the right external carotid artery of the patient by an embolus of adipose tissue.¹³ Despite the above-mentioned surgical procedure and the following medical treatment with intravenous mannitol for 10 days, the patient did not fully recover, resulting in permanent severe neurologic disabilities. Moreover, three similar cases were described by Wang et al in 2014 and 2018, with a poor functional outcome for the involved patients.^{14,15} Only four complications (15%) in the temporal region were described as mild.

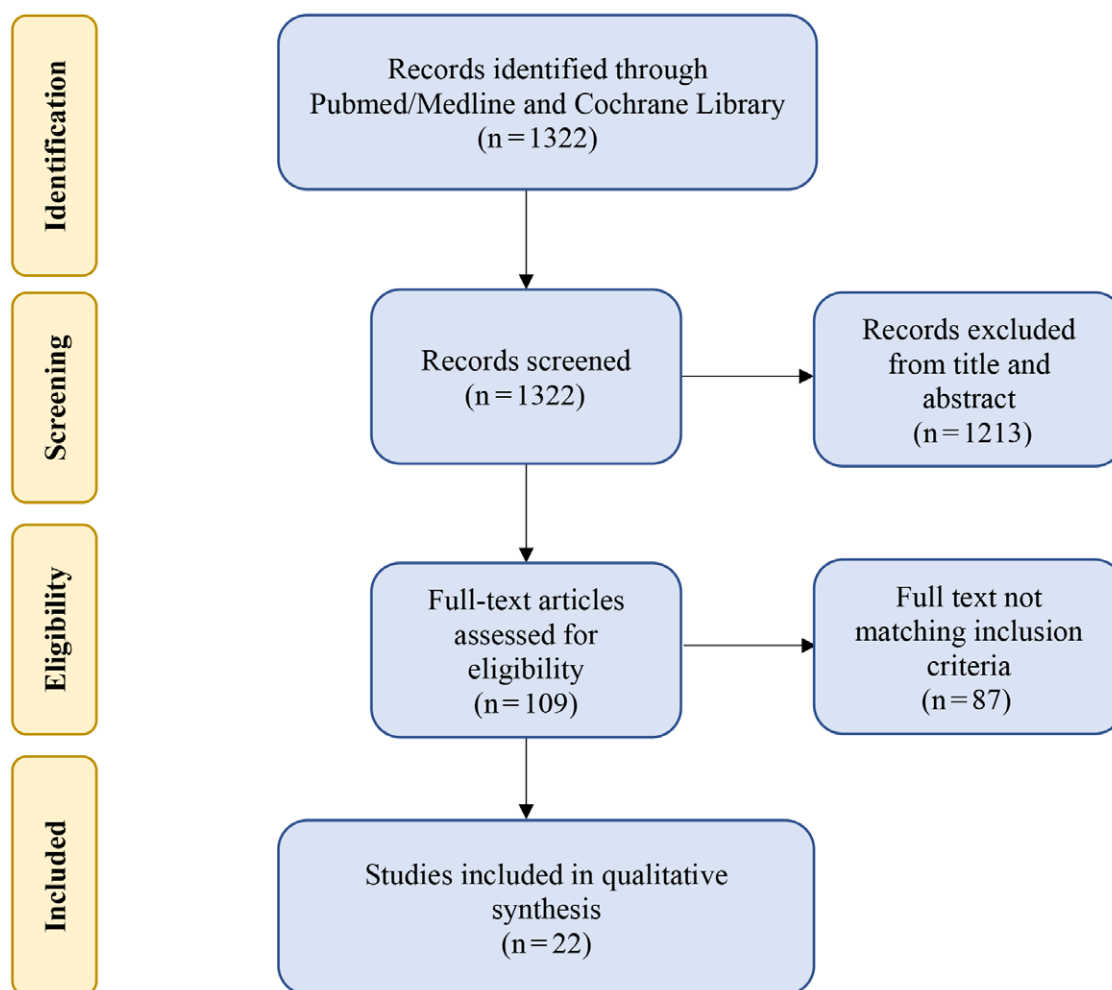


Fig. 1. PRISMA flowchart.

Table 1. Rates of Mild or Transient Complications in Decreasing Order

Mild or Transient Complications	n = 26
Lipogranuloma	12
Mycobacterial abscess	2
Blepharoptosis	2
Eyelid swelling	2
Conjunctival injection	1
Livedo reticularis	1
Alopecia	1
Lagophthalmos	1
Proptosis	1
Hirsutism	1
Ageusia	1
Dystrophic calcification papules	1

The cheek region was represented by only four patients (7%) who were included in the present review. Among them, three were classified as mild complications and one was included as severe, regarding a fat embolus in the external carotid system after AFG in multiple areas of the face including temples

Table 2. Rates of Severe or Permanent Complications in Decreasing Order

Severe or Permanent Complications	n = 32
Hemiplegia	11
Vision loss	7
Decreased level of consciousness	5
Aphasia	3
Skin necrosis	3
Death	1
Hemianopsia	1
Iris depigmentation	1

and forehead, so likely not caused solely by cheek inoculation.¹³

In the chin region, three (5%) complications were described, out of which two were mycobacterial abscesses that successfully responded to systemic treatment.^{10,16} After a treatment of the wrinkles of the glabella, one severe complication has been described by Yoon et al, represented by an immediate acute infarction of the left cerebral hemisphere leading to altered mental status, hemiplegia and death of the patient 4 days after the treatment.¹⁷

Table 3. Complication Rates (Mild or Transient, Severe or Permanent) per Anatomic Area

Area	n Total Complications	% Total Complications	n Mild Complications	% Mild Complications	n Severe Complications	% Severe Complications
Forehead	26	44.8%	19	73%	7	21.8%
Temples	21	36.2%	4	15.3%	17	53.1%
Cheeks	4	6.8%	3	11.5%	1	3.1%
Chin	3	5.1%	0	0%	3	9.3%
Glabella	1	1.7%	0	0%	1	3.1%
Nose	1	1.7%	0	0%	1	3.1%
Eyelids	1	1.7%	0	0%	1	3.1%
Face-NR	1	1.7%	0	0%	1	3.1%

In addition, one severe complication was noted after the injection of autologous fat in the region of the nose, reporting vision loss without improvement, though selective pharmaco-mechanical thrombolysis was performed with a micro-catheter and urokinase.¹⁸

After peri-orbital fat grafting, upper eyelid ptosis was noted in one patient described by Li et al, subsequently treated successfully with blepharoplasty and the removal of the injected fat.¹⁹ Finally, in the included literature, the authors could not define the exact region of fat injection in one case before the onset of neurological with permanent symptoms.²⁰

DISCUSSION

The review of the current literature primarily revealed that one of the underlying challenges in assessing the complications after AFG is the absence of an accurate and unequivocal terminology that indicates the affected region of the face and the severity of the complication. As Marten et al describe, a universal nomenclature does not exist currently.²¹ Moreover, due to the widespread increasing demand for facial rejuvenation procedures including AFG, determining the exact number of procedures performed worldwide and establishing an accurate rate of complications is almost impossible. As long as any type of data entry of these procedures into specific registries will not be mandatory, it will be extremely difficult to assess the surgery-dependent and independent morbidity. Groen and coworkers reported in a meta-analysis published in 2017, including 1205 patients undergoing AFG to the face for aesthetic purposes, a complication rate of 6%. The authors thereby referred commonly occurring minor complications, including hematoma, fat necrosis, and irregular fat distribution. Of interest, no major complications were reported, such as vascular injuries, emboli, or neurological symptoms.²² In fact, as described by Kim et al⁵ and Grahovac and Rubin,²³ complications in general and severe or major complications in particular are extremely rare when considering their incidence overall. Another recent work by Schiraldi et al correlated the approximately 3 million total AFG procedures to the face performed worldwide between 2015 and 2019 according to ISAPS reports and the 15 severe complications reported in their overview of the literature, resulting in a theoretical complication rate of approximately 0.0005%.²⁴ The inhomogeneity of all these findings in the literature

suggests a potential under-reporting of complications after AFG procedures, especially when it comes to the severe and permanent complications. Nevertheless, even if rare and presumably under-reported, this review shows that severe complications with dramatic consequences for the patient can in fact occur after AFG to the face. It is thereby important to know that the risk of complication is clearly associated with the anatomical region of fat injection. According to the reported complication rates, the regions with the lowest risk for major or permanent complications seem to be cheeks, the eyelids, and the nose, reporting one severe complication each per region. The most commonly affected region of the face seems to be the forehead and the temporal region, of which the latter showed the highest rate of severe complications (53% of all severe complications).⁸

In general, vascular embolism is described as the most severe complication associated with AFG.² For instance, in 1989 Dreizen and co-workers¹¹ described a sudden unilateral vision loss after autologous fat injection to the forehead region to treat frontal wrinkles. Furthermore, Xing et al²⁵ described the occlusion of the ophthalmic artery by a fat embolus after the injection of autologous fat for cosmetic purposes. Miao et al²⁶ reported massive infarction of the right hemisphere of the brain after bilateral temporal AFG, similar to the diffuse cerebral infarction described by Qian and coworkers.¹³ In 2022, Dhooghe et al even report three cases of death after the use of AFG to the face.²⁷ When considering these complications, some may recommend the use of nonpermanent fillers, such as HA or CaHa as they seem to be associated with a low level of risk. A review conducted by Shuck and coworkers in 2013 compared the outcomes of 724 patients with Human Immunodeficiency Virus-associated lipodystrophy to the face after AFG and the use of HA/Poly-L Lactic Acid. This study showed that limited data availability and inhomogeneous reporting did not allow to adequately compare these with treatment methods.²⁸ Unfortunately, currently, there are no similar studies comparing the rate of complications between treatments of the face for aesthetic purposes using AFG or nonpermanent fillers, probably due to the several potential above-mentioned biases. However, rare but severe vascular complications have recently been described in the literature following the use of nonpermanent facial fillers as well,⁸ likely sharing the same pathogenic mechanism and clinical manifestations with complications after facial AFG. Vascular

compromise may either arise from intra-arterial injection of the fat respectively filler, leading to partial or total vascular blockage, or from extrinsic vascular compression due to subcutaneous buildup of the fat respectively filler adjacent to a vessel, leading to possible immediate neurological consequences such as decreased mental status, loss of vision, or hemiparesis.²⁹ A systematic review published by Oranges et al in 2021 highlights that among the complications reported after the use of a nonpermanent filler, 37% can be considered severe or permanent, predominantly affecting the forehead, the glabella, and the nose.⁸ Based on this data, surgeons should consider the risk of vascular complications regardless of the material to be used, in particular when injecting into a region of the face at risk area. To choose the optimal technique for facial rejuvenation in a patient, it is therefore important for the surgeon to consider additional factors beyond the complication rate. One advantage of HA-based fillers is their immediate availability compared with fat grafting.³⁰ Moreover, in contrast to AFG no intervention is required for the harvesting of the filler material. Despite the low reported complication rate for AFG at the donor site, the complete absence of a donor site is an important advantage.³¹ Finally, most nonpermanent fillers offer the possibility to reverse undesired effects, such as HA-based fillers with the use of hyaluronidase.³² On the other hand, the use of AFG can provide longer-lasting results compared with HA-based fillers.³³ Although the effects of HA-fillers may last from a few months to a couple of years, AFG can maintain its results for a longer period, as long as the patient does not undergo significant weight loss.^{33,34} Moreover, due to the use of the patient's own adipose tissue in AFG, there is no risk for any allergic reaction,^{4,5} unlike with synthetic fillers that may trigger a reaction to the products' compounds.³³

Finally, the crucial importance of a correct injection technique performed by a qualified professional to prevent complications has been discussed in multiple studies.^{8,35–37} For AFG procedures, Dhooge and co-workers have summarized preventive measures regarding surgical technique of fat harvesting and infiltration, to minimize the surgery-associated risks. These include the following, amongst other things: injection into the muscle and traumatized and scar tissues should be avoided; a so-called pretunnel should be created with a short pause before the actual injection of fat; multiple subcutaneous tunnels should be formed with an injection cannula bigger than the harvesting cannula; injection of small aliquots of fat should be performed with small syringes with low pressure, while applying digital compression proximal to the injection site.²⁷

It has to be noted that the included case reports and case series are considered to have low LoE overall. Furthermore, as already indicated, complications are significantly under-reported in literature. Establishing a registry for treatments and complications in the future, together with more detailed scientific studies on the consequences of this procedure, may improve understanding of the involved mechanisms and aid in reducing the involved risks to optimize the treatment.

CONCLUSIONS

Fat grafting can be used to correct age-related volume loss and contour deformity in the face with a relatively low complication rate. However, severe and persistent complications can still occur, primarily in the forehead and temporal regions of the face, with the latter being associated with the most severe cases. When comparing the complication rates with other techniques, such as the use of nonpermanent synthetic fillers, it is challenging to determine which treatment is safer. Surgeons should understand that no procedure or anatomical region is completely safe and should choose the technique on a patient-by-patient basis, considering all the individual variables. Due to the growing cosmetic industry, more and more personnel with no adequate medical background and training perform procedures of aesthetic medicine. It is therefore essential to seek consultation with a qualified professional to determine the most suitable technique for achieving desired results safely.

Yves Harder, MD

Department of Plastic, Reconstructive and Aesthetic Surgery
 Ospedale Regionale di Lugano,
 Ente Ospedaliero Cantonale (EOC)
 Via Capelli 1, CH-6962 Viganello-Lugano
 Switzerland
 E-mail: yves.harder@eoc.ch

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

- Xie Y, Huang RL, Wang W, et al. Fat grafting for facial contouring (temporal region and midface). *Clin Plast Surg*. 2020;47:81–89.
- Wang K, Rong X, Dang J, et al. Severe vascular complications caused by facial autologous fat grafting: a critical review. *Ann Plast Surg*. 2021;86(3S Suppl 2):S208–S219.
- Shue S, Kurlander DE, Guyuron B. Fat injection: a systematic review of injection volumes by facial subunit. *Aesthetic Plast Surg*. 2018;42:1261–1270.
- Yang HJ, Kang SY. Comparisons between fresh and cryopreserved fat injections in facial lipofilling. *Arch Craniofac Surg*. 2020;21:15–21.
- Kim SM, Kim YS, Hong JW, et al. An analysis of the experiences of 62 patients with moderate complications after full-face fat injection for augmentation. *Plast Reconstr Surg*. 2012;129:1359–1368.
- Crowley JS, Liu A, Dobke M. Regenerative and stem cell-based techniques for facial rejuvenation. *Exp Biol Med (Maywood)*. 2021;246:1829–1837.
- Cortese A, Savastano G, Felicetta L. Free fat transplantation for facial tissue augmentation. *J Oral Maxillofac Surg*. 2000;58:164–169; discussion 169–170.
- Oranges CM, Brucato D, Schaefer DJ, et al. Complications of nonpermanent facial fillers: a systematic review. *Plast Reconstr Surg Glob Open*. 2021;9:e3851.
- Ryeong Park Y, Choi JA, Yoon La T. Periorbital lipogranuloma after cryopreserved autologous fat injection at forehead: unexpected complication of a popular cosmetic procedure. *Can J Ophthalmol*. 2013;48:e166–e168.
- Kim SK, Kim HJ, Hwang K. Mixed infection of an atypical *Mycobacterium* and *Aspergillus* following a cryopreserved fat graft to a face. *J Craniofac Surg*. 2013;24:1676–1678.

11. Dreizen NG, Framm L. Sudden unilateral visual loss after autologous fat injection into the glabellar area. *Am J Ophthalmol*. 1989;107:85–87.
12. Liu H, Wu X, Zhang X, et al. Internal carotid artery embolism after autologous fat injection for temporal augmentation. *Aesthetic Plast Surg*. 2019;43:383–387.
13. Qian H, Ling Y, Zhang M, et al. Massive cerebral infarction following facial injection of autologous fat: a case report and review of the literature. *Front Hum Neurosci*. 2021;15:610945.
14. Wang Q, Zhao Y, Li H, et al. Vascular complications after chin augmentation using hyaluronic acid. *Aesthetic Plast Surg*. 2018;42:553–559.
15. Wang DW, Yin YM, Yao YM. Internal and external carotid artery embolism following facial injection of autologous fat. *Aesthet Surg J*. 2014;34:NP83–NP87.
16. Chang CH, Chang YY, Lu PH. Non-tuberculous mycobacteria infection following autologous fat grafting on the face. *Aesthet Surg J*. 2017;38:NP1–NP5.
17. Yoon SS, Chang DI, Chung KC. Acute fatal stroke immediately following autologous fat injection into the face. *Neurology*. 2003;61:1151–1152.
18. Park SJ, Woo SJ, Park KH, et al. Partial recovery after intraarterial pharmacomechanical thrombolysis in ophthalmic artery occlusion following nasal autologous fat injection. *J Vasc Interv Radiol*. 2011;22:251–254.
19. Li XQ, Wang TL, Wang JQ. Ptosis: an underestimated complication after autologous fat injection into the upper eyelid. *Aesthet Surg J*. 2015;35:NP147–NP153.
20. Li A, Yang J, Ren X, et al. A rare vascular complication caused by autologous fat facial filler. *Aesthetic Plast Surg*. 2020;44:2323–2325.
21. Marten T. Discussion of Shue et al. “Fat injection: a systemic review of injection volumes by facial subunit”. *Aesthetic Plast Surg*. 2018;42:1271–1276.
22. Groen JW, Krastev TK, Hommes J, et al. Autologous fat transfer for facial rejuvenation: a systematic review on technique, efficacy, and satisfaction. *Plast Reconstr Surg Glob Open*. 2017;5:e1606.
23. Grahovac TL, Rubin JP. Discussion: an analysis of the experiences of 62 patients with moderate complications after full-face fat injection for augmentation. *Plast Reconstr Surg*. 2012;129:1369–1370.
24. Schiraldi L, Sapino G, Meuli J, et al. Facial fat grafting (FFG): worth the risk? A systematic review of complications and critical appraisal. *J Clin Med*. 2022;11:4708.
25. Xing L, Almeida DR, Belliveau MJ, et al. Ophthalmic artery occlusion secondary to fat emboli after cosmetic nasal injection of autologous fat. *Retina*. 2012;32:2175–2176.
26. Miao J, Sun W, Zhu Z, et al. A massive right hemisphere infarction after autologous fat grafting for facial filling. *J Craniofac Surg*. 2021;32:e215–e217.
27. Dhooghe NS, Maes S, Depypere B, et al. Fat embolism after autologous facial fat grafting. *Aesthet Surg J*. 2022;42:231–238.
28. Shuck J, Iorio ML, Hung R, et al. Autologous fat grafting and injectable dermal fillers for human immunodeficiency virus-associated facial lipodystrophy: a comparison of safety, efficacy, and long-term treatment outcomes. *Plast Reconstr Surg*. 2013;131:499–506.
29. Halepas S, Peters SM, Goldsmith JL, et al. Vascular compromise after soft tissue facial fillers: case report and review of current treatment protocols. *J Oral Maxillofac Surg*. 2020;78:440–445.
30. De Bouille K, Glogau R, Kono T, et al. A review of the metabolism of 1,4-butanediol diglycidyl ether-crosslinked hyaluronic acid dermal fillers. *Dermatol Surg*. 2013;39:1758–1766.
31. Homer NA, Patel AS, Epstein A, et al. Autologous Fat Transfer Harvest-site Complications: Incidence, Risk Factors, and Management. *Ophthalmic Plast Reconstr Surg*. 2022;38:65–67.
32. Lowe NJ, Maxwell CA, Patnaik R. Adverse reactions to dermal fillers: review. *Dermatol Surg*. 2005;31:1616–1625.
33. Coleman SR. Facial recontouring with lipostructure. *Clin Plast Surg*. 1997;24:347–367.
34. Rohrich RJ, Sorokin ES, Brown SA. In search of improved fat transfer viability: a quantitative analysis of the role of centrifugation and harvest site. *Plast Reconstr Surg*. 2004;113:391–395; discussion 396–397.
35. Rohrich RJ, Bartlett EL, Dayan E. Practical approach and safety of hyaluronic acid fillers. *Plast Reconstr Surg Glob Open*. 2019;7:e2172.
36. Cárdenas-Camarena L, Bayer JE, Aguirre-Serrano H, et al. Deaths caused by gluteal lipoinjection: what are we doing wrong? *Plast Reconstr Surg*. 2015;136:58–66.
37. Chatrath V, Banerjee PS, Goodman GJ, et al. Soft-tissue filler-associated blindness: a systematic review of case reports and case series. *Plast Reconstr Surg Glob Open*. 2019;7:e2173.