Plastic Surgery and Aesthetic Medicine
2023, no 2, pp. 54-62
https://doi.org/10.17116/plast.hirurgia202302154

Fat grafting or hyaluronic acid injections: a map of individual indications

© YU.M. ORLOVA[1], H. RASPALDO[2], J.H. TALBET[3], E.V. VERBO[1]

[1]Institute of Plastic Surgery and Cosmetology, Moscow, Russia;
[2]Face Clinic, Geneva, Switzerland;
[3]Northshore University Hospital, CA, USA

ABSTRACT

Objective. To present directions for solving the problem of choosing augmentation procedure and compare these techniques regarding effectiveness of correction of aging of the middle third of the face.

Material and methods. We selected (evidence level not less than 3) and presented several studies of biological properties of hyaluronic acid fillers, as well as compared with our own study of characteristics of adipose tissue. In these studies, hyaluronic acid fillers were used to correct the middle third of the face with injections into adipose tissue. In our own study, 40 patients underwent face fat grafting for augmentation of the middle third of the face. Preparing fat aspirate and injection technique were identical in all patients: decantation, centrifugation, retrograde injection of fat by tunneling in different planes. We analyzed action mechanism clinically and at the cellular level, effect of injected material on surrounding tissues in long-term period, positive effect on correction of face aging.

Results. We established the recommendations and clinical maps for step-by-step determination of criteria and indications for various methods of augmentation in each patient.

Conclusion. Possible methods for determining augmentation techniques in patients of different ages, types of facial aging, cosmetic history and degree of skin involution are presented. Maps of individual indications will help to identify criteria that have a decisive impact on the outcomes of procedures.

Keywords: *lipofilling, autograft, hyaluronic acid, augmentation, types of facial aging, fillers.*

INFORMATION ABOUT THE AUTHORS:
Orlova Yu.M. — https://orcid.org/0000-0003-0496-6008
Raspaldo H. — e-mail: doctor@raspaldo.fr
Talbet J.H. — https://orcid.org/0009-0000-3877-6646
Verbo E.V. — https://orcid.org/0000-0001-9843-5026
Corresponding author: Orlova Yu.M. — e-mail: section.orlova@gmail.com

TO CITE THIS ARTICLE:
Orlova YuM, Raspaldo H, Talbet JH, Verbo EV. Fat grafting or hyaluronic acid injections: a map of individual indications. *Plastic Surgery and Aesthetic Medicine*. 2023;2:54–62. (In Russ.). https://doi.org/10.17116/plast.hirurgia202302154

Introduction

Prior to analysis of preferable technique for facial soft tissue augmentation, we should identify the stages of face aging and the main areas of facial atrophy requiring correction. Face aging is characterized by a complex of processes invovling decrease of skin elasticity, ptosis and atrophy of facial soft tissues. It is important to understand cellular mechanisms of face aging, sequence of changes and their relationships. This will allow a plastic surgeon or cosmetologist to identify those stages when these changes can be prevented or corrected in various ways.

Face involution includes degenerative changes at several levels including bones, subcutaneous fat and skin **(Fig. 1)**. Bone tissue changes include posterior displacement of the upper jaw, enlargement of the palpebral fissure and reduction of horizontal and vertical projection of the lower jaw [1–3]. Displacement of bones changes position of adjacent soft tissues due to multiple ligaments and overlying fascia. In addition to changes in spatial position of soft tissue complex, there is atrophy of these tissues, mainly due to adipose tissue [4, 5].

One of the main aspects of face involution is displacement of malar fat pad from prezygomatic to subzygomatic area [6]. Finally, negative vector of the lower eyelid is formed, and length of the lower eyelid increases disproportionately. Insufficient volume of tissues in this zone contributes to deepening of nasolacrimal sulcus and pseudohernial protrusions of fat pads through the orbital septum. Nasolabial folds deepen in the middle and lower thirds of the face. Significant involution is characterized by ptosis of corners of the mouth and jowls [7].

To date, the «gold standard» of face rejuvenation is correction of involutive changes at all levels. Surgical methods imply manipulations with three layers: skin, subcutaneous adipose tissue, superficial musculoaponeurotic system (SMAS). SMAS fixation in a new position, creation of dense support structure and excision of excess skin provide lifting of facial skin and soft tissues along the vertical and lateral vectors. However, this method does not allow correction of atrophy of fat layer of the middle third of the face. Only augmentation techniques can provide restoration of harmonious facial contour and proportional shape to soft tissues of the face.

The middle third of the face is the main area for correction of adipose tissue atrophy. This area is defined between the line passing through the lateral and medial canthus of the eye and the line passing through the corner of the mouth and the earlobe. Facial rejuvenation proced-

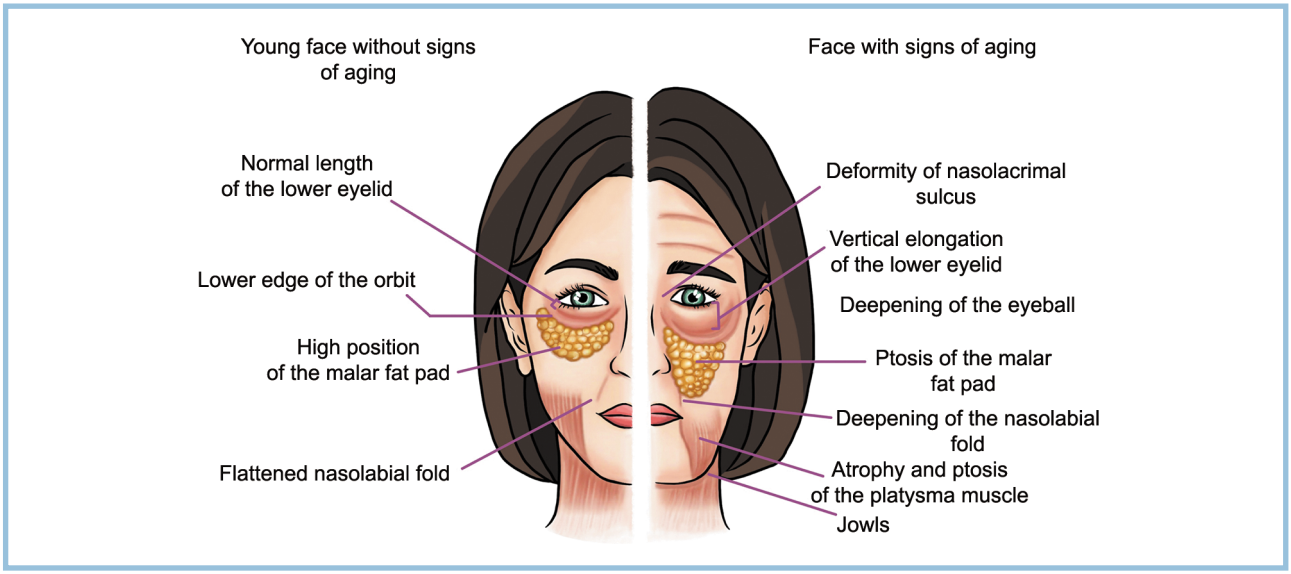


Fig. 1. **Signs of face aging.**

rues include corection of the lower eyelid, nasolacrimal sulcus and malar area. The last triangular area includes malar fat pad (deep and superficial sections). Malar area is laterally bounded by the line connecting the lateral canthus and corner of the mouth, medially by the line connecting the medial canthus and nasolabial fold. The upper border is lower edge of the orbit. Malar fat pad area can also be divided into the areas that are preferred for augmentation and those that should be avoided. In 2005, Terino E.O. et al. [8] described these areas for augmentation with synthetic materials (implants). We present a modification of this classification regarding augmentation techniques. There are the following zones **(Fig. 2)**:

Zone 1 is the largest one and located in projection of $^{2}/_{3}$ of zygomatic bone. Augmentation of this area is essential for subsequent augmentation of neighboring areas.

Zone 2 occupies the medial part of the zygomatic arch. Augmentation of this zone is indicated to create emphasis in people with insufficient volume in this area, but it is recommended to leave zone 2 untouched in most cases. Concomitant augmentation of zones 1 and 2 is indicated for people with a narrow and elongated face type, as this significantly increases inter-zygomatic distance and visually expands the middle third of the face.

Zone 3 is located between the infraorbital foramen and nasal bone. Augmentation is also undesirable due to unnatural shape of the face.

Zone 4 occupies the lateral part of the zygomatic arch. Augmentation of this zone is also not recommended.

Zone 5 (submalar triangle) is the main area for augmentation of the middle third of the face. The boundaries of this zone pass along inferior edge of zygomatic bone and anterior surface of masticatory muscle. The medial border passes along the nasolabial fold 1-1.5 cm away. Inferior border should not be lower than the line between the corner of the mouth and the midpoint of zone 2. Augmentation of zone 5 is usually combined with augmentation of zone 1.

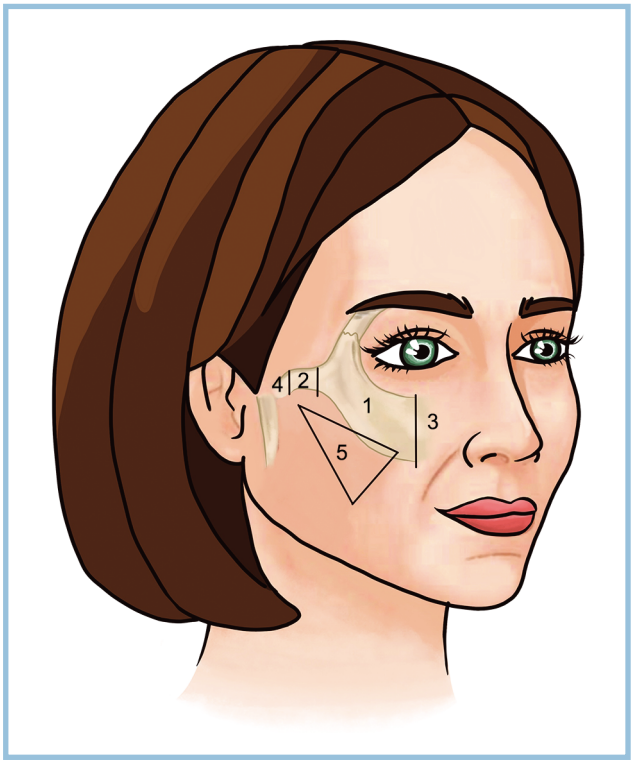


Fig. 2. **Augmentation zones according to E. Terino.**

Thus, only zones 1 and 5 are preferable for augmentation. Isolatged augmentation of zone 1 is indicated for early signs of aging (tired type of the face, prolapse of hernias in the orbital region). Augmentation of zones 1 and 5 is required for more pronounced face aging with negative vector of the lower eyelid, deepening of nasolabial fold and formation of nasolacrimal sulcus.

At the same time, one should remember on individual types of facial aging when choosing facial rejuvenation technique. According to Kolgunenko I.I. (1974), there are 5 types of facial aging: tired face, fine wrinkled, deformation, combined and muscular types. These variants of face aging differ in atrophy of skin, subcutaneous fat and facial muscles. Tired face type is characterized by early aging: reduced skin turgor, pastosity and changes in facial muscle tone. These processes emphasize nasolabial folds and contribute to ptosis of the corners of the eyes and lips, while shape of the face is not changed. Fine wrinkled type of face aging is characterized by degenerative-dystrophic changes in epidermis and dermis, reduced skin elasticity and barrier properties of skin, as well as skin dryness. Deformation type of face aging is characterized by similar skin changes, as well as hypertonicity of the main muscles of the upper and lower thirds of the face (frontalis muscle, procerus muscle, depressor labii inferioris muscle, depressor anguli oris muscle) and hypotonicity of the muscles of the middle third of the face (zygomatic major and minor muscles, orbicularis oculi muscle, risorius muscle, buccinator muscle). Face oval is disturbed, and we observed gravitational displacement of subcutaneous fat. Combined type of face aging includes signs of the tired, fine wrinkled and deformation types. Muscular type of face aging is characterized by atrophy and shrinkage of subcutaneous fat, smoothness of facial oval line, pronounced marionette lines, forehead wrinkles and deep nasolabial folds.

In addition to the above-described symptoms of involution, there is also violation of regeneration and functional disorganization of skin and soft tissue cells. Thinning of epidermis, reduced area of capillary network, elasticity, proliferation of keratinocytes, fibroblasts and endothelial cells contribute to defective re-epithelialization, reduced collagen synthesis and revascularization [15]. Angiogenesis is decreased, and collagen fibers are accumulated in the middle layer of the vascular wall. The lowest density of vessels following face aging is observed in buccal and parotid-masticatory areas. There are different features of skin microcirculation in various types of aging [16].Comparison of laser Doppler flowmetry data and visual type of skin aging reveaeld predominant spastic type of microcirculation in patients with fine wrinkled type of aging (hypertonicity of arterioles and congestion signs in venules). Atonic type of microcirculation predominates in people with deformation type of face aging (hypotonicity of arterioles, increased blood volume in arterioles and congestion). People with combined type of face aging have spastic-congestive type of microcirculation (changes at all levels of microcirculatory bed, increased myogenic tone of arterioles, capillary and venular stasis). Obviously, restoration of microcirculation depending on the type of skin aging is essential for correction. Important components of aging are depletion of stem cell niches, loss of their ability to proliferate and transition of cells to apoptosis or necrosis. Stem cells lose their ability to self-renewal and differentiation, and «aging» cells accumulate (cells damaged during stress and temporarily stopping their cellular cycle).

Thus, we can conclude that correction of only external signs of face aging will not lead to a full-fledged result. Treatment strategy is like a pyramid based on the impact on cellular processes. Now there are many cosmetic products with multidirectional action not only replenishing the volume and suitable for correcting superficial defects, but also affecting cellular microenvironment in recipient area. At the same time, surgical correction of the middle zone of the face including adipose tissue processing for lipofilling is being improved. Therefore, plastic surgeons should consider all available methods to determine optimal treatment strategy in each case. To date, injections of hyaluronic acid and facial lipofilling are the most popular among minimally invasive methods for correcting the middle zone of the face (insufficient volume of soft tissues). Let's consider the advantages and disadvantages of each approach.

Material and methods

Lipofilling is a common procedure for correction of face aging because autologous fatty tissue is a biocompatible product with high plasticity. Injections of autologous fatty tissue into aesthetic areas of the face provide natural contour since biomaterial is perfectly compatible with facial soft tissues, especially if injections are carried out into subcutaneous adipose tissue. Autologous fatty tissue is a viable tissue and includes stromal cells. The last ones provide a regenerative effect and can influence engraftment, angiogenesis and immune modulation [9]. Plasticity of autologous fatty tissue reduces tissue trauma following injection and further adaptation in facial tissues. However, the issue of autologous fatty tissue resorption is still not resolved, and up to 30% of autologous fatty tissue are resorped in aesthetic areas of the face. Nevertheless, certain part of autologous fatty tissue is no longer subject to resorption after engraftment in recipient zone and provides long-term augmentation of facial soft tissues. Migration of autologous fatty tissue and asymmetry of injection zones can occur due to the lack of specific protocol for this procedure and insufficient surgical experience. Only surgical correction is advisable for these complications. You should also remember about morbidity of donor zone after lipofilling. There is a risk of cicatricial deformities and skin irregularities during aggressive liposuction **(Table 1)**.

Hyaluronic acid injections are characterized by sufficient predictability and accuracy of administration, as well as speed of procedure compared to lipofilling. Indeed, the last one requires preoperative management, anesthesia (local conduction anesthesia or intravenous anesthesia) and short-term hospital-stay. However, the result of cosmetic correction through hyaluronic acid injections is short-lived (within a year regardless of filler

Table 1. **Characteristics of lipofilling and injections of hyaluronic acid fillers**

Augmentation technique	Advantages	Disadvantages
Lipofilling	Autologous, biocompatible product Plastic material Natural face contour Long-term result Regeneration through mesenchymal stromal cells Less tissue trauma	Unpredictable percentage of engraftment Migration Asymmetry Morbidity of donor zone
Injections of hyaluronic acid fillers	Local injection Predictable outcome Minimal invasiveness Speed of procedure	Short-term result Side effects following long-term injections Fibrous capsule Trauma associated with a needle Immunogenicity

Table 2. **Molecular effects of lipofilling and injections of hyaluronic acid fillers**

Augmentation technique	Molecular effect
Lipofilling	Interaction with myofibroblasts — process of repair Adipose tissue stem cells: immunomodulation, adipogenic, antiapoptotic, antifibrotic, angiogenic effects
Injections of hyaluronic acid fillers	Weakening of links between the cell and extracellular matrix Mitogenic effect Effect on mesenchymal stromal cells High molecular weight hyaluronic acid: anti-inflammatory cytokines, endothelial cell proliferation Low molecular weight hyaluronic acid: pro-inflammatory cytokines

density). Repeated corrections are necessary, and fibrous capsule occurs at the injection sites. There is a risk of latent inflammation in response to foreign body in soft tissues. Long-term injections of hyaluronic acid fillers can result pastosity of the face and impaired lymphatic drainage **(Table 1)**.

Injections of hyaluronic acid fillers weaken the links between cells and extracellular matrix. As a result, cell migration and disruption of tissue structure are possible. Stimulating effect of fillers lies in their mitogenic effect that carries certain risks. Hyaluronic acid products can affect mesenchymal stromal cells of facial tissues and result release of cytokines [10]. High molecular weight hyaluronic acid initiates release of anti-inflammatory cytokines and proliferation of endothelial cells, while low molecular weight hyaluronic acid initiates release of pro-inflammatory cytokines **(Table 2)**.

Tissue processes following injections of various hyaluronic acid fillers are considered in detail [11]. The authors compared cosmetic products regarding their structure and effect on surrounding soft tissues via analysis of histological slices in 8 and 114 days after injections. After 8 days after injection, there is no damage to the epidermis and dermis, as well as inflammatory infiltrates in all samples. Only a few mast cells are observed. Cohesive gel spreads from injection point and reaches papillary dermis without its penetration. There are differences for the Juvéderm filler. After 8 days, this gel is distributed in the form of small aggregates and does not reach papillary layer of dermis. Restylane filler forms large aggregates throughout the entire reticular layer of dermis and does not reach papillary layer after 8 days. After 114 days, it was impossible to visualize hyaluronic acid aggregates (apparently, due to reduced amount of exogenous hyaluronic acid (outside cells) and increased amount inside cells, or as a result of reduced accumulation of coloring substances by hyaluronic acid).

Histological analysis of collagen and elastin fibers revealed inhomogeneous distribution of hyaluronic acid inclusions between the fibers, their disorganization and looseness. The result was the same in all samples after 8 and 114 days. There was no increase in the number of T-lymphocytes or B-lymphocytes after 8 and 114 days. Similarly, there was no increase in amount of myofibroblasts or type I procollagen. Thus, there was no effect of hyaluronic acid on the quality and structure of skin. The samples contained a few macrophages, histiocytes and cytoplasmic inclusions. There was no effect on dermal fibroblasts in all samples. On the contrary, Quan T. et al. [17] found increment of procollagen level in patients older than 70 years after injection of hyaluronic acid into the dermis.

According to facial soft tissue ultrasound data, injections of hyaluronic acid result anechoic round subcutaneous pseudocysts decreasing in size over time (3–6 months) [12, 14]. At the same time, conglomerates of hyaluronic acid with lidocaine form pseudocysts with internal hyperechoic contents, possibly cellular debris. These pseudocysts also undergo lysis over time. In case of complications, inflammatory reaction occurs after injection of fillers and pseudocysts aggregate forming a single infiltrate and fistulous canals to subdermal level.

Histological analysis of autologous fatty tissue in 3 and 6 months after injections reveals normal and viable adipose tissue [13]. There are no signs of inflammatory infiltration, fibrous capsule, abnormal mitotic activity or other disturbances of homeostasis. Volumetric fraction of adipose tissue was 90%, relative volumetric fraction of connective tissue — 9%, relative volumetric density of blood vessels — 1%.

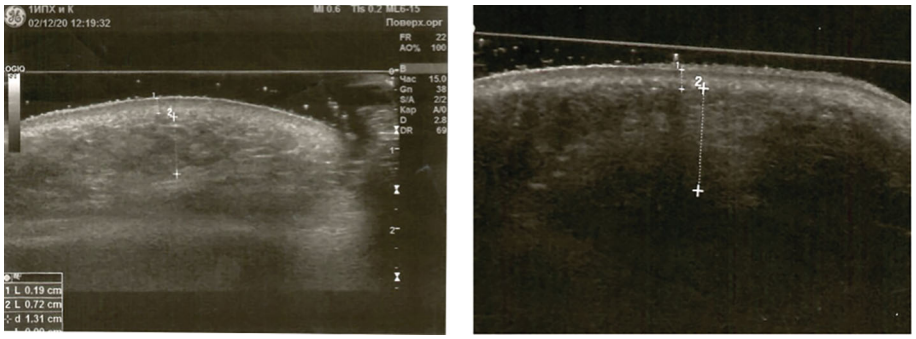


Fig. 3. **Ultrasound examination of autologous fatty tissue in subcutaneous layer of the middle third of the face.**

Ultrasound of facial soft tissue in 3 months after injections reveals separation of fatty autograft layer. However, these signs disappear after 6 months, and subcutaneous fat layer looks like a homogeneous structure **(Fig. 3)**.

There are differences in autologous fatty tissue engraftment in various aesthetic areas of the face. The largest volume of autologous fatty tissue after 6 months was observed in infraorbital-buccal and zygomatic regions. The smallest volume of autologous fatty tissue was found within the corner of the mouth [13]. Foreign colleagues obtained similar data [14]. Thus, we can identify the factors affecting autologous fatty tissue engraftment (thick subcutaneous fat layer, density of vascularization, proximity of mimic muscles and bones, presence of ligaments). Tissue distribution of hyaluronic acid is similar in all facial areas.

Results

Having presented a complete picture of clinical and biological characteristics of two methods of augmentation (lipofilling and injections of hyaluronic acid), we can identify the main criteria determining treatment strategy in patients with face aging (age, type of face aging, previous procedures, zone of injection, number of necessary zones, layer of injection). Step-by-step analysis of these criteria is valuable to determine preferable augmentation technique for a particular patient **(Fig. 4)**.

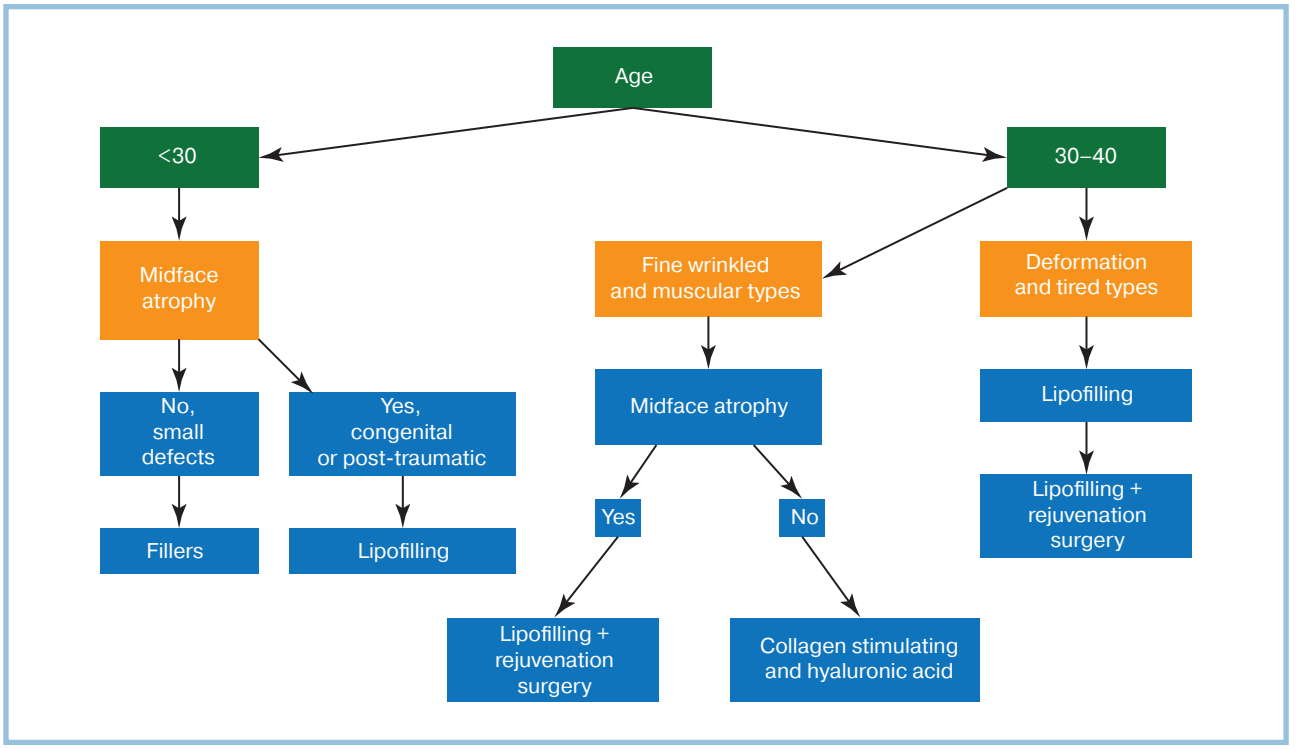


Fig. 4. **Map of individual indications in patients aged 30–40 years.**

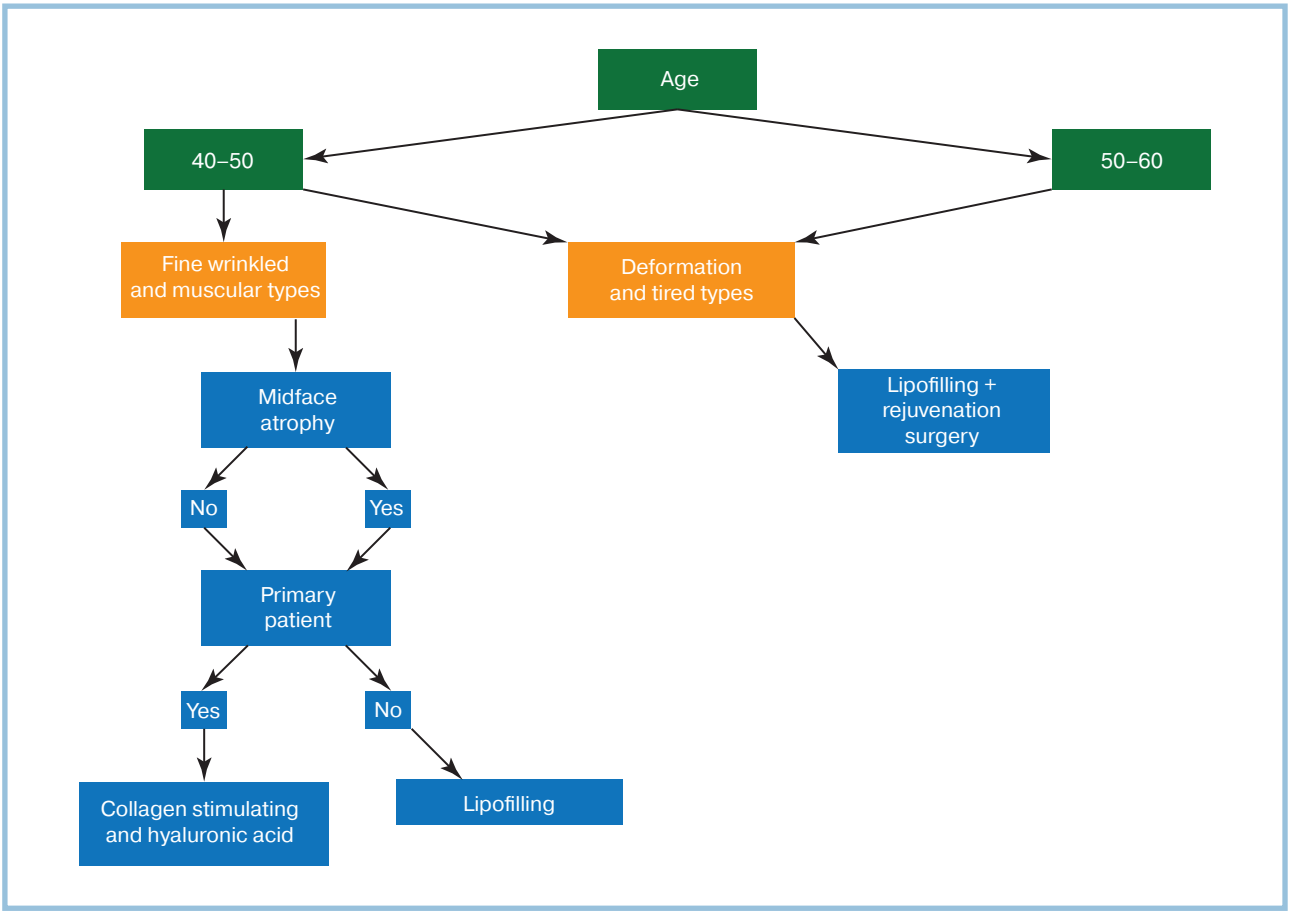


Fig. 5. **Map of individual indications in patients aged 50–60 years.**

Both methods of augmentation are possible in young patients (up to 30 years old) requiring correction of minor age-related changes or defects. However, lipofilling is necessary for large post-traumatic or congenital facial defect due to biocompatibility of autologous fatty tissue with tissues. Large volumes are replenished by autologous material, since there is no pronounced inflammatory reaction to foreign bodies as in case of hyaluronic acid. Autologous fatty tissue is also more plastic and pliable. Therefore, fatty tissue can take the shape of cicatricial and irregularly shaped defects. Lipofilling is also recommended for patients under 40 years of age with a deformation type of face aging due to the risk of impaired drainage function of the face and pastosity after injections of fillers. In such patients, autologous fatty tissue adapts well in tissues due to well-developed subcutaneous fat layer. In patients with thin subcutaneous fat layer (fine wrinkled and muscular types of face aging), one should consider the amount of correction. Hyaluronic acid fillers can be used for minor changes and no severe atrophy of the middle third of the face. Patients with atrophy of the middle third of the face require lipofilling alone or in combination with rejuvenation procedures **(Fig. 5)**.

The choice of augmentation technique in patients aged 40–50 years is also based on the presence or absence of atrophy of the middle third of the face and anamnestic data. Lipofilling should be performed after previous repeated facial contouring procedures with synthetic fillers to avoid negative consequences (chronic aseptic inflammation and impaired lymphatic drainage). Older patients are characterized by reduced tissue metabolism, disturbed angiogenesis, congestion signs and reduced cellular regeneration. Therefore, autologous materials are preferable since they do not cause adverse effects. Autologous materials are more compatible with own facial tissues. The advantage of lipofilling lies not only in successful replenishing of the middle third of the face, but also in improvement of skin quality. Therefore, autologous fatty tissue injections are also used as mesotherapy. In patients aged 50–60 years and older, we recommend surgical correction combined with lipofilling.

Conclusion

We presented possible approaches for determining the augmentation technique in patients of various ages, types of face aging, cosmetic history and degree of involution. The maps of individual indications will be valuable to identify the criteria influencing postoperative outcomes.

No conflict of interests to declare.

REFERENCES

1. Farkas JP, Pessa JE, Hubbard B, Rohrich RJ. The science and theory behind facial aging. *Plast Reconstr Surg Glob Open*. 2013;1(1):8-15.
2. Kahn DM, Shaw RB Jr. Aging of the bony orbit: A three-dimensional computed tomographic study. *Aesthet Surg J*. 2008;28(3):258-264.
3. Mendelson B, Wong CH. Changes in the facial skeleton with aging: implications and clinical applications in facial rejuvenation. *Aesthetic Plast Surg*. 2012;36(4):753-760.
4. Lambros V. Observations on periorbital and midface aging. *Plast Reconstr Surg*. 2007;120(5):1367-1376 [discussion 1377].
5. Rohrich RJ, Ghavami A, Constantine FC, Unger J, Mojallal A. Lift-and-fill face lift: integrating the fat compartments. *Plast Reconstr Surg*. 2014; 133(6):756-767.
https://doi.org/10.1097/01.prs.0000436817.96214.7e
6. Moss CJ, Mendelson BC, Taylor GI. Surgical anatomy of the ligamentous attachments in the temple and periorbital regions. *Plast Reconstr Surg*. 2000; 105:1475-1490 [discussion 1491-1498].
7. Windhager S, Mitteroecker P, Rupić I, Lauc T, Polašek O, Schaefer K. Facial aging trajectories: A common shape pattern in male and female faces is disrupted after menopause. *American Journal of Physical Anthropology*. 2019; 169(4):678-688.
https://doi.org/10.1002/ajpa.23878
8. Terino EO. Alloplastic Midface Augmentation. *Aesthetic Surgery Journal*. 2005;25(5):512-520.
https://doi.org/10.1016/j.asj.2005.06.004
9. Moseley TA, Zhu M, Hedrick MH. Adipose-derived stem and progenitor cells as fillers in plastic and reconstructive surgery. *Plast Reconstr Surg*. 2006;118:121-128.
10. Dovedytis M, Liu ZJ, Bartlett S. Hyaluronic acid and its biomedical applications: A review. *Engineered Regeneration*. 2020;1:102-113.
https://doi.org/10.1016/j.engreg.2020.10.001
11. Tran C, Carraux P, Micheels P, Kaya G, Salomon D. *In vivo* Bio-Integration of Three Hyaluronic Acid Fillers in Human Skin: A Histological Study. *Dermatology*. 2013;228(1):47-54.
https://doi.org/10.1159/000354384
12. Wortsman X. *Sonography of Cosmetic Procedures*. In: Wortsman X, ed. Dermatologic Ultrasound with Clinical and Histologic Correlations. New York, NY: Springer; 2013:373-399.
https://doi.org/10.1007/978-1-4614-7184-4_15
13. Orlova YuM, Manturova NE, Verbo EV, Ustyugov AYu. Efficiency evaluation of the use of the stromal vascular fraction in facial surgery. *Plastic Surgery and Aesthetic Medicine*. 2021;3:5-15. (In Russ.).
https://doi.org/10.17116/plast.hirurgia20210315
14. Bucky LP, Kanchwala SK. The role of autologous fat and alternative fillers in the aging face. *Plast Reconstr Surg*. 2007;120(6 Suppl):89-97. PMID: 18090347.
https://doi.org/10.1097/01.prs.0000248866.57638.40
15. Smirnova IO. Functional morphology of skin agein. *Uspekhi gerontologii*. 2004;13:44-51. (In Russ.).
16. Imaeva NA, Potekaev NN, Tkachenko SB, Shuginina EA. Microcirculation disturbances in various skin ageing types. *Kardiovaskulyarnaya terapiya i profilaktika*. 2008;7(3):107-110. (In Russ.).
17. Quan T, Wang F, Shao Y, et al. Enhancing structural support of the dermal microenvironment activates fibroblasts, endothelial cells, and keratinocytes in aged human skin in vivo. *J Invest Dermatol*. 2013;133:658-667. Epub 2012 Oct 25.
https://doi.org/10.1038/jid.2012.364

Received 02.02.2023
Accepted 18.02.2023