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Review Article

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Aesthetic Medicine

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Plastic surgery, maxillofacial surgery

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GalynaViktorovnaKhrushch plastic surgeon, maxillofacial surgeon, international candidat ASPS, Periorbital area is worthily considered as one of the most complicated regions in terms of correction of the age-related changes using injection techniques of medical aesthetics.

According to the classification of I.I. Kolgunenko Russian (1974), tired morph type of age-related changes which is the most physiological type of aging, incorporates changes mainly focused in the middle third of the face, including in the periorbital area. These changes include the formation of grooves (tear trough, palpebromalar groove, nasojugal groove) (Figure 1), dark under-eye circles, mimic wrinkles formation, fat compartment displacement, change in mimic muscle tone, stretching of ligamentous structures, overhang of the upper eyelid.

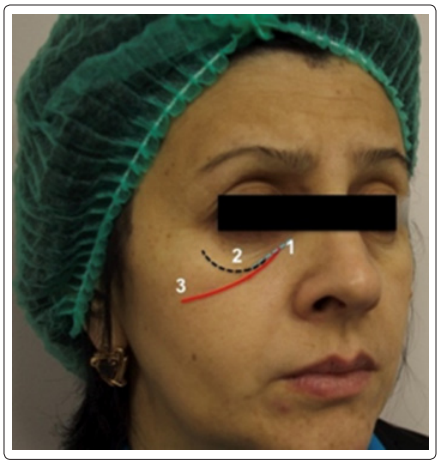


Figure 1

The combination of these signs is associated with age-related changes, even if observed in young patients, being related to the constitutional features of a subject. The most detailed classification of age-related changes occurring simultaneously in all anatomical layers (muscles, fatty tissue, skin, ligamentous apparatus) both in the periorbital and in adjacent areas (buccal, frontal, eyebrow) was proposed by T. Hestler and F. Nahai (Figure 2) [1]. Importantly, the key features of age-related changes of the periorbital area are rarely seen separately, often occur in substantially young patients, and become more pronounced over time.

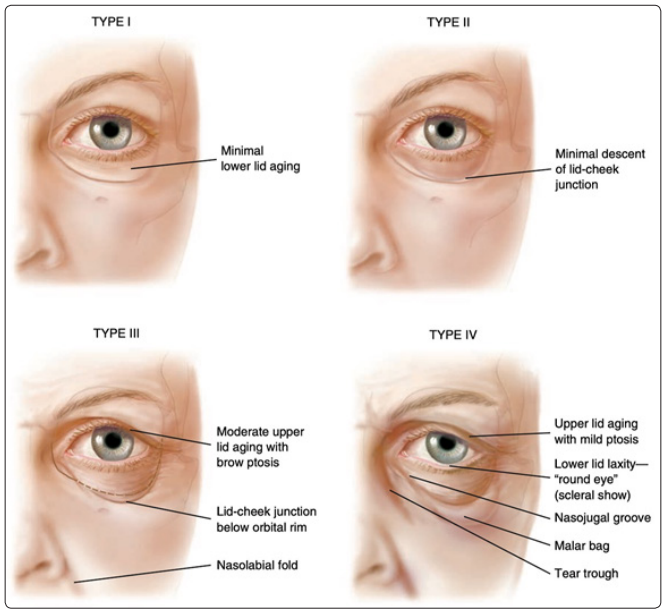


Figure 2

10 key (external) Signs of Aging in the Periorbital Area:
The appearance of "dark" under-eye circles,
The appearance of wrinkles under the lower eyelid;
Crow's feet appearance;
Eyebrow and upper eyelid descent;
Lower eyelid dropping, pseudohernial sacs;
Fatty hernia appearance;
Festoon appearance;
Visualization of the lacrimal, palpebromalar, and palpebrobuccal grooves;
Suborbital atrophy/displacement;
Bone orbital structures resorption and deformation

Therefore, the most satisfactory result of using the injection correction techniques in the periorbital area can be achieved, when the complex approach and the combined exposure applied to all the layers and structures subject to age involution (Figure 3).

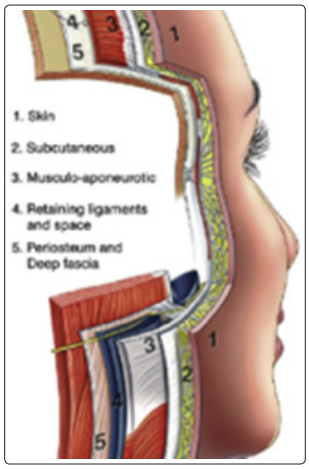


Figure 3

Non-invasive techniques are increasingly popular over the last years due to their relative simplicity and minimum rehabilitation time [2]. The appropriate algorithm of the combined complementary techniques (botulinum therapy, contour and volumetric face plasty using fillers, mesotherapy, thread-lifting) and adherence to all necessary precautions, as well as guidelines for the administration of agents, will lead to significant aesthetic improvement of the patient's appearance. The combined use of minimally invasive methods of correction enables to supplement and improve the results of plastic surgery, or to postpone surgery for a long time.

Regional anatomy of the periorbital region

Anatomy of the periorbital region has its own peculiarities which define the maximum susceptibility of this area to age-related changes.

Skin of infraorbital area is as thin as 0.6-0.4 mm, and in Caucasians is almost deprived of fatty tissue at all. In the area of the lower eyelid, the skin fits tightly to the orbicular muscle of the eye, which, with increased activity of m. orbicularis oculi and with lost dermal tone, contributes to the appearance of facial wrinkles. With aging, the skin elasticity decreases, causing its flabbiness, wrinkling, atrophy, and the formation of excesses, which inevitably leads to the loss of the frame functions of the dermal layer.

Orbicular muscle of the eye lies right under the skin with minimal fat above it. It consists of orbital (p.orbitalis) and palpebral (p.palpebralis) portions. Orbital part of orbicular muscle of the eye has multiple superficial and deep components, and is responsible for voluntary eyelid closure and lowering the medial part of the brow; it originates from maxillar process of the frontal bone, frontal process of the maxillar bone, medial canthus, and is attached to the lateral canthus along the lateral marign of the orbit. Palpebral part is divided in pre-tarsal (lies above the tarsal plate and is responsible for eyelid closure during involuntary blinking) and pre-septal portions (the latter is responsible for voluntary blinking, drainage of tear fluid). The pre-tarsal and pre-septal portions have superficial and deep components. Horner's deep pretarsal muscle is attached to the posterior lacrimal crest; the superficial pretarsal muscle is attached to the anterior horn of the medial canthal ligament. From the lateral side both are attached to Whitnell's tubercle. Superficial pre-septal muscle originates from the anterior horn of the medial canthal ligament, deep (Jawn muscle) from the lacrimal sac fascia, creates negative pressure during blinking and drains the lacrimal canaliculi. Both are attached to the lateral canthus (Figure 4) [3].

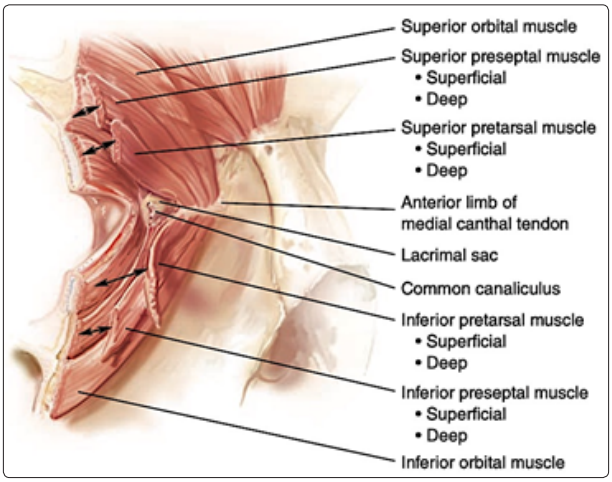


Figure 4: Anatomy of orbicular muscle of the eye. [3]

The next layer is orbital septum, which separates anterior lamella (skin, muscle) from the anterior (conjunctiva, capsulopalpebral fascia, tarsus, medial and lateral canthal tendons) and helps to retain orbital fat within the anatomical borders of orbit. It is attached to the bone along the margin of the orbit (arcusmarginalis) and enters the skin bounding tarsal plate of the upper and lower eyelids. On the upper eyelid, the septum is adherent to the levatoraponeurosis 2 mm above the tarsal plate, on the lower eyelid - with the capsulopalpebral fascia under the tarsal plate. With age, its elasticity is impaired and there is a bulging of periorbital fat with hernial sacs formation, and in the place of attachment of the orbital septum to the bone edge of the orbit there is an intrusion corresponding to the inner corner of the eyelid, extending to the midpupillary line, which is called the lacrimal sulcus (Figure 5) [3].

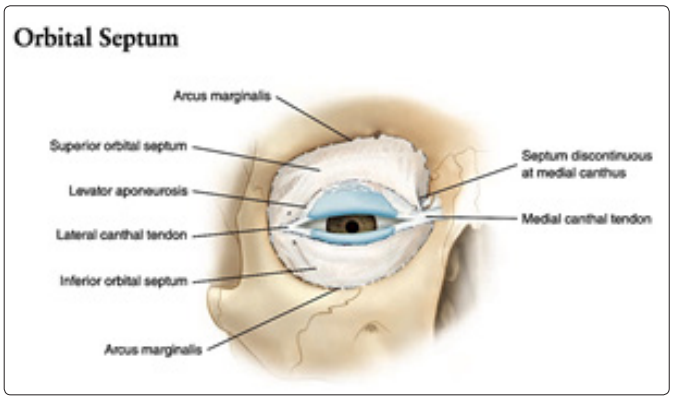
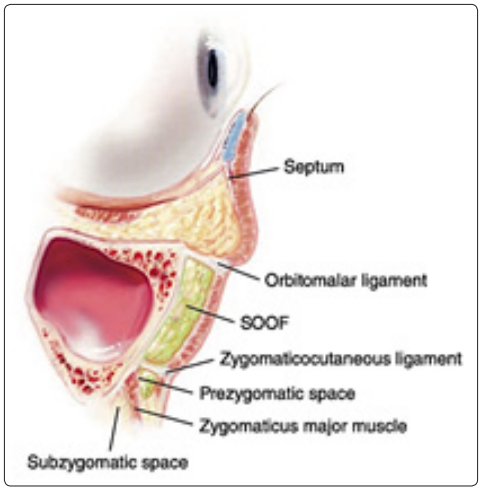


Figure 5: Orbital septum. [3]

The term "lacrimal sulcus" was first introduced by Flowers in 1993 [4]. This is a complex anatomical formation the location and occurrence of which is nowadays disputable. Its occurrence is due to several anatomical factors (Figure 6):

- Fixation of the orbital septum to arcusmarginalis near the medial part of orbita,
- Triangle space which is formed on one side with upper lip levator, and on the other side - with medial portion of orbicular muscle of the eye;
- The absence of fatty tissue under the orbicular muscle of the eye in the medial angle of the eye;

- Atrophic skin and bone structural changes of the orbit;
- Changes in the ligament apparatus of the periorbital area and the orbit itself.



Behind the orbital septum, between the anterior and posterior lamellae there are intraorbital fat bodies. There is nasal (more pale) and central (of more saturated yellow shade) fat bodies in the upper eyelid - they are located in subaponeurotic space anteriorly from the levatoraponeurosis. The fatty bodies are separated from each other with intermediate septa. The lateral part of the upper eyelid is filled with the lacrimal gland, located in the lacrimal fossa. The lateral area of the central orbital body covers the lacrimal gland. In the lateral part of the upper eyelid, in Eisler pocket there is an additional fat body - the Eisler's fatty lump. There are three fatty bodies in the lower eyelid: nasal (more fibrous and pale by appearance and structure), central and lateral. Nasal and central fat compartments are separated by inferior oblique muscle, central and lateral compartments are separated by Lockwood's ligament (Figure 7) [1, 5].

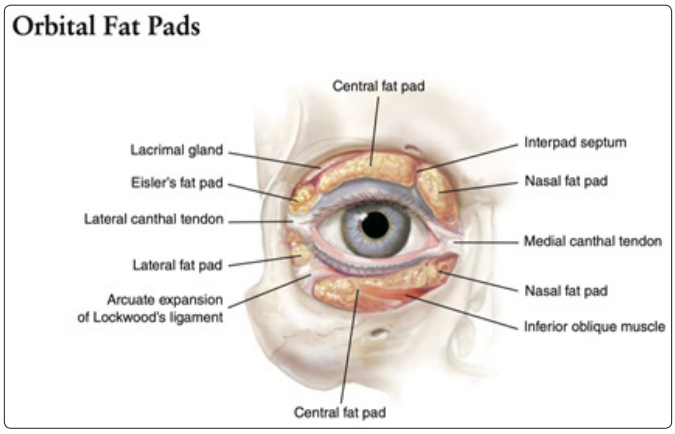


Figure 7: Intraorbital fat Pads[1]

In addition to intraorbital fatty tissue in the periorbital area under the orbicular muscle of the eye (under its orbital portion) there is SOOF (Suborbicularis Oculi Fat) which is a deep fatty tissue divided into medial and lateral portions, partially covering the large and small zygomatic muscles. The anatomy of this area is very important in terms of non-invasive approach for correction, because SOOF region is the best and the safest place to fill the volume of the periorbital region (after the subcutaneous hyaluronic acid injection there is always a risk of swelling due to the hydrophilicity of the substance) and a risk of Tyndall effect (due to the more intense scattering of light by particulate matters).

In the upper eyelid region, a similar safe area is ROOF (Retroorbicularis Oculi Fat). ROOF is located along the upper lateral edge of the orbit behind the orbital part of the orbicular muscle of the eye (Figure 8) [6].

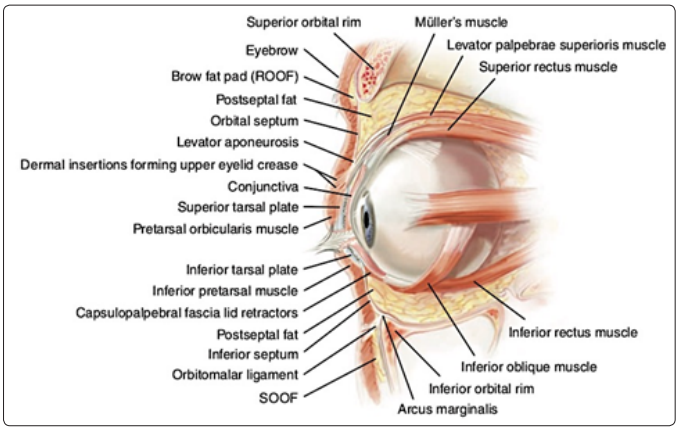


Figure 8: Anatomy of the periorbital area. [6]

Arcuateindrawing between the lower eyelid and cheek in the region of the orbital ligament entry at the border of its palpebral and orbital portions, which is located 4-6 mm below the projection of the bone edge of the orbit, is the palpebromalar groove, which expands lacrimal groove from midpupillary line (Hadoock). The mechanism of palpebromalar groove formation is due to the orbital ligament (Orbicularis Retaining Ligament), which originates from periosteum 4-6 mm below the edge of the orbit and enters through the orbicular muscle of the eye between its palpebral and orbital portions, then fixing in the dermis. Retaining ligaments (4th anatomical layer) are of special interest, because they play the key role in the formation of folds and grooves. The first retaining ligament was found and described by McGregor in 1959. Subsequently, it became known as McGregor's patch - the "zygomatic ligament".

True retaining ligaments which include ORL - Orbicularis Retaining Ligament, originate from bony structures and perforate all the tissue layers of face, then are attached to the skin, branching at the SMAS level to a number of small 2nd and 1st layer branches, forming tree-like structure (Figure 9) [7]. Importantly, these ligaments are stretched, but not displaced with age. This mechanism causes the altered tissues to sink down, with results in characteristic age-related changes - folds and grooves - appearing on the face.

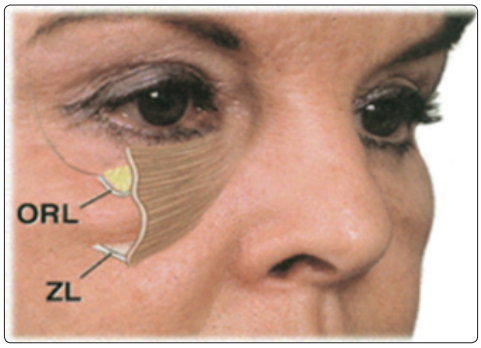


Figure 9: The concept of formation of age-related changes in the periorbital region [7]

Speaking of the fourth anatomic layer, it is necessary to mention facial spaces. These are true voids bounded by retaining ligaments and located under the superficial fascia of the face; they incorporate mimic muscles which are characterized by the absence of any significant anatomic structures (all nerves, vessels, ligaments, and muscles are located beyond the facial spaces); their main function is providing mobility to the soft tissues.

In the periorbital area, there are 2 important facial spaces participating in age-related changes: pre-septal (plays a role in hernial sacs formation) and pre-zygomatic space (plays a role in malar sacs formation). With age there is an expansion of facial spaces, and the sagginess of the facial space roof is seen as an external protrusion of soft tissues (Figure 10 & 11) [8].

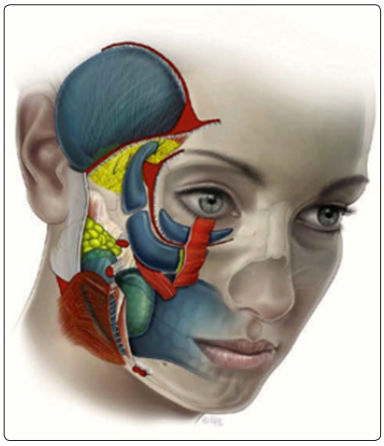


Figure 10: spaces .(8) Facial spaces. [8]

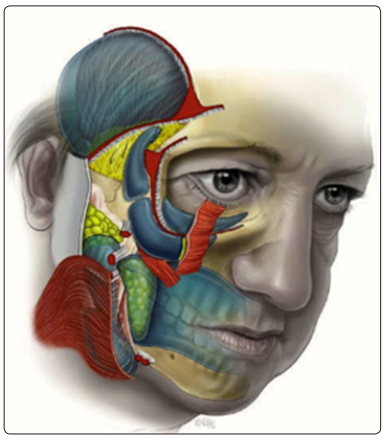


Figure 11: Age-related changes of facial

Fifth layer is periosteum (a thin shell covering the surface of the bone) and facial bones. According to numerous data, with age there is a predominantly clock-wise rotation of maxilla in midsagittal plane in relation to the base of the skull, its anterior wall retro position and the reduction of the maxillary angle.

In the periorbital area, there is an expansion of the orbital aperture walls, resorption of the upper medial and lower lateral edges of its walls. Resorption of the infraorbital margin of maxilla with its subsequent downward and posterior displacement can be a significant factor in stretching the tissues of the lower eyelid, and a negative vector for the angle of the canthal incline (Figure 12 & 13) [9, 10].
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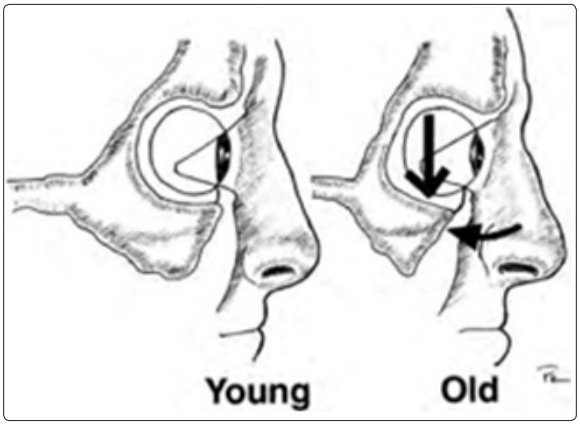


Figure 12: Age-related orbital expansion and displacement (9)

Figure 13: Age-related changes of facial bones (10)

Algorithm of injection correction

Working in the periorbital area has its priority in maximum safety of the drug choice as well as the correction method and technique.

Complex approach to the invour olution changes correction in the periorbital area is based on SLS rule - Stepwise, Layered, Staged.

Stepwise means the sequence of application of certain procedures and drugs in order to achieve their potentiated effects. Layered means the action on any anatomical layer of age-related changes in this region. Staged means an algorithm for alternating or repeating a set of procedures at specific time intervals. Complex action on dermal layer enables resolution of the early signs of age-related changes and promotes to prevent more significant aesthetic problems.

It is known that the concentration of endogenous hyaluronic acid naturally decreases with age. Accordingly, timely artificial replenishment of its level activates the mechanisms of regulation of the genuine synthesis of hyaluronic acid and other dermal matrix components due to the activation of fibroblast cell membrane CD44 receptors.

The combined use of low-molecular hyaluronic acid (HA) in the composition of SKIN-B with the next-generation high-molecular biorevitalization agent, Beautelle 30+ (Beautypharma Co, France) has proven to be a good way to correct problems in the periorbital area.

Apart from HA 20-38 monomer fragments (to directly activate CD44 fibroblast clusters) the SKIN-B agent contains optimal proportion of precursor amino acids (for the synthesis of connective tissue structures with pH 7.4 preventing dermal acidification accompanying any inflammatory process) (Figure 14). SKIN B agent is a potent biostimulator and moisturizer which is preferable to start from.

Figure 14: SKIN-B agent

The Beautelle 30+ contains 1% HA with 3 million Dalton molecular weight; it can remain in tissues for a long time, thereby prolonging the effect of biorevitalization. The manufacturers of Beautelle 30+ use S.I.M.S. technology (soft integrative matrix systems), which enables the high molecular weight HA to be smoothly and gently distributed in the dermal matrix, filling all space and "voids" without external contouring (Figure 15). Beautelle 30+, according to our observations is one of the few revitalization agents that is safe for the periorbital area without the risk of persistent edema.

Figure 15: Beautelle 30+ agent

Also, we recommend including SKIN OX drug in the therapy (Figure 16), especially in patients with dark under-eye circles. Due to glutathione in its composition, which potentiates the transformation of eumelanin into pheomelanin, the drug specifically acts on hyper pigmentation in the periorbital region. Due to the fact that the drug contains sodium ascorbyl phosphate, it affects the tyrosinase enzyme in the process of melanogenesis, thereby preventing the formation of hyperpigmentation, also binding free radicals, providing a protective effect. Optimal complex program is presented in (Figure 17). Injection technique - dermal papules, micropopules. The result is shown in (Figure 18).

Figure 16: Skin OX agent

Figure 17: Periorbital area rejuvenation procedures course scheme

(Figure 18) Female patient A., 36 years old, complained of dark under-eye circles, a tired look, and loss of turgor and dermal thinning in the periorbital area. Examination revealed: loss of turgor, pigmentation, thinning of the skin of the periorbital area, the presence of the lacrimal groove (A).

Revitalization with Skin B was performed at intervals of 1 time per weeks, 3 times, alternating with high-molecular revitalizing agent Beautelle 30+ (2 times); Skin OX agent was injected to act against pigmentation, at intervals of 1 time per week, 2 times. After the end of the treatment course, filling the lacrimal groove with Filorga MHA-18 agent was performed.

The patient 4 months after the procedure course (B))

SKIN COLIN agent deserves the special attention in terms of direct stimulating effect on the second anatomical layer (orbicular muscle of the eye) (Figure 19).

Figure 19: SKIN COLIN agent

Choline, an ingredient of this drug, is a biologically active compound, participating in the synthesis of phospholipids, a precursor for one of the key peripheral neurotransmitters, acetylcholine, that plays an important role in methabolism. Stimulating effect of acetylcholine on muscular tissue can be achieved through its action on cholinergic receptors of myofibroblasts, which obviously stimulates their retraction due to increased acetylcholine synthesis.

Deep intramuscular SKIN COLIN injections are performed using two techniques (Figure 20):
Technique 1 - in the central and medial parts of pre-septal portion of the orbicular muscle of the eye. By strengthening this particular zone, we indirectly reinforce the weak part of the orbital septum of the eye, thus performing additional prevention of hernial sacs in the lower eyelid.

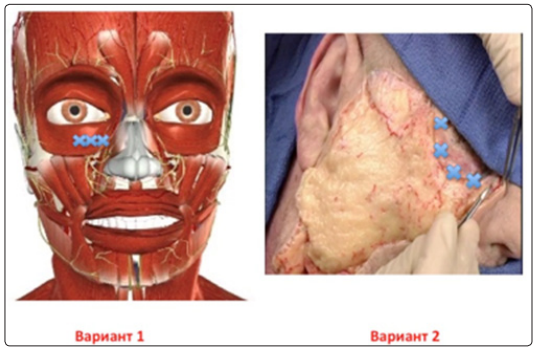


Figure 20: SKIN COLIN drug deep injection points in the orbicular muscle of the eye

Performing injections: the needle is inserted 2-3 mm deep, injection volume is 0.2 ml each, at 3-4 points;
Technique 2 - more suitable for patients with atonic flaccid orbicular muscle of the eye without signs of activity in the lateral region of the orbital portion of Orbicularis oculi. The drug is injected into the orbicular muscle of the eye, at the border of orbital and palpebral portions, in the projection of orbital retaining ligament, at 3-4 points, injection volume 0.1-0.2 ml each. The course is performed weekly, consists of 6 procedures, followed by 2 weeks off and supportive monthly injections.

In patients with predominant activity in the lateral region of the orbital portion of the orbicularis muscle of the eye it is recommended to use botulinum therapy.

With pronounced hernial sacs have appeared, the preferred method of correction is a surgery, but in patients with early orbital fat protrusion a significant clinical improvement can be achieved after conservative therapy with intraorbital and periorbital Conjonctyl injections (Figure 21). The lipolytic effect of the drug is caused by membrane system adipocytes activation, which leads to the formation of adenylatecyclase and the synthesis of cAMP, which activates lipase without interfering with cellular metabolism.

Figure 21: Conjonctyl drug

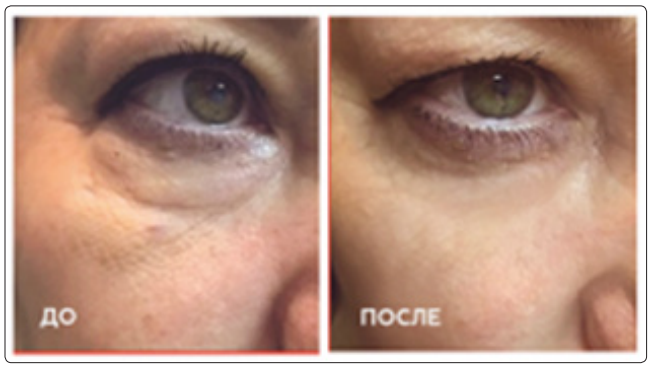
Injection technique: using dynamic test (ask a patient to look up) determine the location of the hernial sac and its borders. Injection at an angle of 45 degrees, 2-3 mm deep in the projection of prolapsed orbital soft tissue, inject 0.2-0.3 ml of the drug in each of 2-4 punctures depending on the presence and the number of hernial sacs and their size. Conjonctyl can be used as superficial subcutaneous injections performed at the projections of sacs; the drug diffuses through the weakened orbital septum. The course consists of 6-8 sessions, 1 per week (Figure 22 & 23).

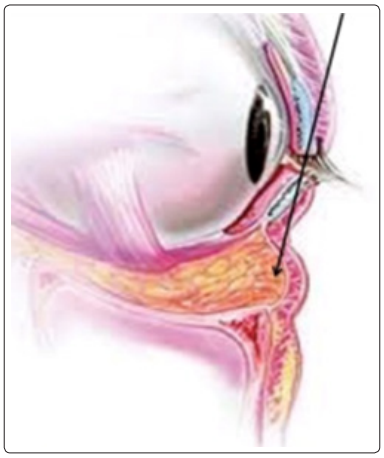
(Figure 22) Female patient N., 58 y.o., complained on periorbital swelling, lower eyelid hernial sacs, overhang fold of upper eyelid, dark under-eye circles. The patient denied the proposed surgery. On examination: hernial bulging (medial, median and lateral sacs. Significant excess of skin with the formation of a hanging fold in the upper eyelid area, medial and median hernial bulging of the upper eyelid. Coetaneous turgor of periorbital area is decreased, there are lacrimal and palpebromalar grooves.

A course of intraorbital Conjonctyl injections was performed into the area of hernial sacs of lower eyelid - 8 sessions once a week. To stimulate the orbicular muscle of the eye, a course of intramuscular SKIN COLIN injections (6 sessions once a week) was performed.

A volumetric remodeling of the periorbital area with Filorga X-HA 3 (bolus extramedullary injections in the SOOF area) was performed.

The patient 2 months after the performed correction course (B)





To obtain deep muscular reinforcement and strengthening of the orbital septum, there is a well-established technique of intramuscular (deep) meso thread lifting.

The anatomic rationale for this technique is that the orbital septum is divided into 2 portions, above and below the fusion with capsulopalpebral fascia. The portion of septum located above is strengthened with capsulopalpebral fascia. The lower portion of the septum at the level of medial and median fat sacs is weak and easily stretched; it is laterally bounded by an arcuate expansion of the capsule-palpebral fascia which fixes it to the Arcusmarginalis (Figure 24) [11].

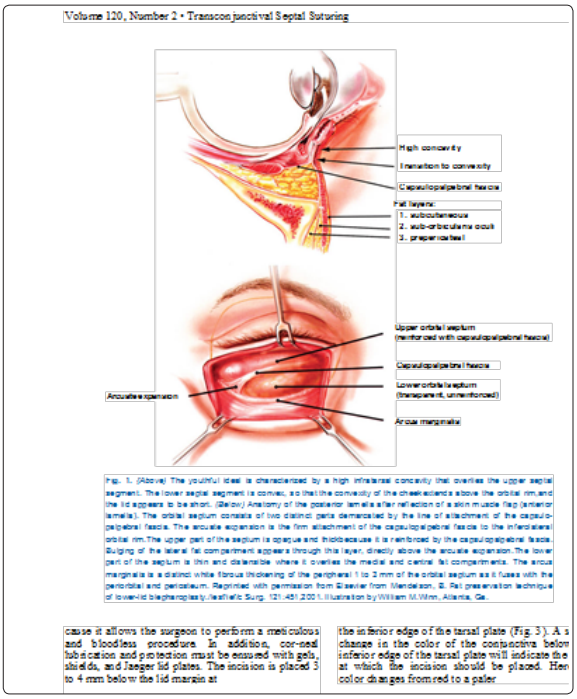


Figure 24: View on the posterior lamella when musculocutaneous flap is removed. [11]

In order to strengthen the myofascial framework of the anterior lamella and indirectly strengthen the orbital septum, it makes sense to install the mesothreads using the grid technique. Smooth 25-38 mm/30-29G mesothreads are used in a number of 10-20 pcs. Installation method - intramuscular (Figure 25).

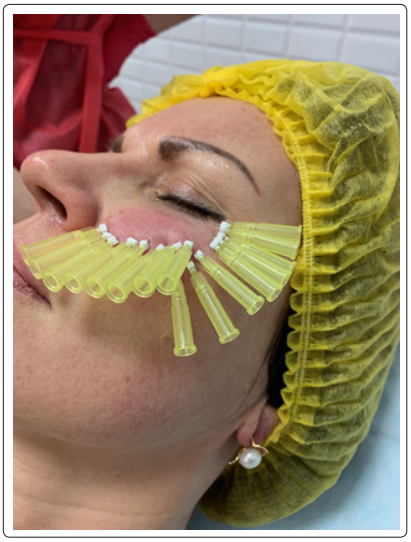


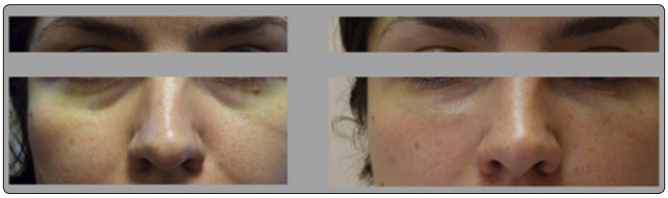
Figure 25: Grid technique of thread lifting

In order to correct palpebromalar and lacrimal sulci, the invariably most popular correction method is volumetric filling with stabilized hyaluronic acid-based drugs. Commonly used safe level of filler injection is near the area of deep fat packages (SOOF). It is acceptable to inject superficially the minimum amount of low viscosity filler. The correction scheme of the lacrimal and palpebromaral sulci: bolus subperiostal injections (0.2 - 0.3 ml, medium density drug is used)

Figure 26: The correction scheme of the tear trough and palpebromaral groove: high density drug injection sites are marked in black; low density drug injection sites are marked in blue. See explanations in the text

Figure 27: A female patient O., 34 y.o., complained of dark under-eye circles and tired look

Examination revealed: thinned skin of the infraorbital area, lacrimal groove, early signs of palpebral-buccal groove, malar sac (A). A course of Conjonctyl injections in the area of malar fat sac (6 sessions, once a week) was performed. Deep reinforcement of the periorbital area with 25 mm 30G mesothreads (20 threads) using grid technique, filling of tear trough groove, bolussupraperiostal injections into the SOOF area were used. The patient 6 months after the procedure course (B).



Conclusion

In conclusion, it should be noted that the possibilities of injection aeshetic correction of age-related changes in the periorbital area, unfortunately, are limited by the aging stage, degree and morph type, and the social and economic possibilities of the patient. However, intelligent use of modern techniques of injection aesthetics, proper patient selection, combination of correction techniques that act on al anatomic levels of involution changes, allows us to significantly improve and prolong the final result without the need for surgery.

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