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Mesotherapy and Biorevitalization Within the Prejuvenation Paradigm: A Comprehensive Analysis of Efficacy and Clinical Protocols for Young Facial Skin

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Abstract

This study examines the use of injectable modalities - mesotherapy and biorevitalization - in the therapeutic management of patients aged 18–35 years. The evidentiary foundation of the research is constructed from a systematized review of specialized literature, clinical observations, and market statistics for 2023–2024. The conceptual architecture of the paper is organized around a paradigmatic shift from predominantly corrective aesthetic medicine toward a preventive model of care aligned with the concept of prejuvenation, wherein the priority is early intervention aimed at preserving the structural and functional potential of the skin and reducing the likelihood of developing pronounced age-associated changes.

The report's core propositions elucidate the molecular and biological mechanisms of action of polynucleotides (PDRN), amino acid clusters, and hyaluronic acid, taking into account the physiological characteristics of the young dermis. The biochemical and cellular effects of these substances are considered in detail in relation to the regulation of reparative processes, the metabolic activity of the dermal matrix, and the maintenance of hydration parameters that determine tissue quality at preclinical stages of involution. In the analytical section, classes of products and their therapeutic relevance are systematically compared in addressing the most frequent clinical objectives within this age cohort.

Outcome assessment is based on correlating clinical endpoints with the dynamics of objective indicators, which makes it possible to substantiate the selection of composition and injection technique in accordance with the leading pathogenetic factor.

Keywords: *Prejuvenation, Mesotherapy, Biorevitalization, Hyaluronic Acid, Polynucleotides (PDRN/PN), Skin Quality, Post-Acne, Clinical Protocols.*

CONTENT

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INTRODUCTION

Contemporary dermatology and aesthetic medicine are entering a phase of conceptual reorientation: the clinical priority is gradually shifting from reactive correction of already manifest signs of aging toward early prevention and the maintenance of tissue equilibrium. In international practice, the term prejuvenation has become established to denote this logic, integrating preventive directions with rejuvenation methods [1]. Unlike the classical anti-aging paradigm, which is oriented toward eliminating established markers of involution (deep wrinkles, gravitational ptosis, pronounced architectonic remodeling of soft tissues), prejuvenation focuses on preserving the cellular pool, sustaining homeostasis at the dermal–epidermal interface, and slowing extracellular matrix degradation at a stage of minimal or absent clinical manifestations [2].

The age group most receptive to this strategy has been young adults - Generation Z and millennials within the 18–35 range. The Galderma report NEXT 2024 indicates the formation of a new behavioral pattern: aesthetic interventions are interpreted as an element of comprehensive health stewardship, comparable in significance to nutritional practices, physical activity, and stress management [3]. A sociocultural catalyst is social media and the phenomenon of Zoom dysmorphia, in which prolonged self-observation via the front-facing camera and videoconferencing intensifies fixation on micro-unevenness and tonal heterogeneity [2]. Against this background, demand is growing for a filter in real life - improvement of skin quality (texture, color, light reflectance) while preserving individual facial features.

Economic indicators confirm a structural pivot in demand toward minimally invasive procedures among younger audiences. The United States aesthetic medicine market in 2023 was valued at 38.19 billion dollars, and the projection for 2033 reaches 136.69 billion with a compound annual growth rate (CAGR) of approximately 13.6% [4]. The global market demonstrates a comparable trajectory: 129.0 billion dollars in 2023 with a forecast to 488.7 billion by 2033 [5]. This dynamic reflects not only an expansion of the technological supply, but also the normalization of aesthetic practices as part of everyday medicine of well-being.

A key growth driver is the increasing share of nonsurgical interventions. According to ISAPS data for 2024, the total number of nonsurgical procedures increased by more than 40% relative to figures from four years earlier [6]. Within the demand structure of Generation Z (up to 29 years), the emphasis is shifting: while neuroproteins remain significant, 2024 statistics record a sharp increase in interest in methods aimed at hydration and dermal quality, including biorevitalization and mesotherapeutic protocols [7]. An important feature is the aspiration for a natural look, meaning a result perceived as an improvement in skin condition without a noticeable transformation of facial expression or anatomical proportions. Additionally, market masculinization is noted: the number of men seeking aesthetic services has grown by 18%, with dominant requests for subtle procedures that enhance skin quality and the perceived freshness of appearance [5].

The pathophysiology of conditions characteristic of young skin differs substantially from involutional changes of mature age. In the 20–30 range, the synthetic activity of fibroblasts generally remains high; however, it is precisely during this period that the burden of exogenous factors, consolidated under the concept of the exposome, increases. Ultraviolet radiation, air pollutants, tobacco smoke, circadian rhythm disruption, and chronic stress generate early oxidative imbalance, leading to lipid peroxidation, damage to cellular membranes, and the initiation of proinflammatory cascades described as inflammaging [1]. As a result, even in the absence of pronounced wrinkles, early markers may develop, including reduced optical radiance of the skin, microrelief irregularity, and instability of vascular reactions.

A separate place is occupied by the postinflammatory spectrum of changes most frequently associated with Acne Vulgaris: atrophic scars, persistent erythema, and postinflammatory hyperpigmentation (PIH). These conditions carry high psychosocial significance and require not masking, but targeted remodeling of the dermal matrix and normalization of the inflammatory response [9]. In this context, early intervention acquires particular value: the formation of stable scar deformities and dyschromias is largely determined by the duration of inflammation and the quality of barrier-function recovery.

The dehydration factor in young age is often underestimated, although clinical practice demonstrates a frequent combination of transepidermal water loss with functional vulnerability of the stratum corneum. A decrease in endogenous hyaluronic acid levels may be less age-driven and more stressor-related, intensifying under climatic conditions, aggressive skin care, excessive exfoliation, and disruption of the epidermal lipid profile. Against this background, even minor barrier disturbances become a trigger for reactive erythema, irritation, and a dull skin tone, forming demand for procedures that increase hydration and improve the quality of dermal–epidermal communication.

A clinically meaningful phenotype in a subset of young

patients is the so-called tired morphotype, manifested by puffiness, reduced turgor in the midface, and a tendency toward microcirculatory disturbance. This presentation often correlates with sleep deficit, high stress load, and irregular nutrition, which is reflected in vascular tone and lymphatic drainage [10]. Within prejuvenation, the vector shifts toward restoring tissue perfusion, reducing subclinical inflammation, and stabilizing barrier parameters, since these mechanisms largely determine the visual signs of freshness and an even tone.

Methodologically, prejuvenation relies on the principle of biological appropriateness: intervention should correspond to the current level of tissue resources and pathogenetic targets rather than chronological age. In this context, risk stratification by exposome factors, phototype, propensity to postinflammatory dyschromias, and vascular-bed reactivity becomes especially important. Priority is given to protocols that improve skin quality by supporting the matrix, reducing oxidative stress, and optimizing barrier function, whereas excessive aggressiveness of interventions at a young age increases the probability of adverse events and aesthetic disharmonization of the result.

An additional dimension is the ethical and communicative aspect: the growing popularity of early aesthetic practices reinforces the need for clinically substantiated indications and for the prevention of dysmorphophobic tendencies. Under conditions of social media influence, objective efficacy criteria are critically important (dynamics of texture, hydration parameters, tone uniformity, and erythema severity), because subjective nonconformity with a filter does not always correlate with a true dermatologic problem [2]. Thus, in its modern interpretation, prejuvenation represents not a set of procedures, but a comprehensive medical strategy in which aging prevention is tightly linked with the treatment of exposome-induced disturbances, barrier support, and a correct assessment of psychosocial factors that shape the request for intervention.

The aim of the work is to conduct a comprehensive comparative analysis of the efficacy and safety of mesotherapy and biorevitalization in patients aged 18–35 within the prejuvenation paradigm and to formulate clinically substantiated algorithms for selecting products and injection techniques for the leading phenotypes of young skin.

The author's hypothesis is based on the assumption that, in young skin, maximal reproducibility of outcomes and minimization of adverse events are achieved through pathogenetically stratified selection of an injection methodology (hyaluronic acid for dehydration; PDRN/PN for post-acne, erythema, and the tired morphotype; mesococktails/amino acids for exposome-induced functional disturbances), with control of the total hydrophilic load and protocol personalization.

Scientific novelty consists in proposing an integrative prejuvenation model for the 18–35 age cohort that unites molecular targets (CD44/RHAMM/ICAM-1; A2A→VEGF) with practical clinical algorithmic solutions (indications, technique, intervals, control metrics, and risk profile), thereby enabling a transition from universal schemes to predictable personalized prevention of early involutional and postinflammatory changes.

CHAPTER 1. THEORETICAL FOUNDATIONS: MECHANISMS AND DEFINITIONS

Within CHAPTER 1 Theoretical Foundations: Mechanisms and Definitions, the theoretical framework of injectable modalities is presented in a sequential manner through the lens of mechanisms of action, pharmacology, and precise terminology, in order to differentiate their aims and expected effects in young patients. In Section 1.1, mesotherapy is examined as a technology of targeted intradermal delivery of microdoses with predominantly metabolic and regulatory support (cofactors of collagenogenesis, antioxidant capacity, control of subclinical inflammation, effects on microcirculation and seboregulation), with an emphasis on restoration of cutaneous homeostasis without hyperstimulation. In Section 1.2, biorevitalization is interpreted as receptor-mediated stimulation by native hyaluronic acid with activation of the CD44, RHAMM, and ICAM-1 axes, where the determining variables include molecular-weight parameters, the depot effect, immunomodulation, and the linkage between early hydration and delayed matrix reorganization. In Section 1.3, biorepair is presented as an approach with a more pronounced regenerative potential, based on polynucleotides (PDRN/PN) and peptide complexes that influence A2A receptors, proinflammatory cytokines, and VEGF, as well as the substrate provision of repair, thereby providing a conceptual explanation for shifting the dermis from a survival mode to controlled restoration and to more structurally grounded clinical outcomes.

Mesotherapy: The Pharmacology of Microdoses

Mesotherapy, originally conceptualized by Michel Pistor through the principle little, infrequently, and in the right place, is interpreted in contemporary scholarly terms as a technology for targeted intradermal delivery of pharmacologically active compounds into the zone of dermal–epidermal interaction and the perivascular spaces. This route of administration provides direct contact of active components with the cellular populations that determine the state of the cutaneous matrix and barrier function (fibroblasts, keratinocytes, endothelial cells), while minimizing the influence of systemic circulation and reducing losses associated with traversing epidermal barrier structures. [11]

With respect to young skin, mesotherapy is positioned primarily as a regulatory and metabolically supportive therapy. The mesococktails used in most cases do not qualify as true stimulators of tissue remodeling; rather, they function as cofactors of key biochemical processes that ensure physiological synthesis of extracellular matrix proteins and adequate cellular energy supply. Thus, ascorbic acid

is functionally significant for the hydroxylation of proline and lysine during collagen biosynthesis; B-group vitamins are involved in enzymatic reactions of energy metabolism (including within the tricarboxylic acid cycle), and amino acids form the substrate base for protein synthesis and reparative processes. [12]

The key therapeutic vector in work with young patients becomes the restoration of parameters of cutaneous homeostasis: reduction of functional dysregulation of the sebaceous glands, support of antioxidant potential, and attenuation of subclinical inflammation that accompanies seborrheic states and early manifestations of barrier-function imbalance. Of particular importance is the impact on the microcirculatory link: intradermal administration of components in the perivascular zone can indirectly improve tissue trophism and the dynamics of intercellular exchange, which is expressed in more stable indicators of hydration, tone, and cutaneous reactivity. [14]

From a pathophysiological standpoint, the effectiveness of mesotherapy in young individuals is appropriately considered through the lens of correcting the dermal microenvironment. Maintaining an optimal redox balance constrains cascades of lipid peroxidation that affect sebum quality and the condition of the follicular apparatus, and it also reduces the risk of oxidative damage to matrix proteins by reactive oxygen species. An additional mechanism involves effects on the cytokine profile and the skin's neuroimmune responses: decreasing the intensity of oxidative stress and local inflammatory activity promotes normalization of barrier regeneration and reduces sensitivity, particularly when seborrhea is combined with episodes of irritation.

From a clinical perspective, mesotherapy in this age group is justified as a method for preventive correction of functional disturbances rather than as an instrument of aggressive stimulation. The most substantiated endpoints include stabilization of sebum production, reduction in the severity of postinflammatory changes, increased resilience to external stressors, and improvement of skin-quality parameters without formation of an overstimulated phenotype. Selection of the cocktail composition and the administration protocol should be determined by the dominant pathogenetic link (oxidative stress, sebaceous dysregulation, signs of dehydration, post-acne changes), because excessive multicomponent formulations increase the likelihood of undesirable reactions without a proportionate gain in efficacy.

Biorevitalization: Receptor-Mediated Stimulation

The term biorevitalization, introduced by A. Di Pietro in 2001, became established to denote intradermal administration of native (unmodified) hyaluronic acid (HA) of a specified molecular weight and concentration. The conceptual specificity of the method is defined not so much by substance delivery as by the initiation of a regulatory dermal response: in mesotherapy, the dominant idea is trophic support, whereas in biorevitalization the central element is a signaling effect that triggers reconfiguration of the cellular response and the extracellular matrix.

Exogenous HA interacts with specialized receptors on the membrane of dermal fibroblasts, primarily CD44, RHAMM (Receptor for Hyaluronan-Mediated Motility), and ICAM-1. Ligand–receptor binding, especially along the HA–CD44 axis, activates intracellular signaling cascades associated with increased fibroblast proliferation, stimulation of endogenous hyaluronic acid synthesis, collagen and elastin production, and a reduction in the activity of matrix metalloproteinases [1]. Accordingly, biorevitalization is understood as a directed modulation of dermal matrix remodeling and an enhancement of its functional integrity.

Within Table 1, a description is presented of molecular targets and clinical endpoints in young skin.

Table 1. Molecular Targets and Clinical Endpoints in Young Skin (compiled by the author based on [1, 8, 15]).

Class / Component	Primary Target (Receptor/Pathway)	Key Biological Effect	Expected Clinical Changes (18–35)	Practical Caveat for Young Skin
Native hyaluronic acid (biorevitalization)	CD44, RHAMM, ICAM-1	Hydration reserve plus extracellular matrix regulation, reduction of matrix metalloproteinase activity	Rapid improvement in hydration, enhanced luminosity, attenuation of fine creases	In patients predisposed to puffiness, use minimal volumes and an appropriate injection depth; otherwise, there is a risk of edema and papules
Partially stabilized hyaluronic acid (skin boosters)	Extracellular matrix depot plus moderate biosignaling	Sustained support of turgor and viscoelasticity	More even texture, prevention of dehydration	Do not volumize: the goal is tissue quality; titrate the hydrophilic load
Polydeoxyribonucleotide / Polynucleotides (PDRN / PN)	Adenosine receptors A2A leading to an anti-inflammatory profile; VEGF	Decrease in TNF-α and IL-6, improved microcirculation, remodeling	Post-acne topography, erythema, periorbital thin skin, dermal densification	Advantageous for an edematous or fatigued morphotype: low risk of hydrophilic fluid retention

Amino acid clusters (hyaluronic acid plus amino acids)	Substrate support of collagenogenesis	Metabolic support of fibroblasts, gain structural proteins, including the basement membrane	Gradual densification, refinement of microrelief, improved tone	The effect is cumulative; a course and interval are essential, and an immediate result should not be expected
Vitamin and mineral mesotherapy cocktails	Cofactor reactions (redox balance, energy metabolism)	Antioxidant protection plus trophic support	Enhanced radiance, more even tone, reduced reactivity	Multicomponent formulations increase the risk of individual reactivity; the more sensitive the patient, the simpler the composition should be

The realization of this biological response is critically dependent on the molecular weight of the administered HA: ranges on the order of 1–2 million Daltons are typically regarded as optimal, as they provide sufficient receptor affinity and predictable biosignaling. Low-molecular-weight fragments can function as danger signals, amplifying proinflammatory reactions and angiogenesis, whereas excessively large molecules demonstrate limited receptor accessibility and less effective cellular communication [17, 24]. In tissues with preserved dermal potential, the goal of intervention shifts from compensating volumetric deficit to establishing a stable hydro-reserve and reducing the likelihood of fibroblast apoptosis.

An additional consideration is HA participation in maintaining the viscoelastic properties of the intercellular substance and in controlling the diffusion of water, ions, and signaling molecules within the dermis. Following intradermal administration, a temporary depot effect is created that contributes to restoration of the cellular microenvironment: the organization of the proteoglycan scaffold improves, conditions for collagen fiber assembly normalize, and the severity of degradative matrix shifts under oxidative stress decreases. In parallel, an immunomodulatory component is observed, conditioned the influence of HA on cell migration and on the balance of proinflammatory and reparative mediators, which is important for the appropriate course of tissue renewal processes without an excessive inflammatory phase.

From a clinical and biological perspective, the effect of biorevitalization is appropriately understood as a combination of early hydration changes and delayed matrix reorganizations associated with renewal of fibroblast synthetic activity. The outcome is determined not only by the choice of molecular weight and concentration, but also by administration parameters (depth, papule distribution, intervals), as well as by the baseline condition of the dermis and the rate of enzymatic degradation of HA by hyaluronidases. When dermal cellular resources are preserved, the priority becomes maintenance of matrix quality and prevention of functional fibroblast depletion, whereas in the presence of pronounced involutional changes a combined strategy is required, aimed at correcting structural and regulatory disturbances of the dermal compartment.

Biorepair: Regenerative Potential

Biorepair, as a comparatively new layer of injectable modalities, is associated with the use of products aimed not at short-term dermal hydration, but at initiating cascades of tissue recovery with features of genuine regeneration. The most typical representatives of such agents are polynucleotides (PDRN) and multifactor peptide compositions capable of influencing the cellular microenvironment, modifying the inflammatory response, and supporting the reparative potential of the fibroblast pool.

The pharmacodynamics of PDRN is largely realized through activation of adenosine A2A receptors, which shapes a pronounced anti-inflammatory profile: production of TNF-a and IL-6 decreases, while secretion of vascular endothelial growth factor (VEGF) increases and fibroblast migratory activity rises [18]. This combination of effects is interpreted as a mechanism linking attenuation of chronic low-intensity inflammation with improved microcirculatory support of tissue and the creation of conditions for extracellular matrix remodeling.

In addition to receptor-mediated signaling influences, nucleotide fragments serve as a metabolic resource for the DNA synthesis salvage pathway, enabling more rapid cellular recovery in situations of energy deficit, stress, or ischemia [19]. This aspect is of particular significance for tissues with impaired perfusion and a high proportion of fibrotically altered matrix, including scar tissue, where the speed and quality of the cellular response are often limited by substrate availability and by an imbalance of reparative mediators.

From a pathophysiological standpoint, bioreparative approaches are appropriately understood as an attempt to shift the dermis from a survival mode into a mode of controlled restoration. Under conditions of chronic microinflammation and oxidative stress, fibroblasts tend toward phenotypic drift characterized by predominance of catabolism and reduced matrix-synthetic activity; reducing proinflammatory stimuli in parallel with strengthening VEGF-dependent processes promotes normalization of tissue metabolism and increases remodeling efficiency. Accordingly, the clinically observed dynamics of skin-quality improvement with biorepair is logically linked not to a single active ingredient, but to a

comprehensive reconfiguration of cellular signaling, the vascular component, and matrix interactions [25, 28].

An additional mechanism relevant to polynucleotides is considered to be an increase in cellular resilience to adverse influences through support of replicative and reparative processes, which reduces the likelihood of functional burnout of the dermal cellular pool. Against this background, peptide complexes within bioreparants may enhance the directionality of the response, functioning as regulatory molecules that facilitate synchronization of neocollagenesis, organization of the elastin framework, and stabilization of the matrix. Taken together, this creates prerequisites for a more durable and structurally substantiated effect compared with methods that are limited primarily to hydration or short-term trophic changes.

CHAPTER 2. CLASSIFICATION AND CHARACTERIZATION OF PRODUCTS FOR YOUNG SKIN

Selecting a product for patients aged 18–35 years requires a strict, differentiated approach that excludes heavy gels capable of inducing edema.

Hyaluronic Acid (HA)

In aesthetic medicine, products based on hyaluronic acid (HA) are conventionally systematized according to two key parameters: the molecular weight of the polymer and the presence of interchain crosslinks. These characteristics determine the material's rheological properties, its resistance to enzymatic degradation, the degree of hydrophilicity, and the specifics of interaction with the extracellular matrix. Clinically, it is precisely the combination of molecular weight and the level of stabilization that determines the duration of effect, the pattern of tissue distribution, and the likelihood of transient reactions associated with osmotic water attraction and local microcirculatory changes.

Native (non-crosslinked) HA is traditionally regarded as the foundational substrate for classical biorevitalization, which is aimed at improving hydration and providing metabolic support to the dermis without generating volume. For young skin, concentrations on the order of 10–15 mg/mL are advisable, because this range allows a pronounced moisturizing effect while minimizing undesirable events. Use of higher concentrations is associated with the risk of more prolonged papules and the formation of hydrophilic edema due to the product's increased capacity to retain water at the injection site.

Skin boosters are products based on stabilized HA, typically partially crosslinked, intended for prolonged hydration and improvement of skin turgor. Their principal distinction lies in the absence of a volumization objective: instead, the formation of a functional scaffold and a moisture depot within the dermis is achieved, supporting tissue quality for months. With appropriate product selection and injection technique, the effect can persist for up to 6–9 months [13, 16]. The most substantiated use of this group is in patients with a fine-wrinkled type of aging, in whom the leading manifestations are dehydration, reduced elasticity, and multiple superficial folds without pronounced tissue deficit.

The clinical significance of molecular weight is expressed in the balance between biological activity and persistence: lower-molecular-weight fractions are characterized by faster metabolism and, as a rule, shorter effect duration, whereas larger and/or stabilized structures demonstrate increased resistance to hyaluronidases and longer residence within the dermis. At the same time, the degree of crosslinking affects not only degradation time, but also viscoelastic characteristics, determining product spreadability, its ability to integrate into the matrix, and the severity of post-injection reactions. Consequently, selection of a specific HA form should be grounded in a predictable tissue need - from short-term hydration to long-term support of the dermal matrix.

Issues of tolerability and complication prevention require particular attention, because even non-volumizing products can produce transient phenomena such as edema, localized puffiness, or prolonged papules when concentration, bolus volume, and injection depth are mismatched. Reducing the risk of undesirable effects is achieved through correct indication selection, assessment of baseline inclination to edema, calibrated control of total injected volume, and adherence to principles of uniform product distribution. Within comprehensive protocols, combining different HA forms with procedures aimed at dermal remodeling is acceptable; however, priority should be given to the biological logic of intervention sequencing and to control of the total hydrophilic load on the tissues.

Polynucleotides (PDRN/PN)

Among products derived from the milt of salmonid fish are biopolymers based on polynucleotides (including DNA fragments/PDRN), used in regenerative protocols of aesthetic medicine as modulators of dermal repair. Their clinical value is associated not with mechanical tissue filling, but with a biological influence on the cellular and vascular components of the skin: normalization of trophic support, reduction of chronic subclinical inflammation, and indirect stimulation of extracellular matrix remodeling.

Within the indication framework, these products are regarded as a gold standard for the correction of post-acne sequelae, cicatricial changes, and striae in young patients [21]. A principal distinction from hyaluronic acid is the absence of pronounced osmotic water attraction: while similarly oriented toward improving skin quality, they do not provoke hydrophilic fluid retention, which lowers the risk of puffiness and makes them a rational choice for deformational and tired morphotypes [21]. This is particularly relevant in anatomical zones predisposed to edema and in the presence of baseline microcirculatory lability.

Reported biological effects include improved microcirculation, more rapid maturation of postinflammatory changes and

lightening of congestive macules, as well as smoothing of skin topography through gradual remodeling of the dermal matrix [22]. In scar-related defects, the expected result is linked to effects on collagen fiber quality and the organization of the intercellular substance, which clinically manifests as reduced contrast of atrophic elements and increased uniformity of the skin surface.

At the molecular level, polynucleotide activity is understood as multifaceted: enhancement of fibroblast metabolic activity, support of angiogenesis and reparative neocollagenesis, and antioxidant and anti-inflammatory potential that indirectly improves the quality of regeneration. In post-acne contexts, this is of particular importance because persistent microinflammation and vascular dysregulation sustain chronic erythema and hyperpigmentation, slowing dermal recovery and producing heterogeneous relief.

In practical application, efficacy is determined by appropriate patient selection and by injection technique that accounts for lesion depth and the severity of fibrotic changes. The most predictable results are achieved with a course-based approach, in which biological stimulation is combined with control of factors that maintain chronicity of the process (excessive traumatization, active inflammation, photodamage). In combined programs, sequential integration with modalities intended to induce remodeling (device-based and injectable approaches) is permissible; however, priority is given to a strategy that minimizes edematous burden on tissues and ensures physiologic restoration of the dermal matrix without hyperreactivity of the vascular component.

Amino Acid Clusters

Combined complexes that include hyaluronic acid and a strictly specified pool of amino acids (most commonly glycine, proline, lysine, leucine) belong to the group of targeted-action bioreparants, in which the hydrophilic HA matrix is paired with substrate support for protein anabolism. This composition makes it possible to simultaneously influence the water balance of the extracellular matrix and the metabolic needs of dermal cells involved in renewal of the collagen framework. Of fundamental importance is the standardized composition of the amino acid component: selection of these specific amino acids reflects their role in the formation of collagen chains and in ensuring the structural stability of fibers.

Mechanistically, amino acids in the L-form are regarded as ready building units that can be rapidly incorporated into the biosynthetic pathways of collagenogenesis without preceding energy-intensive stages of proteolysis and subsequent liberation of amino acids from proteins. This creates conditions for more effective metabolic support of fibroblasts during reparative reconfiguration of the dermis, especially when signs of matrix depletion are present. Research data indicate that combining HA with amino acids provides more pronounced dermal densification and enhanced synthesis of type IV collagen compared with hyaluronic acid monotherapy [12].

Particular attention should be given to type IV collagen as a key component of the basement membrane that determines the quality of the dermal–epidermal junction and the functional cohesion of the skin layers. Increasing its synthesis in the context of combined formulations may be clinically meaningful in conditions accompanied by reduced density and elasticity, deterioration microtopography, and diminished tissue resistance to mechanical loads. In this respect, amino acid complexes potentially affect not only the volume of hydration, but also deeper parameters of matrix architecture, creating prerequisites for durable improvement in skin quality.

The practical effectiveness of such products is determined less by an immediate visual effect than by the gradual dynamics of remodeling, manifested as increased turgor, reduced prominence of fine folds, and greater uniformity of the skin surface. Because the dominant mechanism is associated with metabolic stimulation and substrate support of synthesis, a course-based approach and appropriate intervals between procedures are of principal importance for accumulation of a biological result. An additional advantage is considered to be the possibility of more precise personalization of protocols: priority shifts toward improving dermal density and the quality of the connective-tissue framework without an emphasis on volumization.

Table 2. Comparative Characteristics of Drug Groups for Young Skin (compiled by the author based on [1, 33, 40]).

Drug Group	Main Component	Key Mechanism	Priority Indications (18–30 years)	Risk of Puffiness
Biorevitalizers	Native hyaluronic acid (1–2 million Da)	CD44 stimulation, hydration	Dryness, reduced turgor, fine wrinkles	High
Skin boosters	Stabilized hyaluronic acid	Prolonged hydration reserve	Porous skin, prevention, dryness	Medium
Polynucleotides	PDRN / PN	DNA repair, angiogenesis	Acne, scars, post-acne, dark circles	Low
Amino acids	Hyaluronic acid plus amino acids	Substrate for collagenogenesis	Thinned skin, striae, laxity	Low
Mesotherapy cocktails	Vitamins, antioxidants	Metabolic cofactors	Dull complexion, stress-affected skin, pigmentation	Low

Thus, multicomponent vitamin–mineral mesotherapeutic complexes (for example, NCTF) should be regarded as agents intended primarily for metabolic and antioxidant support of the dermis, delivering a quality-oriented clinical effect (improved trophism, enhanced microcirculation, tone leveling, increased radiance, and accelerated recovery after insolation and photostress) with minimal risk of edema, yet without an expectation of pronounced volumization or structural remodeling; their rational use is most justified in patients aged 18–30 years with a tired and stress-associated skin phenotype and post-insolation changes within course-based programs, while the variability of formulations and concentrations necessitates reliance on the evidence base of the specific product, precise selection of indications, and consideration of individual reactivity to reduce the risk of hypersensitivity and post-procedural inflammation.

CHAPTER 3. METHODOLOGY: SELECTION ALGORITHMS AND INJECTION TECHNIQUES

Within chapter 3 Methodology: Selection Algorithms and Injection Techniques, a practice-oriented methodological framework is presented that delineates how, on the basis of the clinical presentation, to construct a decision-making algorithm for selecting among mesotherapy, biorevitalization, skin boosters, and bioreparative approaches.

Therapy Selection Algorithm Based on the Clinical Presentation

The choice between mesotherapeutic protocols and biorevitalization should be structured around the leading symptom complex and the presumed pathogenetic target of correction. In postinflammatory changes following acne, the primary direction is attenuation of low-intensity inflammation, reduction of tissue reactivity, and stimulation of dermal remodeling. Under such conditions, preference is given to PDRN as monotherapy or in combination with mesopreparations containing silicon and zinc, which makes it possible to support reparative processes and normalize local metabolic reactions. Use of high-concentration pure hyaluronic acid is considered undesirable, because in the presence of microinflammatory foci it may indirectly create conditions favorable for persistence of bacterial flora, thereby reducing outcome predictability and increasing the risk of prolonging the inflammatory cascade [9].

When signs of dehydration predominate and a fine-wrinkled pattern forms, the leading task becomes rapid rehydration and restoration of the barrier properties of the stratum corneum. In this clinical context, classical biorevitalization represents a more substantiated strategy, as it allows a prompt increase in water content in the superficial layers of the skin and improves parameters of elasticity. A course of 2–3 procedures is typically sufficient for rapid stabilization of the hydro-balance, reduction of the wrinkle mesh appearance, and enhancement of the visual uniformity of microtopography [26].

In the tired-face phenotype combined with puffiness, priority shifts toward improving microcirculation and lymphatic drainage characteristics without inducing additional volume. In such cases, mesotherapy with vascular components, including extracts of Ginkgo biloba and artichoke, or amino acid therapy aimed at optimizing tissue metabolism and reducing congestive phenomena, is justified. Particular attention should be given to PDRN, which demonstrates clinical rationale for densifying and improving skin quality in the periorbital region, including the eyelids, while minimizing the risk of induced edema due to the absence of a pronounced volumetric effect [21].

Under a preventive strategy oriented toward prejuvenation in the absence of explicit complaints, the clinical logic is built around maintaining the functional resource of the skin and preventing early signs of chronologic aging and photodamage. In this situation, it is rational to use skin boosters at 6–9 month intervals or course-based regimens of multivitamin mesococktails aimed at enhancing optical radiance, improving tone, and increasing resilience to stressors [27].

Additionally, it is appropriate to consider that method selection is often determined not only by the dominant symptom, but also by tissue reactivity, predisposition to puffiness, characteristics of the skin barrier, and anamnestical data on inflammatory dermatoses. When combined manifestations are present (for example, moderate dehydration in the setting of post-acne), combined and staged protocols become more substantiated, in which inflammatory mechanisms and microvascular disturbances are stabilized first, and only then are techniques that enhance hydration introduced. Such an approach increases safety, reduces the probability of paradoxical reactions, and improves reproducibility of the clinical effect through sequential impact on pathogenetically meaningful links.

Injection Techniques

Technical parameters of an injectable intervention substantially determine the severity of post-procedural phenomena and the length of the rehabilitation window, which is especially important when planning treatment for a socially active patient population. The classical micro-papular technique involves administering the product with a 30G/32G needle at the level of the mid-dermis, forming intradermal depots. This technique provides reproducible product distribution and controlled dosing per unit area; however, it is accompanied by transient visible papules that may persist for up to 2–3 days, particularly when more viscous formulations are used and when injection density is high.

The bioaesthetic points method (BET/BAP) is based on injecting highly flowable products into a limited number of anatomically justified zones - typically five points on each side of the face. Use of agents with pronounced capacity for

tissue diffusion (for example, Profhilo) makes it possible to achieve broad distribution across the dermis and the ligamentous apparatus with a minimal number of punctures. This reduces cumulative tissue trauma, decreases the pain component and the frequency of hematomas, and increases patient compliance due to a more socially acceptable post-procedural profile [20, 23].

The cannula technique involves the use of a blunt-tip cannula 25G/22G for the administration of skin boosters or polynucleotide products. Because of its blunt end, the cannula separates tissues rather than cutting them, which reduces the likelihood of vascular injury and, accordingly, lowers the risk of ecchymoses. An additional advantage is the ability to create extended linear depots and to perform reinforcement of the dermal–subdermal layer from 1–2 access points, which is particularly relevant when uniform distribution is required over large areas and in patients prone to bruising.

The nappage technique (superficial and mid-dermal) is characterized by multiple frequent micro-punctures with delivery of small volumes according to a drop-by-drop principle. It is most often used with mesococktails and protocols aimed at improving microtopography and tone. In addition to the pharmacologic action of the injected components, an important mechanism is the reflexogenic and reparative effect of controlled microtrauma, which initiates a cascade of regeneration and remodeling. At the same time, selection of depth (superficial versus mid-dermal nappage), puncture frequency, and total volume should be matched to vascular reactivity, dermal thickness, and predisposition to post-procedural erythema, because excessive intensity of the technique can prolong the period of hyperemia and increase the risk of petechial elements.

In addition, when determining the preferred technique, it is appropriate to consider not only the anatomical zone and product properties (viscosity, flowability, osmolality, concentration of active fractions), but also individual tissue parameters: the robustness of the dermal framework, the degree of puffiness, microcirculatory features, and anamnestic inclination to post-traumatic pigmentation. In clinical practice, it is precisely the alignment of a product's rheological characteristics with the selected injection technique that establishes the optimal balance among efficacy, safety, and minimization of visible post-procedural manifestations.

CHAPTER 4. CLINICAL INDICATIONS AND PROTOCOLS

Within chapter 4 Clinical Indications and Protocols, the clinically oriented section is presented, in which theoretical mechanisms and methodological algorithms are translated into specific indications, protocols, techniques, and outcome-monitoring criteria for patients aged 18–35 years.

Therapy for Post-Acne Scars and Postinflammatory Erythema

Correction of atrophic post-acne scars, primarily the boxcar and rolling morphotypes, is among the most frequent requests in the young age group and requires a pathogenetically substantiated approach oriented toward releasing fibrotic tethering and initiating controlled dermal remodeling. The clinical problem is grounded in a deficit of the collagen matrix, heterogeneity of dermal architecture, and fixation of the scar base to underlying structures, which determines persistent textural irregularity and limits the effectiveness of strategies that are exclusively hydrating (see Table 3).

Table 3. What to choose and how to manage: protocols by leading clinical phenotype (compiled by the author based on [29, 30]).

Clinical Task (18–35)	First-Line Product	Technique (preferred)	Course / Intervals	Combinations (as indicated)	Objective Metrics for Monitoring	What to Avoid / Risks
Post-acne atrophic scars (rolling/ boxcar)	PDRN/PN	Intradermally into the defect zone plus or minus subcision in the presence of tractional tethering	4–5 procedures, 14–21 days	Microneedling / dermapen in staged sessions	Relief assessment with photo standardization, profilometry / texture analysis, erythema index	Pure high-concentration hyaluronic acid in the setting of active inflammation; risk of flare in active acne
Post-inflammatory erythema / stagnant spots	PDRN/PN or mesotherapy with an anti-inflammatory vector	Superficial-to-mid nappage / papules with a small volume	3–5 procedures, 2–3 weeks	LED / vascular protocols if available, gentle peels	Erythema index, tone uniformity, photographs under identical lighting	Aggressive techniques in patients with high vascular reactivity
Dehydration, fine wrinkle network	Native hyaluronic acid	Micropapules in the mid-dermis	2–3 procedures, 3–4 weeks	Skin boosters for maintenance at 6–9 months	Corneometry / hydration, TEWL, elasticity	Volume or concentration overload leading to edema and papules

Fatigued morphotype plus pastosity	PDRN/PN or amino acid complexes	Cannula / sparse entry points, low traumaticity	3–4 procedures, 2–4 weeks	Microcirculatory mesotherapy components	Puffiness assessment by photographs, density / tone, subjective freshness	Dense hyaluronic-acid products in zones prone to edema
Periorbital dark circles of vascular type	PDRN/PN or specialized mesotherapy for the periorbital area	Ultra-superficial, minimal volumes	3–4 procedures, 2–3 weeks	Lymphatic drainage skincare protocols	Photographs plus color / erythema index if available	Dense hyaluronic acid fillers: risk of malar bags and prolonged pastosity

A polynucleotide-based protocol (PDRN) is considered the foundational injectable regimen, administered as a course of 4–5 procedures at 14–21 day intervals. The injection technique varies depending on defect topography: the product is deposited directly into the scar base, or delivered in a subcisional manner with simultaneous mechanical release of fibrotic bands, which is particularly relevant for rolling scars. Clinical observations indicate a more pronounced and durable improvement in texture leveling when PDRN is used compared with hyaluronic acid in the longer term, a finding attributed to the predominance of biostimulatory and reparative effects over short-term volumetric correction [29].

Enhancement of outcomes is achieved by combining treatment with microneedling, including in the format of fractional mesotherapy (Dermapen). Multiple controlled microinjuries initiate a wound-healing cascade with activation of growth factors, strengthening neocollagenesis, and reorganization of the extracellular matrix, while application of sterile mesococktails increases the availability of active components within the treated zone. This combination makes it possible to address both superficial heterogeneity and dermal deficit simultaneously, improving microrelief uniformity and skin density while maintaining a manageable rehabilitation profile [30, 40].

Additionally, the staged principle of managing atrophic scars is clinically significant: primary control of active inflammation and prevention of new acne lesions, followed by mechanical release of tethering (when fixation is present), and only then sequential biostimulation to build the dermal matrix. Such structuring of therapy reduces the risk of a recurrent inflammatory background capable of leveling out stimulatory procedural effects, and it increases outcome reproducibility, particularly in the presence of multiple scar fields with varying depth and defect geometry.

Prevention of Photoaging

In patients with regular insolation exposure, preliminary stabilization of the skin's oxidative status is advisable, because ultraviolet radiation induces a cascade of free-radical damage, increases inflammatory reactivity, and contributes to the development of dyschromias. In this clinical setting, the use of antioxidant priming is justified, aimed at reducing the intensity of lipid peroxidation, maintaining the functional integrity of the epidermal barrier, and increasing the resistance of the melanocytic component to photostimulation.

A practically applicable protocol is considered to include mesotherapy with antioxidant and metabolic components (vitamin C, glutathione, succinic acid) approximately 2 weeks before the anticipated insolation, followed by a course of biorevitalization after the period of active exposure to restore hydration and correct post-stress changes of the dermis [30]. Such sequencing makes it possible to separate objectives: at the preparatory stage, to minimize the photodamage cascade and the risk of hyperpigmentation; at the restorative stage, to normalize water balance, improve microarchitecture, and reduce the severity of post-insolation dryness.

Succinic acid (succinate) is regarded as a functionally significant component due to its influence on key links of cellular metabolism: participation in mitochondrial respiration is associated with supporting the energetic provision of reparative processes and increasing tissue stress resilience. In the context of dyschromias, succinate is described as a factor capable of reducing melanogenesis activity, which, together with the antioxidant potential of the vitamin C and glutathione system, forms a preventive effect against post-insolation pigmentation when concentrations are correctly selected, injection depth is appropriate, and procedural intervals are observed.

Correction of Dark Circles Under the Eyes

In young patients, the periorbital region is often characterized by a thin dermis and a limited volume of subcutaneous adipose tissue, as a result of which visual translucency of the vascular bed develops with a Tyndall optical effect. An additional contribution is made by high reactivity of the microcirculatory network and a tendency of the tissues toward puffiness, which renders this anatomical zone sensitive both to mechanical trauma and to hydrophilic injectable substances that can increase interstitial hydration and provoke persistent edema.

Within therapeutic regimens, priority is given to products aimed at improving dermal quality without creating additional volume. The most substantiated approach is the use of PDRN or specialized mesopreparations for the periorbital zone that include peptide complexes with lymphatic-drainage orientation and the potential to normalize microcirculation. Such approaches make it possible to increase the density

of the dermal matrix, reduce the visibility of vascular translucency, and improve the uniformity of the skin's optical properties while preserving physiologic topography and minimizing the risk of puffiness [21].

Use of dense hyaluronic-acid fillers in this region in young patients is often accompanied by prolonged edematous phenomena, including the formation or exacerbation of malar bags. This is related to the combination of HA's high hydrophilicity, limited compliance of periorbital tissues, and features of lymphatic drainage, as a result of which even a small excess deposit or superficial placement of the product can lead to persistent contour deformation. Accordingly, preference is given to methods that provide moderate dermal densification and biostimulation with minimal volumetric effect, as well as to injection techniques that reduce the likelihood of superficial product displacement and post-procedural edema.

CHAPTER 5. RESEARCH FINDINGS: COMPARATIVE ANALYSIS OF EFFICACY (2020–2024)

A comparison of contemporary clinical data indicates that polynucleotides demonstrate more pronounced and more durable efficacy than hyaluronic acid in the correction of scar-related changes and in improving skin-quality parameters. In a randomized, double-blind study [31], PDRN and hyaluronic acid were compared within periorbital rejuvenation protocols, enabling evaluation of both early and delayed effects of the intervention.

On the subjective satisfaction assessment measured by a visual analog scale (VAS), hyaluronic acid was characterized by a faster attainment of peak values at week 4, which predictably corresponds to immediate tissue filling and a hydration-driven effect. At the same time, by week 16 a clear decline in scores was recorded, reflecting the limited duration of a predominantly symptomatic impact. In contrast, PDRN use was accompanied by a gradual increase in satisfaction, with peak values forming in the 10–12 week interval and subsequent stabilization at a plateau level through week 28, consistent with the kinetics of biologically mediated reconstruction of the dermal matrix and reparative processes.

Analysis using the GAIS (Global Aesthetic Improvement Scale) confirmed the advantage of polynucleotides at the delayed assessment point: at week 16, the degree of improvement in the PDRN group was statistically significantly higher than in the hyaluronic acid group (p=0.0398) [31]. The findings are conceptually consistent with differences in mechanisms of action: PDRN is associated with induction of regenerative responses and tissue remodeling, whereby the clinical effect unfolds over time and is characterized by greater durability; hyaluronic acid, while providing a rapid visual response, more strongly reflects a temporary masking component through volumetric and hydration effects. To illustrate the dynamics of efficacy and market trends, Figure 1 is presented below.

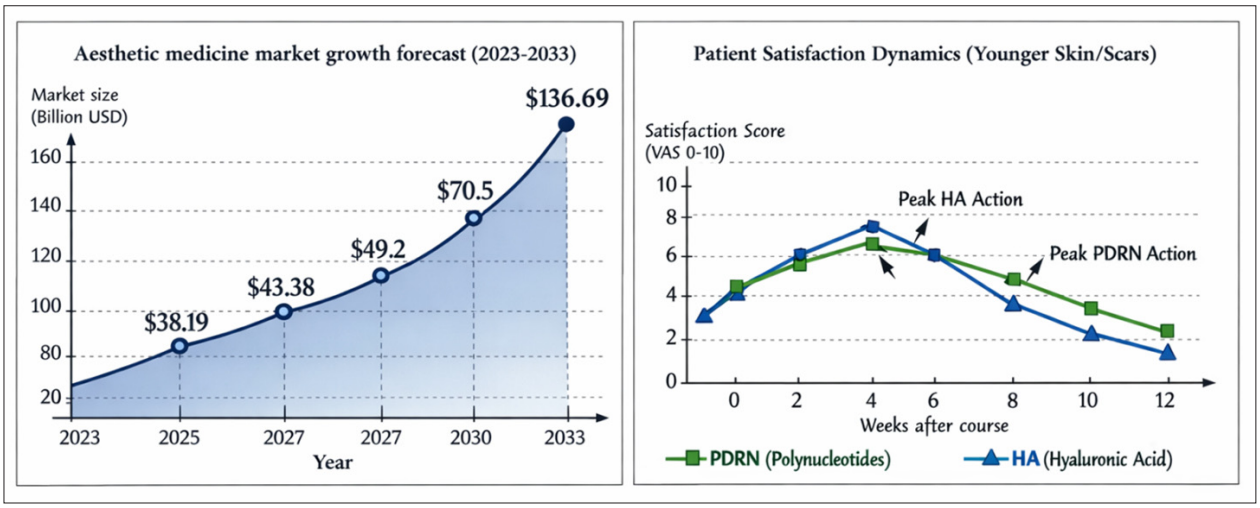

Figure 1. Forecasted Growth of the Aesthetic Medicine Market (in billion USD) (compiled by the author based on [31]).

The comparative results of the clinical-data analysis for 2020–2024 demonstrate fundamentally different efficacy profiles for hyaluronic acid and polynucleotides (PDRN/PN): hyaluronic acid provides a faster early visual response (peak subjective satisfaction by approximately week 4), driven predominantly by a hydration and volumization, symptomatic mechanism; however, by week 16 the effect predictably diminishes. In contrast, polynucleotides are characterized by a delayed but more durable clinical outcome (progressive increase through weeks 10–12 followed by a plateau through week 28), which is consistent with biologically mediated regeneration and remodeling of the dermal matrix and is supported by a statistically significant advantage on GAIS at week 16 (p=0.0398) compared with hyaluronic acid, particularly for tasks involving correction of scar-related changes and improvement of skin-quality parameters.

When instrumental approaches are used, including wrinkle profilometry, following a course of classical mesotherapy only a moderate change is often recorded in indices characterizing skin texture. At the same time, the proportion of positive subjective responses remains extremely high and in many

studies exceeds 90% [32]. This phenomenon is attributed to the fact that a substantial share of perceived improvements pertains to characteristics that are insufficiently sensitive to standard device-based quantification: more pronounced skin radiance, a subjective sense of freshness, reduced reactivity, and visible leveling of skin tone are reported.

Table 4. Safety: Expected Reactions, Red Flags, and Prevention (compiled by the author based on [31]).

Adverse Event	Typical Time of Onset	Usual Duration	What to Do (briefly)	Prevention (key)	Red Flags (urgent)
Erythema / soreness / papules	Immediately	24–72 h (papules last longer with viscous products)	Local cold application, gentle regimen, barrier-supportive skincare	Correct depth and volume, less trauma	Increasing pain, progressive swelling, fever
Microhematomas	Immediately / within the first hours	3–10 days	Arnica / cold application, patient counseling	Cannula in high-risk zones, discontinuation of anticoagulants for medical indications	Extensive hematoma with progression of pain
Infection / abscess / pyoderma	24–72 h and later	Variable	Medical examination, therapy according to clinical presentation	Strict asepsis, hands-off for 24 h	Pus, fluctuance, systemic symptoms
HSV reactivation	24–96 h	7–14 days	Antiviral therapy according to standards	Prophylaxis in patients with a history of HSV	Rapid spread of eruptions, pain, temperature elevation
Nodules / granulomas (rare)	Weeks to months	Variable	Differentiate: technique-related versus hypersensitivity	Do not inject dense or viscous products superficially, minimize mixing of cocktails	Progressive nodules, redness, pain
Vascular complications (extremely rare, but critical)	Immediately	-	Immediate emergency protocol	Knowledge of dangerous zones, aspiration, small volumes, correct plane	Blanching / livedoid patterning, sharp pain, visual disturbance

Complications with a specific clinical profile include infectious processes, including pyoderma, abscess formation, and reactivation of herpes simplex virus. Their occurrence correlates predominantly with breaches of asepsis and antisepsis, as well as with injections performed outside medical infrastructure, including domestic settings. Granulomatous reactions and nodule formation are described as rare events (less than 1%) and are more often associated either with overly superficial administration of high-density products used in biorevitalization, or with delayed-type hypersensitivity mechanisms to components of injectable mixtures (in particular, zinc compounds or silicon dioxide) [34, 36]. Vascular complications such as embolism and ischemia are generally uncharacteristic of mesotherapy due to the liquid consistency of the solutions used; however, the literature describes episodes following administration of substantial volumes of stabilized hyaluronic acid into anatomically high-risk zones, including the glabella and the nasal region. Allergic reactions also retain clinical relevance: anaphylactoid and anaphylactic responses to B-group vitamins are possible, as are reactions to protein impurities when biomaterials such as PDRN or collagen are insufficiently purified.

In younger populations, a distinct risk profile is recognized, especially among patients with acne. Injectable interventions can provoke inflammatory flares, facilitated by needle-induced microtrauma and by the creation of a hydrophilic milieu after hyaluronic acid administration, which may increase the likelihood of dissemination of Cutibacterium acnes. In the presence of papulopustular elements, biorevitalization is considered contraindicated until stable remission is achieved; in certain clinical scenarios, the need for prophylactic adjunctive use of topical or systemic antibacterial agents is discussed.

It is also noted that fatal outcomes cited in the statistics [34] are, in the overwhelming majority of episodes (approximately 90%), associated not with medically appropriate procedures, but with the activities of unlicensed operators, the use of counterfeit or non-injectable substances (including liquid silicone and technical oils), and the performance of manipulations in nonmedical, domestic conditions.

CHAPTER 6. COMBINED MODALITIES

In the context of increasing clinical effectiveness while simultaneously reducing the number of clinic visits, which aligns with Generation Z's pronounced demand for speed and practical efficiency, protocols that combine procedures within a single session became widely adopted in 2024.

Combining injectable techniques with topical acid-based interventions is regarded as an option with demonstrable synergism. In practical schemes, after microneedling or mesotherapy, so-called biorevitalizing peels are applied, which include, for example, PRX-T33 and BioRePeelCl3. The formation of microchannels as a consequence of needle or Dermapen exposure creates conditions for more pronounced transdermal delivery of peel components, including trichloroacetic and kojic acids, into deeper skin layers. In parallel, the injected formulations serve as substrate support for reparative processes induced by controlled chemical injury, thereby pathogenetically amplifying the regenerative response [35]. Clinical studies indicate that this approach is associated with more noticeable lightening of dyschromias and a reduction in pore prominence compared with use of a single modality [30].

A distinct position among combined approaches is occupied by Mesobotox, which consists of superficial intradermal administration of microdoses of botulinum toxin in substantial dilution, most often in saline or in combination with mesotherapeutic formulations. The key therapeutic vector is reduction of cholinergic stimulation of sweat and sebaceous glands, as well as gentle relaxation of superficial muscle fibers functionally linked to the skin. This produces clinically meaningful reduction in oiliness (seboregulation), visual pore tightening, and smoothing of a fine-wrinkled pattern, yielding a pronounced microrelief-leveling effect while preserving physiologic facial expressiveness [37]. In its clinical profile, the technique is especially justified for oily skin and facial hyperhidrosis in young patients.

CHAPTER 7. POST-PROCEDURAL CARE

The quality of post-procedural management can determine up to 50% of the final clinical outcome and simultaneously serves as a key factor in preventing adverse events, first of all postinflammatory hyperpigmentation (PIH). The greatest vigilance is required in patients with Fitzpatrick phototypes III–IV, because heightened melanogenesis reactivity in this group increases the likelihood of persistent dyschromias when restrictions are not observed.

During the first 24 hours after the intervention, a strict hands-off regimen is warranted, with minimization of any mechanical impact. Contact with tap water is excluded; preference is given to cleansing with sterile normal saline or chlorhexidine. Decorative cosmetics and touching the facial skin are also inadmissible, because the early period is characterized by microinjuries and microchannels that require sealing to reduce the risk of bacterial contamination and an inflammatory cascade [38].

Photoprotection is regarded as a required component of accompaniment throughout the entire course and for at least 2 weeks after the last procedure. Use of broad-spectrum products with SPF 30–50+ reduces the likelihood of PIH, because the inflammatory response to trauma is accompanied by functional hypersensitivity of melanocytes to ultraviolet radiation and an increased tendency toward uneven pigmentation [39].

For a period of 3–5 days, exclusion of factors that intensify vasodilation, edema, and irritation is recommended: thermal loads (sauna, steam room, hot baths), intense physical activity, during which sweat additionally sensitizes traumatized skin, as well as alcohol consumption, which contributes to increased puffiness and microcirculatory disturbances [41].

Within cosmeceutical support, a temporary refusal from potentially irritating and keratolytically active components is advisable, including retinoids, AHA and BHA acids, and mechanical exfoliants, for approximately 5–7 days, to prevent additional barrier-function damage and prolongation of erythema. As preferred support, reparative-profile products are indicated, containing panthenol, hyaluronic acid, extracts of Centella asiatica, or epidermal growth factor (EGF), which facilitates barrier stabilization and accelerates restorative processes [42].

CONCLUSION

A synthesis of the 2024 body of publications indicates the consolidation of mesotherapy and biorevitalization as key components of aesthetic-correction algorithms for young patients (18–35 years). The strengthening of the prejuvenation concept has driven a reorientation of clinical goals and efficacy criteria: emphasis has shifted away from volumization and hypercorrection toward nuanced optimization of qualitative skin parameters (skin quality), including tone uniformity, microrelief, hydro-balance, and markers of inflammatory reactivity.

A clinically pivotal principle is strict pathogenetic differentiation in selecting both the product and the technique. In post-acne scars and concomitant inflammatory changes, polynucleotides (PDRN) assume priority, demonstrating a pronounced regenerative potential and a more durable trajectory of tissue restoration than hyaluronic acid. When signs of dehydration and reduced turgor predominate, classical biorevitalizants remain the optimal option, providing a rapid hydration response, whereas in preventive protocols the use of skin boosters is justified, oriented toward maintaining dermal-matrix parameters and achieving prolonged improvement in skin quality.

The overall safety profile of these modalities remains high, provided that procedures are performed in strict accordance with medical standards and are accompanied by appropriate post-procedural management. In young patients, clinical vigilance should be shifted toward risks specific to this population: the potential to provoke acne flares and the tendency toward postinflammatory hyperpigmentation, especially in the presence of factors associated with heightened melanogenic reactivity.

The forward trajectory of aesthetic correction for young skin is taking shape in the direction of combined protocols

integrating injectable modalities with chemical peels and or device-based technologies. Such regimens make it possible to intensify the visible outcome, including achieving a pronounced effect of skin translucency and uniformity (glass skin), while simultaneously reducing recovery time and minimizing social maladaptation.

As a result, injectable approaches in young age are viewed not only as a means of targeted correction of aesthetic imperfections, but also as an element of a long-term strategy for preserving the functional and structural potential of the skin, consistent with the contemporary model of proactive aesthetic medicine and prevention-oriented beauty.

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