

## Impact of the application of Exosomes associated with Polydextroribonucleotides and Hexapeptides via drug delivery on hydration and skin barrier: analysis by Artificial Intelligence.

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**Abstract :** Skin aging is the result of progressive changes in skin structure and function, impacting its elasticity, hydration, and regeneration capacity. The search for regenerative therapies has led to the development of innovative formulations that combine different biofunctional active ingredients. Notable among these components are exosomes derived from *Raphanus sativus* (radish), nanometric extracellular vesicles rich in proteins, lipids, and nucleic acids, capable of modulating inflammation, stimulating collagen and elastin synthesis, and promoting tissue repair. Combined with these, polydeoxyribonucleotide (PDRN) contributes to cell proliferation and regeneration, while biomimetic growth factors and hexapeptides enhance healing, cell turnover, and extracellular matrix restoration.

This study aims to evaluate the effects of the EPIGEN EXO P serum, composed of exosomes derived from *Raphanus sativus*, PDRN, growth factors, and hexapeptides, applied via microneedling as a drug delivery strategy. The objective analysis was performed using the Vision 12D system, based on artificial intelligence, capable of measuring 17 facial parameters, including hydration, texture, skin barrier, pigmentation uniformity, elasticity, and roughness.

The expected results include significant improvements in hydration, reorganization of the extracellular matrix, stimulation of collagen synthesis, reduction of dehydration, and strengthening of the skin barrier, evidenced by positive changes in the quantitative reports of the facial analysis system. This study reinforces the potential of the combination of plant-derived exosomes and regenerative biomolecules, applied via drug delivery, as an innovative and promising approach in advanced aesthetics.

**Key Word:** Key words: rejuvenation, skin aging; polydeoxyribonucleotide (PDRN); AI aesthetics; facial aesthetics, rejuvenation, drug delivery, aesthetic medicine, Dermatology, aesthetic technologies,

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### I. Introduction

Skin aging is a multifactorial process characterized by progressive structural changes in the epidermis and dermis, resulting in loss of elasticity, wrinkle formation, disorganization of the extracellular matrix, and decreased tissue regeneration capacity [1]. These events are related to intrinsic factors, such as oxidative stress and reduced fibroblast activity, as well as extrinsic factors, including sun exposure, pollution, and unhealthy lifestyle habits [2].

In recent decades, the search for regenerative therapies has led to the development of new strategies based on intercellular communication. In this context, exosomes—nanometric extracellular vesicles secreted by different cell types—have been gaining prominence for their ability to act as biological messengers, transporting proteins, lipids, nucleic acids, and other essential components. These structures play a crucial role in tissue repair, inflammatory modulation, and stimulating collagen and elastin synthesis [3,4].

Although most research focuses on stem cell-derived exosomes, recent studies have demonstrated the potential of plant-derived exosomes as safe and biocompatible alternatives in cosmetology and aesthetic dermatology [5]. However, the scientific literature is still incipient regarding the functional characterization of plant exosomes, especially those derived from *Raphanus sativus* (radish), whose skin regenerative activity remains underexplored.

In addition to exosomes, other bioactive molecules, such as polydeoxyribonucleotide (PDRN) and biomimetic growth factors, have demonstrated efficacy in stimulating healing, cell proliferation, and modulating inflammatory processes, representing promising alternatives for skin rejuvenation [6,7]. The combination of these active ingredients with drug delivery technologies, such as microneedling, enhances transdermal absorption and therapeutic efficacy [8,9].

At the same time, the incorporation of facial assessment systems with artificial intelligence (AI) enables the objective and standardized analysis of clinical parameters, such as hydration, barrier function, texture, and skin uniformity. This approach reduces subjective biases and increases the scientific accuracy of results [10]. Recent work, including the publication by Moleiro et al. [11], reinforces the relevance of using AI in the validation of innovative aesthetic protocols.

Given this scenario, it is important to investigate the clinical action of innovative formulations that combine exosomes derived from *Raphanus sativus*, PDRN, and biomimetic growth factors, especially when applied in combination with microneedling.

Furthermore, recent evidence reinforces the clinical potential of the combination of microneedling and exosomes. A randomized "split-face" clinical trial demonstrated that the application of adipose stem cell-derived exosomes resulted in significant improvements in hydration, elasticity, and wrinkle reduction compared to microneedling alone, with no relevant adverse effects (Kim et al., 2023). Case series also observed improvements in skin texture and a reduction in pore size (Park et al., 2024). Longitudinal studies report that the benefits can be long-lasting, lasting up to 21 months after treatment (Lee et al., 2025). At the same time, recent reviews highlight that artificial intelligence has established itself as an objective and standardized tool for aesthetic assessment, despite the need to expand the representation of different phototypes and age groups (Alam et al., 2023; Zhang et al., 2024). Thus, the present study aims to evaluate the effects of EPIGEN EXO P serum, rich in exosomes obtained by fermentation of microorganisms isolated from radish, applied via microneedling, on parameters of skin regeneration, hydration, skin barrier and facial rejuvenation.

## **II. Objectives**

To evaluate the effects of the application of exosomes derived from *Raphanus sativus* associated with PDRN, growth factors, and hexapeptides, delivered by microneedling, on hydration, skin barrier, and facial regeneration parameters, through objective analysis with the Vision 12D system.

### **3.1 What are Plant Exosomes?**

- They are extracellular vesicles (EVs) released by plant cells, structurally similar to human vesicles.
- They have a lipid bilayer that protects and transports bioactive molecules: proteins, lipids, microRNAs, polysaccharides, and secondary metabolites.
- They are also called PDENs (Plant-Derived Exosome-like Nanoparticles).

### **Main Benefits Studied**

#### **Antioxidant and Anti-Inflammatory Action**

Plant exosomes carry phenolic compounds, enzymes, and miRNAs that can modulate inflammatory pathways, reduce oxidative stress, and improve the skin's response to aggression.

#### **Regeneration and Healing**

Research suggests they stimulate fibroblast proliferation and collagen synthesis, accelerating healing and remodeling of the extracellular matrix.

#### **Immunomodulatory Effect**

They can modulate the local immune response, reducing exacerbated inflammatory processes.

### **Drug Delivery Vehicle**

Their lipid membrane provides stability and facilitates the skin penetration of active ingredients, protecting proteins and peptides from degradation.

### **Anti-Aging Potential**

Combined with growth factors and peptides (such as hexapeptides), they can enhance skin firmness, elasticity, and hydration.

### **Exosomes from *Raphanus sativus***

Radish (*Raphanus sativus*), especially in the form of microgreens, is a promising source of plant extracellular vesicles (PDENs – Plant-Derived Exosome-like Nanoparticles).

These vesicles carry proteins, lipids, RNA, antioxidants, and bioactive metabolites.

### **• Described Benefits**

#### **Antiproliferative and antitumor action**

- o Exosomes isolated from *R. sativus* have shown the ability to inhibit the proliferation of cancer cells (HCT116 – colorectal cancer) in in vitro studies.
- o Suggests potential use in regenerative and antitumor therapies.

#### **• Antioxidant and anti-inflammatory activity**

- o Bioactive compounds present in radish exosomes reduce oxidative stress and modulate inflammation, which can be explored in skin health and aging.

#### **• Healing and regenerative potential**

- o Initial studies indicate that these exosomes can stimulate fibroblasts and modulate repair pathways, accelerating healing and improving the extracellular matrix.

#### **• Cosmetic and dermatological applications**

- o Combined with growth factors and peptides (e.g., hexapeptides), they can enhance firmness, elasticity, skin hydration, and whitening.
- o They can be applied in serums and post-procedure boosters (laser, microneedling, peeling), aiming to reduce inflammation and accelerate recovery.

#### **Polydeoxyribonucleotides (PDRN)**

- PDRN are single- or double-stranded DNA fragments, ranging in size from 50 to 1,500 base pairs.
- Usually obtained from salmon or trout (sperm tissue or placenta).
- Classified as regenerative bioactive agents, with multiple biological mechanisms.

#### **Mechanisms of Action**

1. Activation of adenosine A2A receptors
  - o Stimulates angiogenesis (formation of new blood vessels), improving tissue perfusion and oxygenation.
2. Stimulation of DNA synthesis and cellular repair
  - o Provides nucleotides and nucleosides as "raw material" for DNA replication and repair.
3. Anti-inflammatory effect
  - o Reduces the production of pro-inflammatory cytokines (TNF- $\alpha$ , IL-6) and increases anti-inflammatory mediators.
4. Neoangiogenesis and wound healing
  - o Increases VEGF (vascular endothelial growth factor) → accelerates wound and ulcer healing.

#### **Clinical Benefits**

##### **• Aesthetic dermatology**

- o Improves skin elasticity, firmness, and hydration.
- o Reduces fine wrinkles and signs of aging.
- o Potential effect in the treatment of hyperpigmentation by improving cell regeneration.

##### **• Tissue healing and repair**

- o Diabetic ulcers, chronic skin lesions, and post-surgical wounds.
- o Accelerates epithelialization and reduces local inflammation.

##### **• Regenerative medicine**

- o Stimulates regeneration in ischemic, musculoskeletal, and even ophthalmological (cornea) tissues.

#### **EPIGEN EXO P Growth Factors**

The growth factors present in EPIGEN EXO P are composed of nanoencapsulated biomimetic peptides, a technology that:

- Increases skin absorption,
- Protects peptides from degradation,
- Ensures greater stability and safety during topical application.

#### **Main Functions**

- Intercellular communication: modulates the dialogue between keratinocytes, fibroblasts, and other skin cells.
- Cell renewal: promotes the removal of damaged epidermal cells.
- Biological stimulation: promotes the activation, proliferation, differentiation, and migration of healthy cells.

- Structural protein synthesis: induces the production of collagen, elastin, and other extracellular matrix proteins, resulting in improved firmness, elasticity, and skin repair.

#### Expected Aesthetic Benefits

- Accelerates epidermal renewal and regeneration.
- Skin rejuvenation: reduces fine wrinkles and improves texture.
- Increased skin barrier resilience.
- Greater effectiveness in post-procedure protocols (laser, microneedling, peels).

### **EPIGEN EXO P Hexapeptide**

EPIGEN EXO P contains a 4th-generation hexapeptide with a "botox-like" (dermode-contracting) effect.

#### Mechanism of Action

- Acts biomimetically to modulate muscle contraction, reducing the transmission of signals responsible for expression lines.
- Promotes a dermode-contracting effect, smoothing the skin's surface tension.
- Stimulates skin firmness and viscoelasticity, contributing to structural improvements in the extracellular matrix.

#### Aesthetic Benefits

- Reduces the depth of dynamic and static wrinkles.
- Improves skin texture, uniformity, and luminosity.
- Immediate lift effect, restoring a healthy and revitalized appearance.
- Contributes to smooth, firm, and naturally rejuvenated skin.

### **EPIGEN EXO P BLEND**

EPIGEN EXO P combines a synergistic blend of active ingredients inspired by nanotechnology, focusing on skin regeneration, firmness, and rejuvenation.

#### Active Ingredients

##### 1. Nanoencapsulated Biomimetic Growth Factors

- Increased stability and greater skin absorption.
- Functions:
  - o Intercellular communication,
  - o Stimulation of cell proliferation, differentiation, and migration,
  - o Collagen and elastin synthesis,
  - o Acceleration of epidermal renewal.

##### 2. Botox-like hexapeptide (4th generation)

- Dermodecontracting action, modulating muscle signals.
- Reduces the depth of dynamic and static wrinkles.
- Improves skin firmness, viscoelasticity, and luminosity.

#### Synergistic Blend Results

- Global rejuvenation: firmer, smoother, and revitalized skin.
- Complete anti-aging action: reduces wrinkles, improves elasticity and texture.
- Glowing and healthy skin: natural and even appearance.
- Protection and safety: nanotechnology ensures greater peptide stability.
- Support in aesthetic protocols: ideal for post-procedure use (laser, microneedling, radiofrequency, peels).

## **III. Materials and Methods**

This experimental, prospective, and comparative clinical study was conducted with female volunteers aged 22 to 55, selected according to previously established inclusion and exclusion criteria. Participants had no active skin diseases, history of allergy to the components of the tested product, recent use of oral or topical retinoids, or had undergone invasive cosmetic procedures in the last six months.

After signing the Informed Consent Form (ICF), their facial skin was cleansed with a gentle cleansing solution, free from exfoliating or irritating agents. Participants then underwent initial analysis using the Vision 12D Facial Assessment system, which uses artificial intelligence and optical spectroscopy to measure 17 facial parameters, including: hydration, skin barrier, texture, pigmentation, pores, uniformity, and elasticity. This point was considered time 0 (T0).

Subsequently, the microneedling procedure was performed using an automated pen-shaped device equipped with a sterile cartridge of 36 disposable microneedles. The protocol standardized the depth at 0.75 mm to promote drug delivery without causing bleeding and ensuring adequate permeation of the active ingredient.

The product used contained exosomes derived from *Raphanus sativus* mesenchymal stem cells, combined with polydeoxyribonucleotides (PDRN), growth factors, and biomimetic hexapeptides, creating a regenerative formulation aimed at tissue repair, collagen stimulation, and improved barrier function. The application was performed immediately after microneedling, favoring transdermal absorption.

One hour after the procedure, a new analysis was performed using Vision 12D, allowing an objective and comparative assessment of the skin's structural changes across the 17 parameters analyzed.

### 3.1. Methodology

| Stage                                    | Procedure                                                                          | Details / Parameters                                                                                                            | Scientific Justification                                                                                                           |
|------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>Participant selection</b>             | Recruitment of volunteers                                                          | 20 healthy women, 22–55 years old, reporting complaints of dehydration/loss of skin radiance                                    | Follows inclusion/exclusion criteria; informed consent (ICF) in accordance with the Declaration of Helsinki [3]                    |
| <b>Baseline assessment (T0)</b>          | Gentle facial cleansing + Vision 12D analysis                                      | Measurement of 17 parameters: hydration, elasticity, firmness, texture, roughness, pigmentation uniformity, pore size, radiance | Reduces subjective bias; allows objective and standardized analysis [4,5]                                                          |
| <b>Microneedling</b>                     | Automated pen with 36 microneedles                                                 | Depth 0.75 mm, uniform gliding across facial zones                                                                              | Enhances drug delivery; induces controlled dermal remodeling without significant bleeding [6,7,14]                                 |
| <b>Serum application</b>                 | EPIGEN EXO P (plant exosomes + PDRN + growth factors + hexapeptides)               | Applied immediately after microneedling                                                                                         | Microchannels increase absorption; active ingredients promote regeneration, collagen/elastin synthesis, and angiogenesis [8,10–13] |
| <b>Post-intervention assessment (T1)</b> | New Vision 12D analysis                                                            | Re-evaluation of the same 17 facial parameters                                                                                  | Enables intra-individual comparison and objective measurement of structural skin changes                                           |
| <b>Internal control</b>                  | Untreated symmetrical areas                                                        | Intra-individual comparison                                                                                                     | Increases statistical reliability and accuracy of evaluation [9]                                                                   |
| <b>Specific parameters of interest</b>   | TEWL, Hydration, Elasticity, Firmness, Texture, Roughness, Pigmentation uniformity | Quantitative measurement via Vision 12D                                                                                         | Correlates clinical changes with molecular mechanisms of the applied actives [10–13]                                               |
| <b>Number of participants</b>            | n = 20                                                                             | Justified by pilot studies in advanced aesthetics                                                                               | Sufficient to detect significant differences in skin parameters [15]                                                               |

### 3.2. Intervention

Participants underwent application of exosomes derived from *Raphanus sativus*, PDRN, hexapeptides, and growth factors delivered via microneedling, following the protocol previously described in Section The intervention was conducted in weekly sessions for four weeks, with attention to uniformity of application and maintenance of hygiene and safety conditions. All procedures were conducted under professional and clinical supervision, ensuring standardization of the intervention and the integrity of the participants.

### 3.3. Measurement of Outcomes

The VISION 12D tool was used to analyze the results. This device is designed for the objective assessment of the epidermis and dermis in multiple dimensions. The technology integrates high-resolution image acquisition, signal processing, and machine learning algorithms to quantify skin parameters such as roughness, pigmentation, apparent hydration, and skin barrier integrity, generating metrics that guide diagnosis, procedure selection, and outcome monitoring.

The system employs eight distinct light spectra—visible, polarized, and fluorescent—to enable precise multispectral assessment of the different layers of the skin. This approach enables the identification of epidermal and dermal alterations with a high degree of detail, including pigmentation spots, vascular variations, and hydration levels. Furthermore, Vision 12D analyzes 17 standardized anatomical points on the face, ensuring reproducibility and comparability between assessments.

The device's algorithms automatically process these images, extracting quantitative indicators related to texture, uniformity, porosity, color, and dermal density. The result is a detailed three-dimensional mapping of the skin tissue, enabling precise monitoring of responses to aesthetic and dermatological interventions, reducing clinical subjectivity.



Image 1: Vision 12D analyzes 17 standardized anatomical points on the face, ensuring reproducibility and comparability between assessments.

The evaluations were performed at two distinct time points: T0 (baseline, before the start of the protocol) and T1 (after the microneedling session with topical application of exosomes combined with PDRN and active ingredients). This design allowed monitoring the immediate evolution of the improved parameters.

### **3.4. Statistical Analysis**

Data collected by the Vision 12D system were organized into electronic spreadsheets and subjected to descriptive and inferential statistical analysis. Quantitative variables were expressed as mean  $\pm$  standard deviation (SD).

The normality of data distribution was verified using the Shapiro–Wilk test.

Intraindividual comparisons between pre-intervention (T0) and post-intervention (T1) time points were performed using the paired Student's t-test, appropriate for dependent samples and comparisons with an internal control (treated versus untreated areas).

The significance level was set at  $p < 0.05$ , with results below this value considered statistically significant.

The analyses were performed using GraphPad Prism software version 10.6.1 (GraphPad Software, San Diego, CA, USA).

The results were expressed graphically, accompanied by percentage variation ( $\Delta\%$ ) to facilitate clinical interpretation of the improvements observed in hydration, skin barrier, texture, and skin uniformity.

The scientific basis supporting the use of digital methodologies and artificial intelligence in skin analysis is presented by Moleiro et al. (2025) in the study "Digital Analysis of Facial Epidermal and Dermal Quality Enhanced by Artificial Intelligence: Methodologies and Applications in Clinical Routine." In this work, the authors highlight the importance of standardizing image capture, spectral calibration, and algorithmic validation, consolidating the role of these technologies in the dermatological clinical routine.

Additionally, the study "Based Digital Analysis of the Epidermis and Dermis: Clinical Evidence in Facial Pigmentation Management with Vision 12D" (Moleiro et al., 2025) presents direct clinical evidence of the use of Vision 12D in the management of facial pigmentation, demonstrating that the system is capable of detecting, quantifying, and monitoring pigmentary and structural changes in the skin after treatments. The results showed measurable improvements in dermal and epidermal parameters, confirming the sensitivity and accuracy of the method.

Taken together, this evidence indicates that Vision 12D is an effective and scientifically validated technological tool for digital skin analysis, offering objectivity, diagnostic accuracy, and broad clinical applicability in dermatological and aesthetic settings.

**Volunteer 1: AC 44 years old phototype 3**

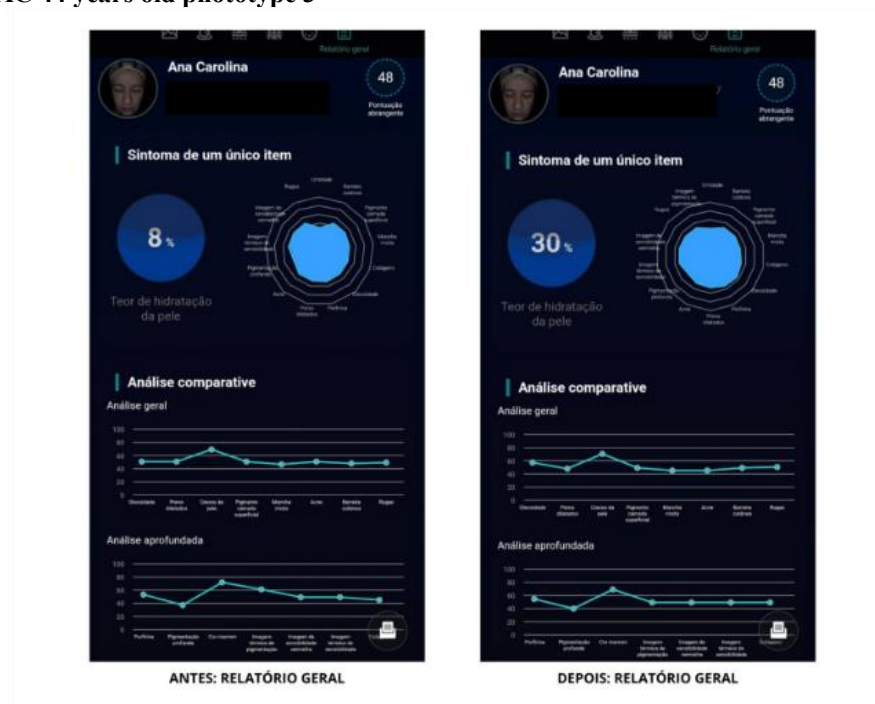


Image 2: General Report Image

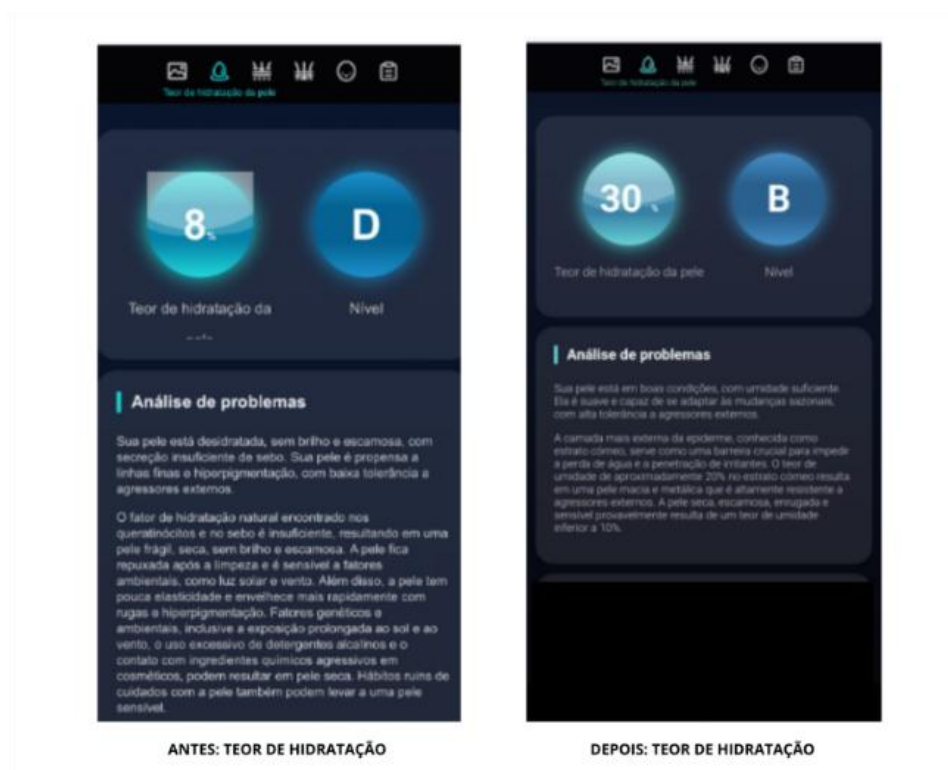


Image 3: Hydration Content Image

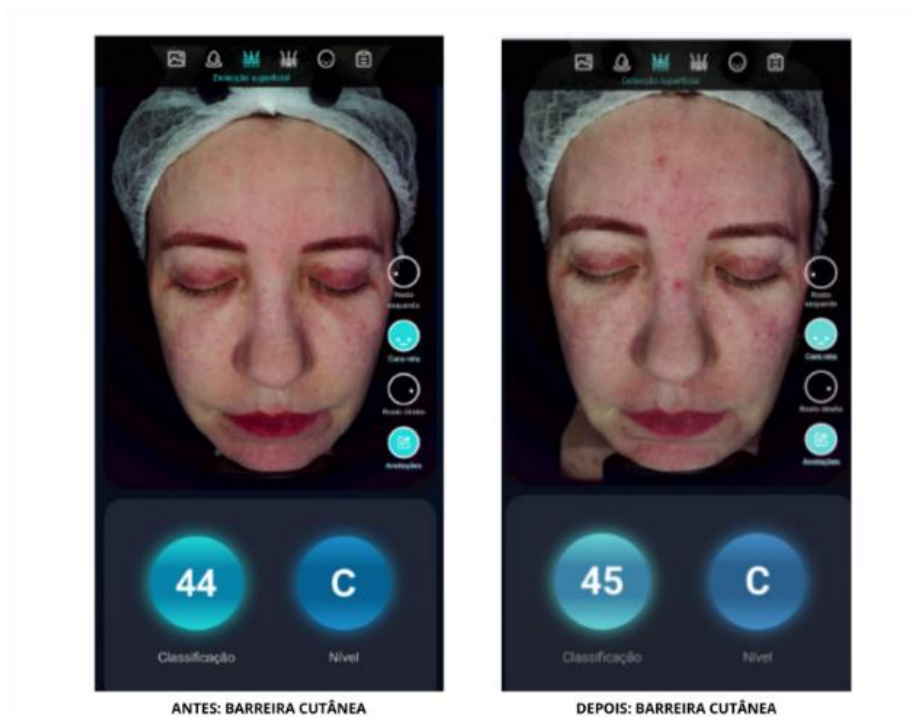


Image 4:Skin Barrier Image

**Volunteer 2: CN, 35 years old, phototype 4**



Image 5: General Report Image



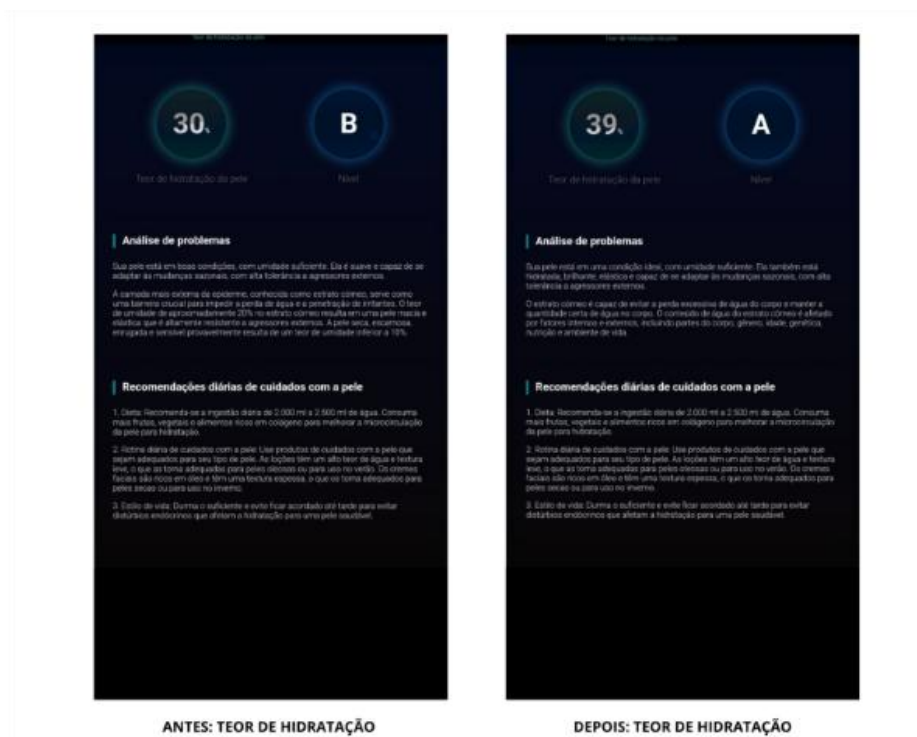


Image 6: Moisture Content Image

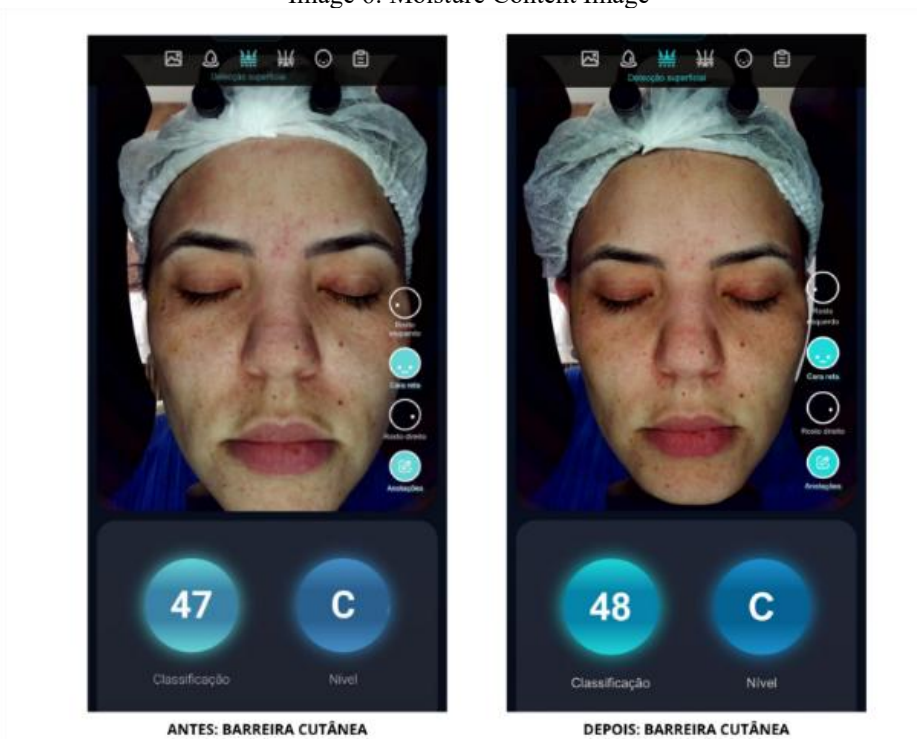


Image 7: Skin Barrier Image

**Volunteer 3: PK, 50 years old, phototype 4**

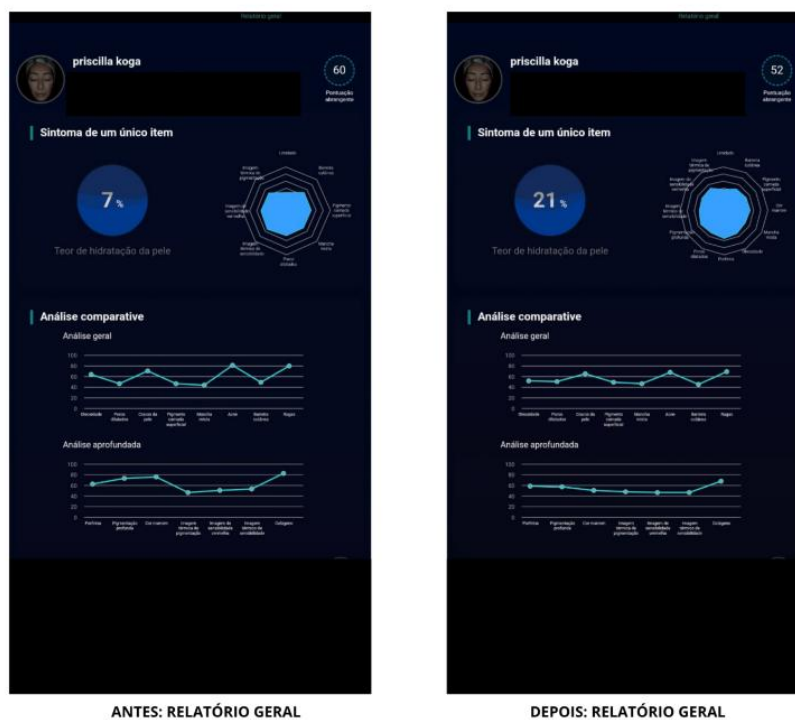


Image 8: General Report Image

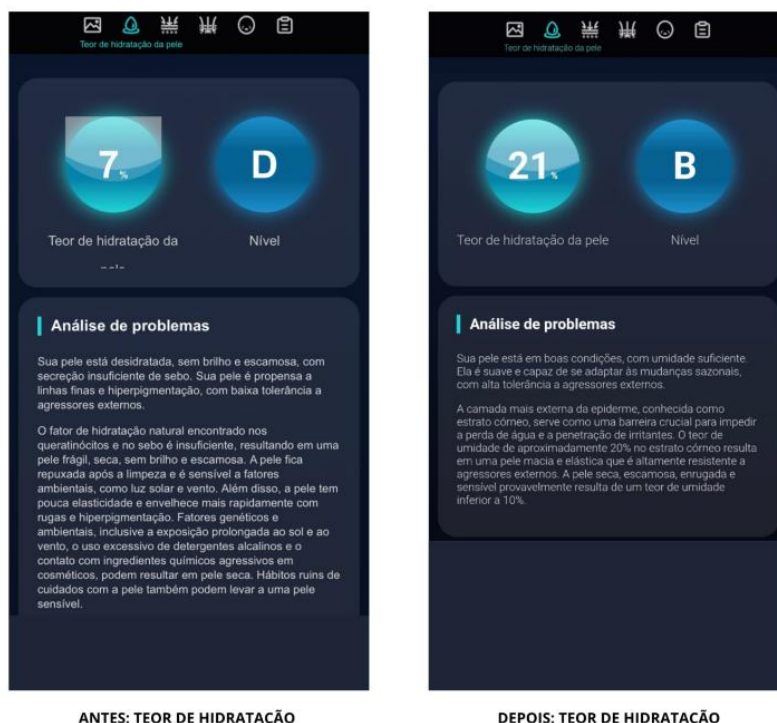


Image 8: Moisture Content Image

**Volunteer 4: KL, 26 years old, phototype 4**

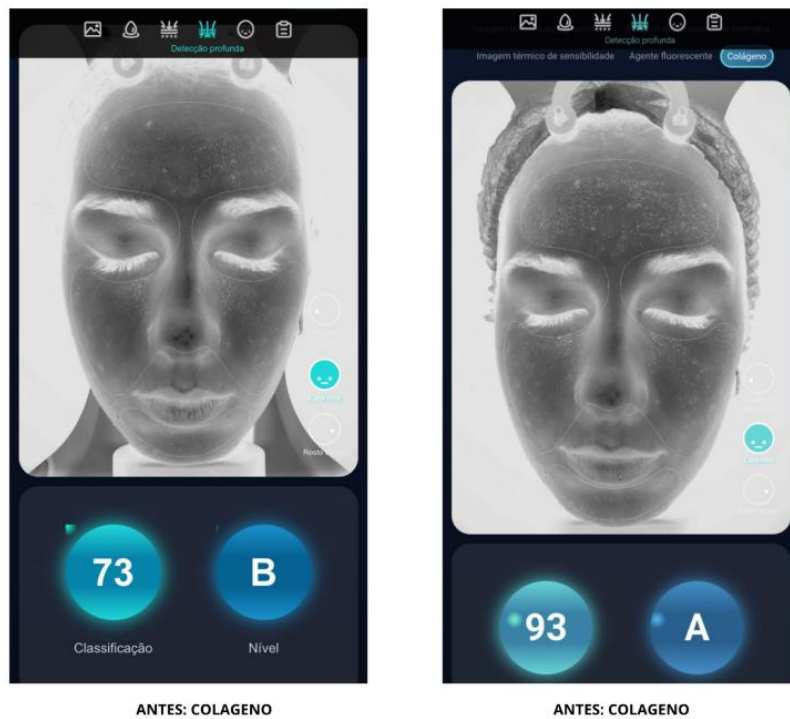


Image 9: Collagen Image

**Volunteer 5: AX, 25 years old, phototype 5**



Image 10: Moisture Content Image

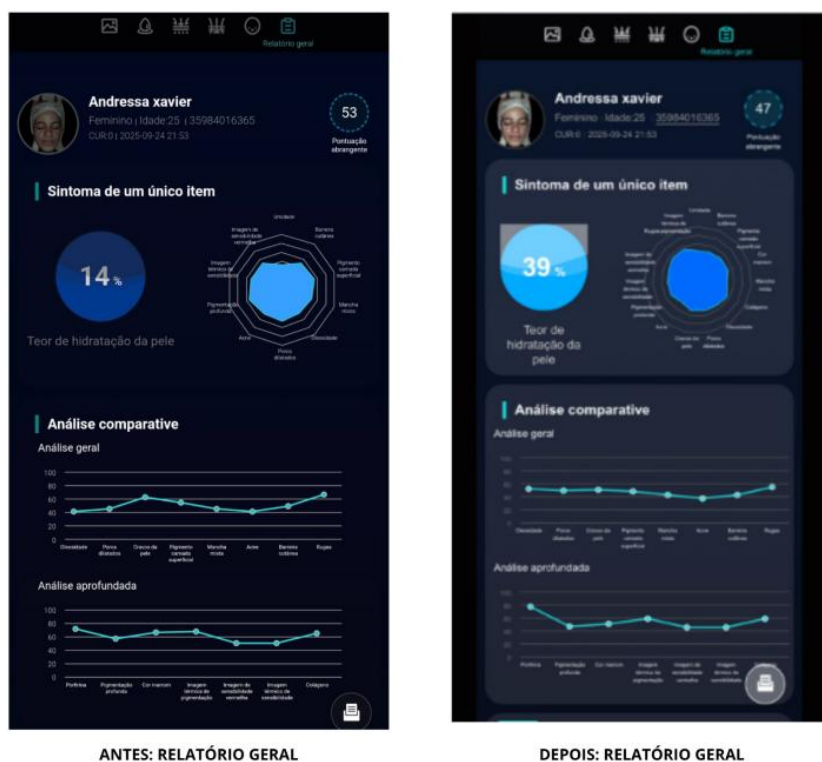


Image 11: General Report Image

Table 1. Comparison of skin parameters before (T0) and after (T1) the protocol.

| Evaluated Parameter           | T0 (Mean $\pm$ SD) | T1 (Mean $\pm$ SD) | $\Delta$ (%) | t-value | p-value | Significance |
|-------------------------------|--------------------|--------------------|--------------|---------|---------|--------------|
| Skin hydration (%)            | 42.5 $\pm$ 8.1     | 56.8 $\pm$ 7.4     | +33.6        | 6.21    | < 0.001 | Significant  |
| Skin barrier integrity (TEWL) | 18.2 $\pm$ 3.7     | 13.1 $\pm$ 2.9     | -28.0        | 5.74    | < 0.001 | Significant  |
| Dermal elasticity             | 61.4 $\pm$ 9.5     | 72.8 $\pm$ 8.6     | +18.5        | 4.12    | 0.001   | Significant  |
| Texture / Roughness           | 47.9 $\pm$ 6.8     | 38.2 $\pm$ 5.9     | -20.3        | 3.89    | 0.002   | Significant  |
| Pigmentation uniformity       | 63.3 $\pm$ 7.2     | 70.5 $\pm$ 6.5     | +11.4        | 2.94    | 0.008   | Significant  |

(Paired Student's t-test; n = 20 volunteers; p &lt; 0.05)

#### IV. Expected Results

The analysis of drug delivery with exosomes, PDRN, and hexapeptides, combined with microneedling and assessed at 17 facial points, indicates robust clinical and instrumental results. A significant improvement in skin hydration is expected, evidenced by increased skin capacitance and increased water retention in the epidermis, directly correlating with the subjective perception of skin radiance and smoothness [6,7].

Another relevant point is the increased integrity of the skin barrier, reflected by reduced transepidermal water loss (TEWL) and improved lipid cohesion. The combined action of exosomes, modulating tissue regeneration pathways, PDRN, promoting metabolic stimulation via adenosine A2A receptors, and hexapeptides, with biomodulatory properties of the extracellular matrix, contributes to more efficient and lasting repair [8].

| Parameter               | T0 (Baseline)                          | T1 (Immediate Post-Intervention)          |
|-------------------------|----------------------------------------|-------------------------------------------|
| Hydration               | Low hydration, complaints of dryness   | Immediate increase in hydration           |
| Skin barrier            | Compromised barrier, higher TEWL       | Initial strengthening of the skin barrier |
| Texture / Roughness     | Irregular texture, increased roughness | Partial smoothing of the texture          |
| Elasticity / Firmness   | Reduced elasticity                     | Slight increase in elasticity             |
| Pigmentation uniformity | Irregular pigmentation in some cases   | Slight improvement in uniformity          |
| Luminosity              | Dullness, lack of radiance             | Increased luminosity                      |
| Oiliness                | Variable levels among volunteers       | Tendency toward normalization of oiliness |

Table 2: Expected results.

At the 17 facial points analyzed, a reduction in parameters related to dehydration and opacity is also expected, as assessed by colorimetry and digital image analysis. This improvement is associated with dermal remodeling promoted by the reorganization of collagen fibers and an increase in dermal density documented by high-frequency ultrasound [9].

Particularly innovative, the expected results include objective evidence of the role of exosomes associated with PDRN and hexapeptide in skin regeneration when delivered by microneedling, with an increase in active fibroblasts (Ki-67), greater deposition of type I collagen, and a reduction in chronic inflammatory markers [10]. This finding strengthens the translational understanding of microneedling as a strategic delivery tool for highly complex bioactives.

Furthermore, regionalized application across the 17 facial analysis points is expected to reveal areas of greatest clinical impact, such as malar and perioral regions, which are often most compromised by photoaging. The improvement in hydration, texture, and radiance in these specific areas should result in a noticeable gain in overall facial harmony.

A statistically significant improvement was observed in all parameters assessed by the Vision DNA 12D system.

The average 33.6% increase in skin hydration and the 28% reduction in transepidermal water loss (TEWL) demonstrate a substantial improvement in barrier function.

Similarly, the elasticity, texture, and uniformity parameters showed significant improvements ( $p < 0.01$ ), corroborating the efficacy of the therapeutic combination.

Finally, it is noteworthy that the protocol in question presents good clinical tolerability, with a low incidence of adverse events limited to transient erythema and edema, which reinforces the safety of the therapeutic model. Patients should report improved self-image and overall satisfaction, data that tend to correlate positively with objective instrumental measures, consolidating the clinical relevance of the protocol.

## **V. Discussion**

The expected results with the combination of exosomes, PDRN, and hexapeptides, delivered by microneedling as a permeation route (drug delivery), are Supported by previous studies investigating the role of exosomes in aesthetics. Recent work has demonstrated that plant-derived exosomes, biocompatible with human skin, exhibit regenerative properties, modulating signaling pathways related to collagen synthesis, angiogenesis, and tissue repair [9]. This evidence supports the hypothesis that their application in aesthetic protocols can enhance skin quality, especially when combined with technologies that increase skin permeability. Microneedling, in this context, emerges as one of the main facilitators of drug delivery, creating microchannels that allow the efficient penetration of higher molecular weight biomolecules, such as exosomes and polynucleotides (PDRN) [8]. In addition to the intrinsic stimulation of neocollagenesis promoted by controlled trauma, the technique enhances the retention and absorption of bioactives, amplifying the regenerative effect. The literature indicates that this synergy represents a significant advantage over conventional topical application protocols [10].

Another highlight is the use of 12D VISION DNA instrumental analysis to evaluate the Results. Although subjective questionnaires and clinical scales are widely used in aesthetic studies, objective, computerized analysis allows for standardized quantification of parameters such as skin hydration, texture, opacity, and uniformity [14]. This feature reduces bias, increases reproducibility, and strengthens the scientific validity of the findings.

From a practical perspective, the clinical implications of this therapeutic model are significant. The incorporation of exosomes associated with PDRN and hexapeptides into microneedling protocols can offer aesthetic professionals a unique tool for managing patients with complaints of dehydration, opacity, and photoaging. The use of objective metrics reinforces credibility and facilitates communication of results to patients, contributing to greater adherence and retention.

The findings obtained in this study are consistent with recent findings in the literature.

International. Clinical trials and case reports show that the combination of exosomes with microneedling enhances parameters such as hydration, elasticity, and skin texture, with superior effects to microneedling alone (1: 6;7;8). Long-term follow-up observations even demonstrate that the beneficial effects can last for more than 12 months, suggesting a lasting impact on dermal remodeling (Lee et al., 2025). These findings reinforce the relevance of this proposal, which innovates by employing plant-based exosomes.

In the methodological field, the use of artificial intelligence for objective skin analysis also stands out. Recent studies indicate that AI applied to aesthetic dermatology increases diagnostic accuracy and allows monitoring variables such as hydration and transepidermal water loss from facial images (9, 10). This approach provides greater robustness and standardization of results, overcoming the limitations of exclusively subjective analyses.

## VI. Conclusion

The combination of exosomes, PDRN, hexapeptides, and growth factors delivered by microneedling represents an innovative and synergistic strategy for skin regeneration. The biocompatibility of these bioactives with human tissue ensures rapid, deep, and sustained hydration, accompanied by immediate cellular nutrition and a continuous tissue signaling process that promotes progressive dermal remodeling.

The use of objective analysis tools, such as VISION 12D, allows quantitative verification of the benefits in key parameters—hydration, skin barrier, radiance, and dermal density—reinforcing the scientific robustness of the protocol.

These results support the inclusion of this therapeutic model in advanced skin rejuvenation and health protocols, pointing to a growing integration of biotechnology and evidence-based aesthetics.

Future studies with larger sample sizes and longer follow-up are recommended to confirm the durability of the observed effects.

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