

**COMPARISON OF THE  
EFFECTS OF PDRN,  
NIACINAMIDE AND  
HYALURONIC ACID, WHEN  
ASSOCIATED WITH THE  
MICRONEEDLING  
TECHNIQUE, IN THE  
TREATMENT OF FACIAL  
REJUVENATION: A  
SYSTEMATIC REVIEW**

COMPARAÇÃO DOS EFEITOS DO PDRN, NIACINAMIDA E ÁCIDO  
HIALURÔNICO, QUANDO ASSOCIADOS À TÉCNICA DE  
MICROAGULHAMENTO, NO TRATAMENTO DE REJUVENESCIMENTO  
FACIAL: UMA REVISÃO SISTEMÁTICA

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## ABSTRACT

**Objective:** To compare the efficacy of PDRN, niacinamide, and hyaluronic acid when associated with the microneedling technique in the treatment of facial rejuvenation. **Materials and Methods:** A systematic literature review with a qualitative–quantitative approach was carried out. Scientific articles were searched in the *PubMed*, *ScienceDirect*, *Cochrane Library*, and *SciELO* databases. **Results:** The analysis of the articles demonstrated that all the studied agents presented positive effects in facial rejuvenation when combined with microneedling. PDRN stood out for tissue regeneration and cellular biostimulation; niacinamide for its antioxidant, depigmenting, and DNA-protective effects; and hyaluronic acid for deep hydration and improvement of dermal texture and support. **Conclusion:** It was found that the association of microneedling with the agents PDRN, niacinamide, and hyaluronic acid constitutes a promising, safe, and effective approach for facial rejuvenation. Although all present complementary benefits, PDRN demonstrated greater regenerative potential, niacinamide greater versatility, and hyaluronic acid remains a reference for hydration and superficial filling.

**Keywords:** Skin biostimulation; Tissue regeneration; Neocollagenesis; Transdermal drug delivery; Aesthetic dermatology.

## RESUMO

**Objetivo:** Comparar a eficácia do PDRN, da niacinamida e do ácido hialurônico quando associados à técnica de microagulhamento no tratamento do rejuvenescimento facial. **Materiais e Métodos:** Foi realizada uma revisão sistemática da literatura com abordagem qualitativa-quantitativa. Artigos científicos foram pesquisados nas bases de dados PubMed, ScienceDirect, Cochrane Library e SciELO. **Resultados:** A análise dos artigos demonstrou que todos os agentes

estudados apresentaram efeitos positivos no rejuvenescimento facial quando combinados com o microagulhamento. O PDRN destacou-se pela regeneração tecidual e bioestimulação celular; a niacinamida, por seus efeitos antioxidantes, despigmentantes e de proteção do DNA; e o ácido hialurônico, pela hidratação profunda e melhora da textura e sustentação dérmica. **Conclusão:** Constatou-se que a associação do microagulhamento com os agentes PDRN, niacinamida e ácido hialurônico constitui uma abordagem promissora, segura e eficaz para o rejuvenescimento facial. Embora todos apresentem benefícios complementares, o PDRN demonstrou maior potencial regenerativo, a niacinamida maior versatilidade e o ácido hialurônico permanece como referência para hidratação e preenchimento superficial.

**Palavras-chave:** Bioestimulação da pele; Regeneração tecidual; Neocolagênese; Administração transdérmica de medicamentos; Dermatologia estética.

## **INTRODUCTION**

The search for interventions that promote facial rejuvenation has been intensified by the social valorization of youth and aesthetics, translated into a growing demand for minimally invasive procedures that provide effective and safe results.

Among these interventions, the microneedling technique stands out, which consists of the percutaneous induction of collagen through multiple perforations in the skin, promoting tissue regeneration. Associated with this technique, the use of agents such as PDRN (polydeoxyribonucleotide), niacinamide (vitamin B3), and hyaluronic acid has become a promising strategy to enhance the desired clinical effects.

In this context, the present research proposes to answer the following question: what is the efficacy of PDRN, niacinamide, and hyaluronic acid, when associated with the microneedling technique, in the treatment of facial rejuvenation? Thus, the general objective of this study is to compare the effects of these three agents in facial rejuvenation when used in conjunction with the microneedling technique.

The specific objectives are: to identify the main mechanisms of action of PDRN, niacinamide, and hyaluronic acid in facial rejuvenation; to analyze the clinical benefits of the association of these agents with microneedling; and to compare the results reported in the literature regarding the regenerative, antioxidant, and hydrating efficacy of these agents.

This study is justified by the growing relevance of microneedling associated with dermocosmetic agents in the aesthetic market, estimated at 89.64 billion dollars in 2024, with a projection to reach 239.98 billion dollars in 2033,<sup>1</sup> as well as by the scarcity of comparative studies that support the selection of therapeutic protocols according to the objectives of the treatment and the individual characteristics of the patients. In this context, the present systematic review analyzes the effects of these agents associated with microneedling in facial rejuvenation, contributing to technical-scientific strengthening and to a safer practice in the area of orofacial harmonization.

## **METHODOLOGY**

This is a descriptive literature review with a qualitative–quantitative approach. Therefore, a search was carried out in the Scientific

Electronic Library Online (SciELO), PubMed, ScienceDirect, and Cochrane Library databases, between the months of February and April 2025.

Scientific articles published in English and Portuguese were selected, filtered by the following descriptors: PDRN, Niacinamide, Hyaluronic Acid, Microneedling, and Facial Rejuvenation, combined by the Boolean operators AND and OR.

All original articles indexed with an experimental design (clinical trial — randomized or not) or observational (before-and-after studies, case-control studies) were included. Duplicate articles not available in full text, in full, and articles that did not address the use of the agents PDRN, niacinamide, and hyaluronic acid in interaction with the microneedling technique in the treatment of facial rejuvenation were excluded.

During the search, a technical reading of the resulting articles was carried out, a fundamental stage of the analysis of the material, guided by the inclusion and exclusion criteria, in which titles, abstracts, and keywords were examined, as well as information related to the publication, with a view to ensuring the indexing of the work. The obtained data were imported into a spreadsheet through a specialized program and, subsequently, subjected to descriptive analysis of the content, with the objective of translating them into statistical data of absolute and relative frequency, presented in a table attached to this work. Finally, the selected articles were evaluated regarding adherence to the theme, originality, and methodological quality, according to the flowchart presented in Image 1 (Appendices).

It is worth noting that this systematic review did not delimit specific age groups, sex, or phototypes, and did not seek to analyze differences in effects between men and women, nor between young or elderly individuals. The focus of the research was exclusively on comparing the clinical effects reported in the selected studies, without population segmentation, aiming to obtain an overview of the performance of the agents associated with microneedling in facial rejuvenation.

## RESULTS

Among the twenty studies included in this stage (described in Table 1), different approaches were observed regarding the type of sample, frequency of applications, concentrations used, and follow-up time. The studies, originating from journals of dermatology, regenerative medicine, and aesthetic surgery, include both randomized clinical trials and systematic reviews, *in vitro* studies, and case series, focusing on visual, sensory, and histological parameters. The organization of the selected articles reveals that the investigation of biocompounds applied to facial rejuvenation has been consolidated based on multiple experimental and clinical strategies.

**Table 1 – Studies included in the review**

AUTHOR	YEAR	TYPE OF STUDY	TITLE	JOURNAL	RESUL
Kim, H. M. <i>et al</i> 2.	2022	Experimen tal study	A mixture of topical forms of polydeoxyr ibonucleot ide, vitamin C,	Molecules	Reduct of melan nesis a improv ent c elastic

△ Esta tabela possui muitas colunas e foi cortada para impressão. Para visualizá-la completa, acesse o artigo original em:

<https://revistatopicos.com.br/artigos/comparison-of-the-effects-of-pdrn-niacinamide-and-hyaluronic-acid-when-associated-with-the-microneedling-technique-in-the-treatment-of-facial-rejuvenation-a-systematic-review?noblockage>

**Source:** Donato, Aurita, (2026).

## DISCUSSION

### The microneedling technique

Microneedling is a minimally invasive aesthetic procedure that consists of creating controlled microlesions in the skin, causing disruption of the cutaneous barriers. This process triggers an inflammatory response that stimulates collagen production (neocollagenesis), neovascularization, and elastin synthesis, in addition to creating microchannels that significantly increase skin permeability for topical agents.<sup>22</sup>

The microneedling technique was first introduced in 1995 in South Africa (Cape Town), during a local medical congress, by the surgeon Desmond Fernandes,<sup>23</sup> who developed the *Dermaroller* in 1997.<sup>24</sup> The device consists of a cylinder containing 190 to 1080 stainless steel needles, attached to a polypropylene handle, which makes sterilization of the equipment unfeasible, therefore being intended for disposable use.<sup>25</sup>

Another device used is the *Dermapen*, which operates with disposable microneedles in cartridges, producing vibratory

movements that allow greater precision. The needles used may be made of stainless steel or titanium, ranging from 190 to 450 units. Both the *Dermaroller* and the *Dermapen* have depths ranging from 0.25 mm to 2.5 mm; from 2.0 mm onwards, use is restricted to medical professionals.<sup>26</sup>

The induced microlesions facilitate the absorption of active agents, optimizing treatment protocols for facial rejuvenation, namely: skin flaccidity, wrinkles, expression lines, and improvement of skin texture and luminosity.<sup>27</sup> During application, force is applied, but it is not yet standardized, as it depends on the thickness of the stratum corneum and the skin biotype.

Microneedling using *Dermaroller* or *Dermapen* is not recommended for individuals with active skin infections, tendency to develop keloids, coagulation disorders, herpes zoster, pregnant or lactating women, or patients with uncontrolled autoimmune diseases.<sup>28</sup>

The procedure involves: (a) anamnesis: a thorough analysis of the area to be treated, considering thickness, biotype (especially skin phototypes V and VI), and clinical functional physiology; (b) asepsis: cleaning, exfoliation, and hygiene of the site; (c) application: use of the *Dermapen* with adjustment of needle depth according to the treated region (the 36-needle cartridge is usually the most indicated for facial rejuvenation treatment).<sup>29</sup> During the technique, the *Dermapen* device or *Dermaroller* must be moved horizontally and vertically, longitudinally to the right and to the left, in an average of 10 to 15 passes, applying appropriate force according to the region and the objective of the treatment. After evaluating the skin response (for example, the presence of hyperemia and redness), the professional must inform the patient about these responses and

may then proceed to other areas. The entire process must be documented with photographs (before and after). The cartridges used must, obligatorily, be sterile, disposable, and registered with ANVISA.<sup>30</sup>

Facial rejuvenation treatment using the microneedling technique may require three to six sessions, respecting the interval between sessions (28 to 30 days), also referred to as the dermal cycle.

Since the previously mentioned medical congress, microneedling has evolved into more advanced models, such as robotic microneedling associated with radiofrequency microneedling, which offers more effective results in aesthetic treatments, especially facial ones.<sup>31</sup>

The needles used in robotic microneedling are gold-coated, through which radiofrequency is delivered during the procedure.<sup>32</sup> With radiation ranging between 60° and 70°, this thermogenic technique stimulates neocollagenesis at the level of the reticular dermis, promoting type I collagen production. Integrated into the concept of *drug delivery*, the technique facilitates the penetration of agents such as PDRN, niacinamide, and hyaluronic acid, promoting deep hydration and epidermal renewal, in addition to acting in the treatment of flaccidity and infraorbital and periorbital wrinkles (areas that require increased attention regarding speed).<sup>33</sup>

More recent studies on the microneedling technique in facial rejuvenation have employed modern microneedling pens, such as Dr. Pen A20 and Dermapen 4 (Figures 1 and 2 attached), according to the studies by Gordon H. Sasaki<sup>34</sup> and José A. Foppiani.<sup>35</sup>

## **PDRN**

Regenerative aesthetics is an emerging field within Dermatology and Aesthetic Medicine, which focuses on tissue repair, cellular biostimulation, and modulation of inflammation, aiming to restore the integrity and functionality of the skin.

Among innovative biotechnological agents, polydeoxyribonucleotide (PDRN) stands out, a compound derived from salmon DNA with potent regenerative properties. It has a DNA fraction with a molecular weight ranging from 50–1500 kDa, being mainly obtained from the sperm of the salmon *Oncorhynchus keta*, through enzymatic purification techniques.<sup>36</sup>

The combination with other agents, such as hyaluronic acid, through the microneedling technique in skin treatment and regeneration, has achieved synergistic effects and stimulation of type II and V collagen, in addition to facial rejuvenation, antioxidant action, and neocollagenesis in facial aesthetic treatments.<sup>37</sup>

PDRN is presented as a polymer of deoxyribonucleotides which, when applied topically or injected, acts in DNA and RNA synthesis during the tissue regeneration process. Among the observed benefits are: improvement of skin elasticity and firmness, reduction of fine lines and expression lines, dermal restructuring after procedures such as laser or microneedling, and promotion of collagen remodeling.<sup>38</sup>

Regarding administration, it may be performed by: (a) intradermal route (mesotherapy); (b) topical application associated with microneedling or fractional radiofrequency; (c) combination with

hyaluronic acid and niacinamide, with synergistic effect. The agent presents a high level of safety, low risk of immunogenicity, compatibility with other bioactive compounds, and mild adverse reactions (erythema and local edema)<sup>39</sup>

PDRN represents a significant advancement in regenerative aesthetics, offering a safe, effective, and physiological approach to skin revitalization and tissue regeneration. Its therapeutic versatility and profound biological mechanisms consolidate it as a pillar in regenerative and genetic therapies and in the management of protocols in advanced aesthetics, making it promising in orofacial harmonization, with growing potential in combined protocols.<sup>40</sup>

In Brazil, the use of PDRN began approximately 15 years ago, mainly focused on medical applications in regenerative therapies. In its early uses, it was associated with the regeneration of bone, skin, and joint tissues, in addition to assisting in the management of chronic pain.

## **Niacinamide**

For more than seven decades, vitamin B3 (niacinamide) has been used as a supplement. The discovery of its aesthetic potential occurred through its use in the treatment of pellagra, a disease known as the three Ds: dementia, dermatitis, and diarrhea.

Currently, it presents a protective effect against DNA damage induced by UV radiation in epidermal melanocytes<sup>41</sup> and acts to enhance the effect of individual compounds, such as PDRN and hyaluronic acid, when used in the treatment of photoaging through the microneedling technique. Studies indicate topical applications

with excellent results, including in serum form, according to research conducted using the microneedling technique with the *Dermapen* device equipped with a 36-needle cartridge.<sup>42</sup>

This protective effect against DNA damage increases type I, II, and V collagen, optimizing neocollagenesis, making this agent an ally in skin management in orofacial harmonization procedures, preparing the skin and prolonging the durability of facial procedures in HOF.<sup>43</sup>

## **Hyaluronic Acid**

Aging reduces the production of hyaluronic acid (HA) in the skin, triggering the appearance of wrinkles and the process of skin flaccidity. Present in various connective tissues, this glycosaminoglycan is known for its water-retention capacity and is therefore a key component of the extracellular matrix, providing structural support and playing a crucial role in maintaining skin integrity.<sup>44</sup>

Injectable products based on hyaluronic acid have demonstrated efficacy in reducing wrinkles and improving skin hydration and radiance. Skin hydration is essential to keep it nourished and healthy, helping it perform its primary function, which is to retain molecules, resulting in skin with a youthful and healthy appearance, with glow and vitality.<sup>45</sup>

Hyaluronic acid has been the focus of significant interest in dermatology and advanced aesthetic research due to its potential benefits, including the reduction of expression wrinkles. Another analyzed benefit is the stimulation of fibroblast growth, resulting in

increased production of collagen and elastin, contributing to skin firmness.<sup>46</sup>

Studies by Zhou *et al.*<sup>47</sup> demonstrate that treatments associated with hyaluronic acid, at the correct dosage and timing in patients with aged skin, contribute to skin radiance, luminosity, and nourishment, thus confirming its efficacy in facial rejuvenation treatment.

## **CONCLUSION**

The present systematic review demonstrated that the association of microneedling with the agents PDRN, niacinamide, and hyaluronic acid constitutes an effective approach for facial rejuvenation, since each substance presents complementary mechanisms of action. PDRN stands out for its role in tissue regeneration and cellular biostimulation; niacinamide for its antioxidant, depigmenting, and DNA-protective effects; and hyaluronic acid for promoting deep hydration, improvement of skin texture, and dermal support. The choice of the most appropriate agent depends on individual clinical needs and therapeutic objectives, with hyaluronic acid being widely established in protocols for hydration and superficial rejuvenation.

Despite the promising results, there is a need for more robust and standardized clinical studies to establish safe parameters regarding the concentration, frequency, and method of application of these agents associated with microneedling. Although the scarcity of direct comparative studies limits definitive conclusions, the available findings provide relevant support for improving clinical practice in orofacial harmonization, contributing to safer, more effective, and scientifically grounded therapeutic decisions.

## REFERENCES

1. GRAND VIEW RESEARCH. AVAILABLE IN: <https://www.grandviewresearch.com/industry-analysis/medical-aesthetics-market>. ACCESSED ON: 19 JUN. 2025
2. Kim, Hyoung Moon; Byun, Kyung-A; Oh, Seyeon; Yang, Jin Young; Park, Hyun Jun; Chung, Moon Suk; Son, Kuk Hui; Byun, Kyunghee. A mixture of topical forms of polydeoxyribonucleotide, vitamin C, and niacinamide attenuated skin pigmentation and increased skin elasticity by modulating nuclear factor erythroid 2-like 2. *Molecules*, 2022, 27, 1276. <https://doi.org/10.3390/molecules27041276>.
3. Khan, Aawrish; Wang, Guobao; Zhou, Feng; Gong, Lunli; Zhang, Jun; Qi, Lili; Cui, Haiyan. Polydeoxyribonucleotide: a promising skin anti-aging agent. *Chinese Journal of Plastic and Reconstructive Surgery*, 4 (2022) 187–193. <https://doi.org/10.1016/j.cjprs.2022.09.015>.
4. Park, Hyun Jun; Byun, Kyung-A; Oh, Seyeon; Kim, Hyoung Moon; Chung, Moon Suk; Son, Kuk Hui; Byun, Kyunghee. The combination of niacinamide, vitamin C, and PDRN mitigates melanogenesis by modulating nicotinamide nucleotide transhydrogenase. *Molecules*, 2022, 27, 4923. <https://doi.org/10.3390/molecules27154923>.
5. Lee, Kar Wai Alvin; Chan, Kwin Wah Lisa; Lee, Angela; Lee, Cheuk Hung; Wan, Jovian; Wong, Sky; Yi, Kyu-Ho. Polynucleotides in Aesthetic Medicine: A Review of Current Practices and Perceived Effectiveness. *International Journal of*

6. Zhou, Rongying; Yu, Mei. The Effect of Local Hyaluronic Acid Injection on Skin Aging: A Systematic Review and Meta Analysis. *Journal of Cosmetic Dermatology*, 2025; 24:e16760.  
<https://doi.org/10.1111/jocd.16760>.
7. Marques, Cíntia; Hadjab, Farid; Porcello, Alexandre; Lourenço, Kelly; Scaletta, Corinne; Abdel-Sayed, Philippe; Hirt-Burri, Nathalie; Applegate, Lee Ann; Laurent, Alexis. Mechanistic Insights into the Multiple Functions of Niacinamide: Therapeutic Implications and Cosmeceutical Applications in Functional Skincare Products. *Antioxidants*, 2024, 13, 425.  
<https://doi.org/10.3390/antiox13040425>.
8. Jaiswal, Sharwari; Jawade, Sugat. Microneedling in Dermatology: A Comprehensive Review of Applications, Techniques, and Outcomes. *Cureus* 16(9): e70033.  
<https://doi.org/10.7759/cureus.70033>.
9. Shauly, Orr; Marxen, Troy; Menon, Ambika; Gould, Daniel J.; Miller, Leonard B.; Losken, Albert. Radiofrequency Microneedling: Technology, Devices, and Indications in the Modern Plastic Surgery Practice. *Aesthetic Surgery Journal Open Forum*, Vol 5, 2023, ojad100,  
<https://doi.org/10.1093/asjof/ojad100>.
10. Wu, C.; Yu, Q.; Huang, C.; Li, F.; Zhang, L.; Zhu, D. Microneedles as transdermal drug delivery system for enhancing skin disease treatment. *Acta Pharmaceutica Sinica B*, 2024 Vol 14,

11. Ferreira, Adriana da Silva; Aita, Daniella Leiros; Muneratto, Meire Aparecida. Microagulhamento: uma revisão. *Revista Brasileira de Cirurgia Plástica*, 2020;35(2):228-234.  
<https://doi.org/10.5935/2177-1235.2020RBCP0037>.
12. Kim, Tae-Hee; Heo, Seong-Yeong; Han, Ji Sung; Jung, Won-Kyo. Anti-inflammatory effect of polydeoxyribonucleotides (PDRN) extracted from red alga (*Porphyra* sp.) in RAW 264.7 macrophages. *Cell Biochem & Function*, Vol. 41, Issue7, 2023.  
<https://doi.org/10.1002/cbf.3840>.
13. Lee, Kwang-Soo; Lee, Soyeon; Wang, Hyesoo; Lee, Geonhee; Kim, Seolyeong; Ryu, Yang-Hwan; Chang, Nicole Hyesoo; Kang, Yong-Won. Analysis of Skin Regeneration and Barrier-Improvement Efficacy of Polydeoxyribonucleotide Isolated from *Panax Ginseng* (C.A. Mey.) Adventitious Root. *Molecules*, 2023, 28, 7240. <https://doi.org/10.3390/molecules28217240>.
14. Shin, Sun Mee; Baek, Eun Joo; Kim, Kwang Ho; Kim, Kwang Joong; Park, Eun Joo. Polydeoxyribonucleotide exerts opposing effects on ERK activity in human skin keratinocytes and fibroblasts. *Molecular Medicine Reports*, 28: 148, 2023.  
<https://doi.org/10.3892/mmr.2023.13035>.
15. Picciolo, Giacomo; Mannino, Federica; Irrera, Natasha; Altavilla, Domenica; Minutoli, Letteria; Vaccaro, Mario; Arcoraci, Vincenzo; Squadrito, Violetta; Picciolo, Giuseppe; Squadrito, Francesco; Pallio, Giovanni. PDRN, a natural bioactive compound, blunts inflammation and positively reprograms

healing genes in an in vitro model of oral mucositis. *Biomedicine & Pharmacotherapy*, 138 (2021) 111538. <https://doi.org/10.1016/j.biopha.2021.111538>.

16. Waghule, Tejashree; Singhvia, Gautam; Dubey, Sunil Kumar; Pandey, Murali Monohar; Gupta, Gaurav; Singh, Mahaveer; Dua, Kamal. Microneedles: A smart approach and increasing potential for transdermal drug delivery system. *Biomedicine & Pharmacotherapy*, 109 (2019) 1249–1258.
17. Lee, Jong Hun; Han, Jin Woo; Byun, Jin Hwan; Lee, Won Mi; Kim, Min Ho; Wu, Wen Hao. Comparison of wound healing effects between *Oncorhynchus keta*-derived polydeoxyribonucleotide (PDRN) and *Oncorhynchus mykiss*-derived PDRN. *Archives of Craniofacial Surgery*, 2018, Vol.19 No.1, 20-34. <https://doi.org/10.1016/j.biopha.2018.10.078>.
18. Zhang, Wei; Xie, Yongjun; Liu, Weihua; Lei, Jing; Liu, Yilun. Combination therapy of botulinum toxin type A and hyaluronic acid filler for facial rejuvenation. *International Journal of Clinical and Experimental Medicine*. 2018;11(5):5033-5038. <https://e-century.us/files/ijcem/11/5/ijcem0075353.pdf>.
19. Molina, Beatriz; David, Michel; Jain Ravi; Amselem, Moisés; Ruiz-Rodriguez, Ricardo; Ma, May Y.; Kerrouche, Nabil; Georgantopoulos, Sotirios P.; Radeau, Thierry; Boineau, Dominique. Patient Satisfaction and Efficacy of Full-Facial Rejuvenation Using a Combination of Botulinum Toxin Type A and Hyaluronic Acid Filler. *Dermatol Surg*, 2015;41:S325–S332. <https://doi.org/10.1097/DSS.0000000000000548>.

20. Squadrito, Francesco; Bitto, Alessandra; Irrera, Natasha; Pizzino, Gabriele; Pallio, Giovanni; Minutoli, Letteria; Altavilla, Domenica. Pharmacological activity and clinical use of PDRN. *Front. Pharmacol.* 8:224, 2017. <https://doi.org/10.3389/fphar.2017.00224>.
21. Camilia, A.; Gadila AP; M. F. Dwiputri; S. F. I. Arief; Y. P. Setyadi. The role of Salmon DNA in Skin Regeneration and Anti-Aging. *Journal Medical Informatics Technology*, vol. 3, n° 2, pp. 79–86, 2025. <https://doi.org/10.37034/medinftech.v3i2.95>.
22. Hema; Jindal, Anu; Bala, Rajni; Singh, Amrinder. A review on recent advances and challenges of microneedle technology for enhanced topical treatment of skin disorders. *Archives of Dermatological Research*, 2025, v. 317, article number 706. 2025 Apr 12;317(1):706. <https://doi.org/10.1007/s00403-025-04239-2>.
23. Fernandes, Desmond. Minimally Invasive Percutaneous Collagen Induction. *Oral Maxillofacial Surg Clin N Am* 17 (2005) 51-63. <https://doi.org/10.1016/j.coms.2004.09.004>.
24. Jaiswal, Sharwari; Jawade, Sugat. Microneedling in Dermatology: A Comprehensive Review of Applications, Techniques, and Outcomes. *Cureus* 16(9): e70033. <https://doi.org/10.7759/cureus.70033>.
25. Albano, R. P. S.; Pereira, L. P.; Assis, I. B., Microagulhamento - a terapia que induz a produção de colágeno: revisão de literatura. *Revista Saúde em Foco – Edição n° 10 – Ano: 2018*.
26. Albano, R. P. S.; Pereira, L. P.; Assis, I. B., Microagulhamento - a terapia que induz a produção de colágeno: revisão de

literatura. Revista Saúde em Foco – Edição nº 10 – Ano: 2018.

27. Jaiswal, Sharwari; Jawade, Sugat. Microneedling in Dermatology: A Comprehensive Review of Applications, Techniques, and Outcomes. *Cureus* 16(9): e70033. <https://doi.org/10.7759/cureus.70033>.
28. Albano, R. P. S.; Pereira, L. P.; Assis, I. B., Microagulhamento - a terapia que induz a produção de colágeno: revisão de literatura. Revista Saúde em Foco – Edição nº 10 – Ano: 2018.
29. Shauly, Orr; Marxen, Troy; Menon, Ambika; Gould, Daniel J.; Miller, Leonard B.; Losken, Albert. Radiofrequency Microneedling: Technology, Devices, and Indications in the Modern Plastic Surgery Practice. *Aesthetic Surgery Journal Open Forum*, Volume 5, 2023, ojad100, <https://doi.org/10.1093/asjof/ojad100>.
30. Albano, R. P. S.; Pereira, L. P.; Assis, I. B., Microagulhamento - a terapia que induz a produção de colágeno: revisão de literatura. Revista Saúde em Foco – Edição nº 10 – Ano: 2018.
31. Shauly, Orr; Marxen, Troy; Menon, Ambika; Gould, Daniel J.; Miller, Leonard B.; Losken, Albert. Radiofrequency Microneedling: Technology, Devices, and Indications in the Modern Plastic Surgery Practice. *Aesthetic Surgery Journal Open Forum*, Volume 5, 2023, ojad100, <https://doi.org/10.1093/asjof/ojad100>.
32. Shauly, Orr; Marxen, Troy; Menon, Ambika; Gould, Daniel J.; Miller, Leonard B.; Losken, Albert. Radiofrequency Microneedling: Technology, Devices, and Indications in the

Modern Plastic Surgery Practice. Aesthetic Surgery Journal Open Forum, Volume 5, 2023, ojad100, <https://doi.org/10.1093/asjof/ojad100>.

33. Zhou, Rongying; Yu, Mei. The Effect of Local Hyaluronic Acid Injection on Skin Aging: A Systematic Review and Meta Analysis. *Journal of Cosmetic Dermatology*, 2025; 24:e16760. <https://doi.org/10.1111/jocd.16760>.
34. Sasaki, Gordon H. MicroNeedling Depth Penetration, Presence of Pigment Particles, and Fluorescein-Stained Platelets: Clinical Usage for Aesthetic Concerns. *Aesthetic Surgery Journal*, Volume 37, Issue 1, 1 January 2017, Pages 71–83, <https://doi.org/10.1093/asj/sjw120>.
35. Foppiani, Jose A.; Fanning, James E.; Beltran, Kassandra; Raska, Otakar; Alvarez, Angelica Hernandez; Taritsa, Lulianna; Kim, Eri; Escobar, Maria-Jose; Lee, Daniela; Choudry, Umar; Lin, Samuel J. Microneedling for Facial Rejuvenation: A Systematic Review. *Aesthetic Plast Surg.* 2025, Sep;49(17):4949-4960. [www.doi/10.1007/s00266-025-04972-z](https://doi.org/10.1007/s00266-025-04972-z). Epub 2025 Jun 20.
36. Lampridou, Smaragda; Bassett, Sian; Cavallini, Maurizio; Christopoulos, George. The Effectiveness of Polynucleotides in Esthetic Medicine: A Systematic Review. *Journal of Cosmetic Dermatology*, 2025; 24:e16721. <https://doi.org/10.1111/jocd.16721>.
37. Yudin, Mykhailo; Reznik, Anna; Andrusyak, Vita Yevgenievna; Savitskaya, Irina Mikhailovna. Study of the effect of the combined drug PN and HA on the regeneration of collagen fibers of the skin in an experiment. *Aesthetic Medicine*, 2024; Vol. 10, N. 1: e2024006. <https://doi.org/10.57662/am.v10i1.15157>.

38. Lampridou, Smaragda; Bassett, Sian; Cavallini, Maurizio; Christopoulos, George. The Effectiveness of Polynucleotides in Esthetic Medicine: A Systematic Review. *Journal of Cosmetic Dermatology*, 2025; 24:e16721. <https://doi.org/10.1111/jocd.16721>
39. Lampridou, Smaragda; Bassett, Sian; Cavallini, Maurizio; Christopoulos, George. The Effectiveness of Polynucleotides in Esthetic Medicine: A Systematic Review. *Journal of Cosmetic Dermatology*, 2025; 24:e16721. <https://doi.org/10.1111/jocd.16721>
40. Lampridou, Smaragda; Bassett, Sian; Cavallini, Maurizio; Christopoulos, George. The Effectiveness of Polynucleotides in Esthetic Medicine: A Systematic Review. *Journal of Cosmetic Dermatology*, 2025; 24:e16721. <https://doi.org/10.1111/jocd.16721>
41. Park, Hyun Jun; Byun, Kyung-A; Oh, Seyeon; Kim, Hyoung Moon; Chung, Moon Suk; Son, Kuk Hui; Byun, Kyunghee. The combination of niacinamide, vitamin C, and PDRN mitigates melanogenesis by modulating nicotinamide nucleotide transhydrogenase. *Molecules*, 2022, 27, 4923. <https://doi.org/10.3390/molecules27154923>.
42. Marques, Cíntia; Hadjab, Farid; Porcello, Alexandre; Lourenço, Kelly; Scaletta, Corinne; Abdel-Sayed, Philippe; Hirt-Burri, Nathalie; Applegate, Lee Ann; Laurent, Alexis. Mechanistic Insights into the Multiple Functions of Niacinamide: Therapeutic Implications and Cosmeceutical Applications in Functional Skincare Products. *Antioxidants*, 2024, 13, 425. <https://doi.org/10.3390/antiox13040425>.
43. Marques, Cíntia; Hadjab, Farid; Porcello, Alexandre; Lourenço, Kelly; Scaletta, Corinne; Abdel-Sayed, Philippe; Hirt-Burri,

Nathalie; Applegate, Lee Ann; Laurent, Alexis. Mechanistic Insights into the Multiple Functions of Niacinamide: Therapeutic Implications and Cosmeceutical Applications in Functional Skincare Products. *Antioxidants*, 2024, 13, 425. <https://doi.org/10.3390/antiox13040425>.

44. Zhang, Wei; Xie, Yongjun; Liu, Weihua; Lei, Jing; Liu, Yilun. Combination therapy of botulinum toxin type A and hyaluronic acid filler for facial rejuvenation. *International Journal of Clinical and Experimental Medicine*. 2018;11(5):5033-5038. [www.ijcem.com/ISSN:1940-5901/IJCEM0075353](http://www.ijcem.com/ISSN:1940-5901/IJCEM0075353).

45. Zhou, Rongying; Yu, Mei. The Effect of Local Hyaluronic Acid Injection on Skin Aging: A Systematic Review and Meta Analysis. *Journal of Cosmetic Dermatology*, 2025; 24:e16760. <https://doi.org/10.1111/jocd.16760>.

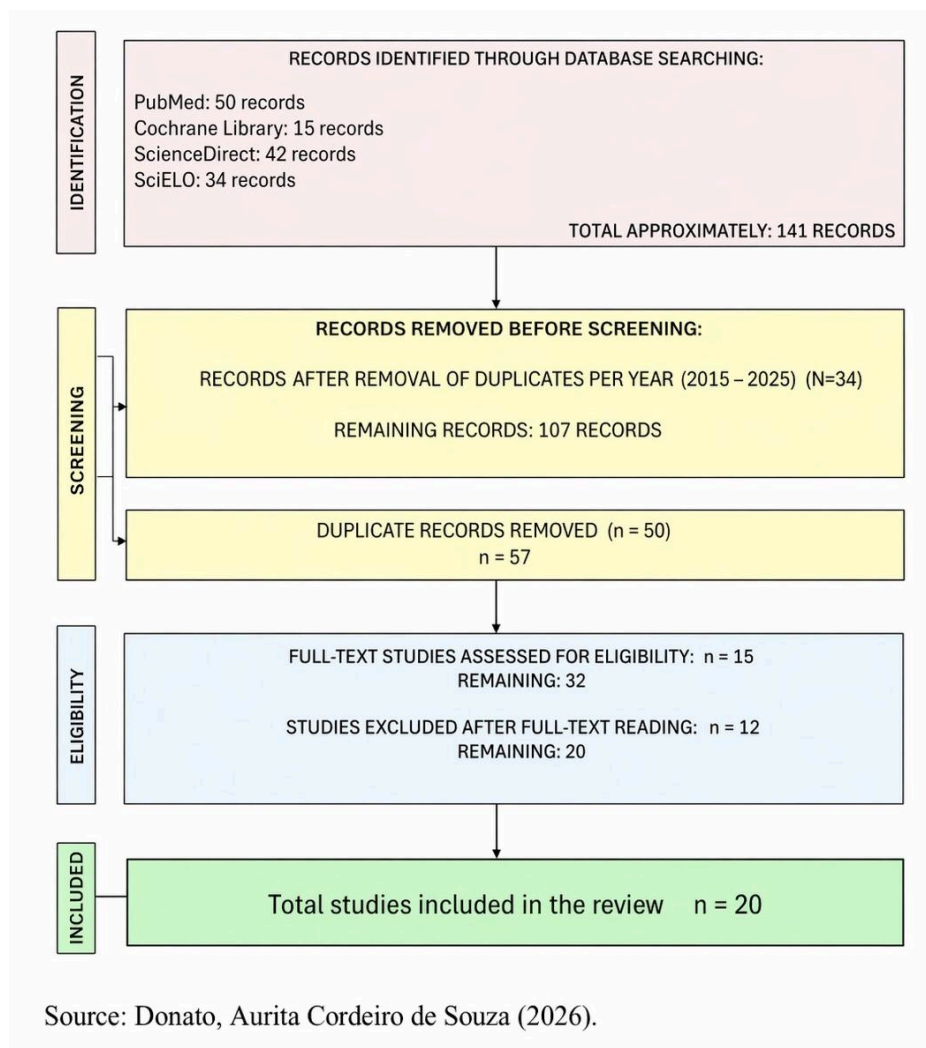
46. Zhang, Wei; Xie, Yongjun; Liu, Weihua; Lei, Jing; Liu, Yilun. Combination therapy of botulinum toxin type A and hyaluronic acid filler for facial rejuvenation. *International Journal of Clinical and Experimental Medicine*. 2018;11(5):5033-5038. [www.ijcem.com/ISSN:1940-5901/IJCEM0075353](http://www.ijcem.com/ISSN:1940-5901/IJCEM0075353).

47. Zhou, Rongying; Yu, Mei. The Effect of Local Hyaluronic Acid Injection on Skin Aging: A Systematic Review and Meta Analysis. *Journal of Cosmetic Dermatology*, 2025; 24:e16760. <https://doi.org/10.1111/jocd.16760>.

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## APPENDICES

**Figure 1** - Prism Flowchart 2020



**Figure 2** - Comparison table of the effects of active ingredients on facial rejuvenation

	Author(s)	Year	Database	Level of evidence
<b>PDRN</b> Effect on facial rejuvenation: regeneration	Picciolo, G. <i>et al.</i>	2023	ScienceDirect	High
	Khan, A. <i>et al.</i>	2022	ScienceDirect	High
	Kim, H. M. <i>et al.</i>	2022	PubMed	Moderate
	Lee, K. S. <i>et al.</i>	2023	PubMed	Moderate
	Squadrio, F. <i>et al.</i>	2017	PubMed	Moderate
	Park, J. <i>et al.</i>	2022	PubMed	Moderate
	Shin, S. M. <i>et al.</i>	2023	PubMed	Moderate
<b>Niacinamide</b> Effects on facial rejuvenation: antioxidant and cellular energy	Park, J. <i>et al.</i>	2022	PubMed	Moderate
	Marques, Cintia. <i>et al.</i>	2024	PubMed	Moderate
	Kim, H. M. <i>et al.</i>	2022	PubMed	Moderate
<b>Hyaluronic Acid</b> Effects on facial rejuvenation: hydration, radiance and dermal filling	Molina, B. <i>et al.</i>	2015	Cochrane Library	High
	Zhou, R. Yu, M.	2025	PubMed	Moderate
	Zhang, W. <i>et al.</i>	2018	Cochrane Library	High

Source: Donato, Aurita Cordeiro de Souza (2026).

## ANEXOS

**Image 1:** Dr. Pen A20 - (FDN registration: K230420)



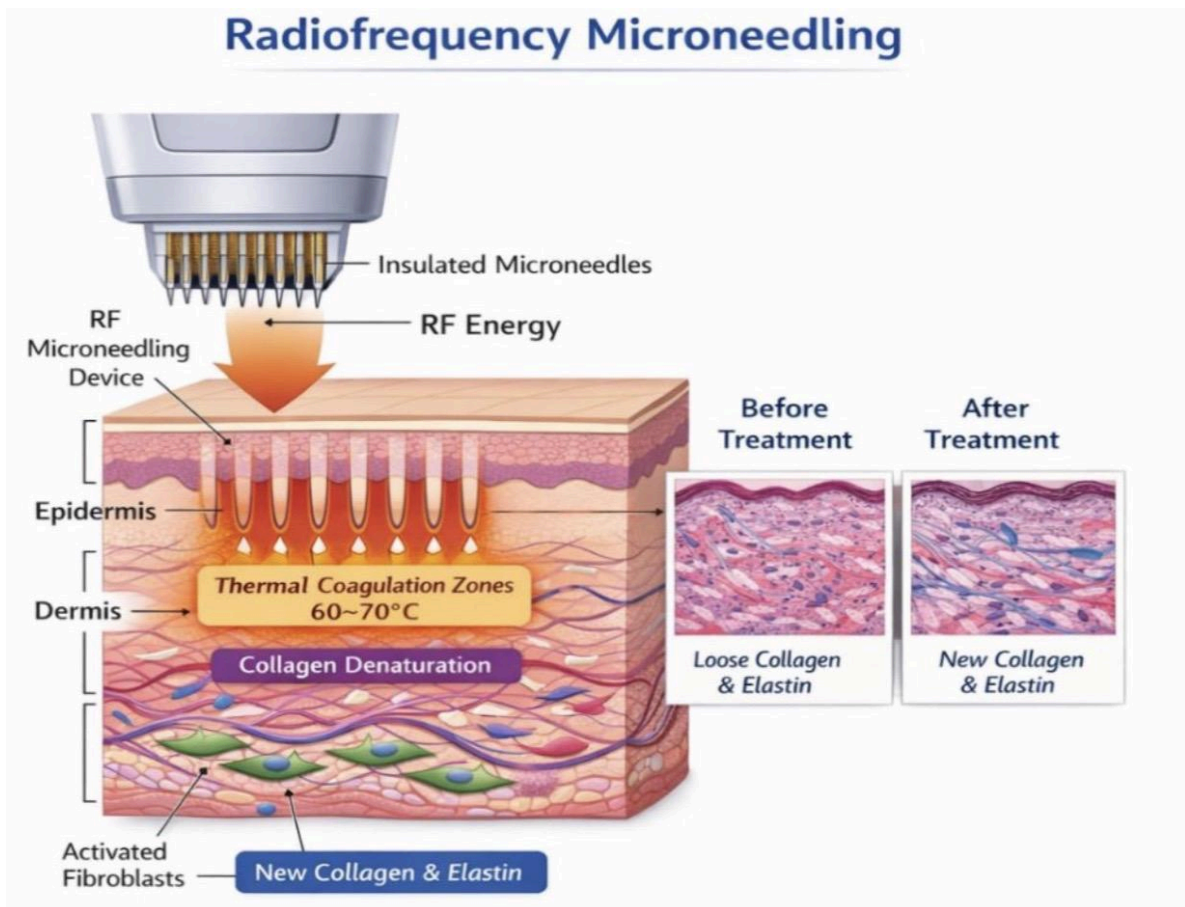
**Source:** FDA. Available at: <https://fda.innolitics.com/submissions/SU/subpart-e%E2%80%94surgical-devices/QA/K230420>. Access on 02 Apr. 2026

**Image 2:** Dermapenword 4 - (registrations: FDA-cleared (K510), CE Mark and TFDA)



**Source:** Dermapenworld.com. Available in: <https://www.dermapenworld.com/en-rw/dermapen-professional/dermapen4-sos-kits>. Access on 02 Apr. 2026

**Image 3:** Mechanism of action of microneedle radiofrequency



Fonte: Waghule et al. (2019)

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