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## **Fractional microneedle radiofrequency - mechanism of action and assessment of safety, effectiveness in the treatment, and possible side effects based on a review of scientific literature**

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Abstract

### **Introduction and purpose:**

For all skin types, micro-needle radiofrequency (FMR) can be a safe and effective aesthetic medicine procedure for the treatment of various dermatological and aesthetic conditions. The aim of the study is to present the mechanism of action and assess safety, treatment efficacy, and possible side effects on the basis of a review of the scientific literature.

### **Description of the state of knowledge:**

FMR uses micro-needles to penetrate the skin to a depth of up to 4.5 mm and deliver radiofrequency current in a fractional manner, producing the controlled fractions of micro-injuries in the dermis, inducing neocollagenesis, neoelastinogenesis, and angiogenesis. FMR has a wide range of positive effects such as skin rejuvenation, skin tightening, facial and body scar remodeling, and hair growth through transdermal collagen induction.

### **Summary:**

Increasingly, patients are looking for minimally invasive methods of skin tightening and fat remodeling. In response, Aesthetic Medicine has proposed a combination of two techniques, micro-needling and radiofrequency. As more and more studies are showing the effectiveness and efficiency of this procedure, also emphasizing its safety, minimal risk of serious side effects, and ease of use, micro-needle radiofrequency is being proposed as an attractive answer to people's desires for a less invasive method of skin rejuvenation. However, further research in this area is needed to optimize the parameters of the treatment to achieve the best results.

**Keywords:** fractional micro-needle radiofrequency, side effects, mechanism of action, safety, effectiveness, treatment, Morpheus8

## **Introduction**

There are many various methods of skin rejuvenation offered by specialists in dermatology and aesthetic medicine. Aesthetic medicine treatments are gaining more and more interest due to increased awareness and greater access to knowledge about skin aging prevention. The skin rejuvenation method that caught our attention was fractional micro-needle radiofrequency, and its "superpower" of minimizing healing time and patient discomfort. In aesthetic medicine, there is a demand for less invasive procedures in which there is an optimal risk-benefit ratio and short post-procedure recovery time, and the effects of the treatments are maximized. Focusing on non-surgical procedures, fractional micro-needle radiofrequency (FMR) fulfills the certain needs and recruitments of groups of individuals. Firstly, it could be proposed as an alternative facial lifting and tightening method among individuals who are not inclined towards injectable treatments such as fillers and neuromodulators. Secondly, it could be proposed for individuals that previously injected fillers or are "overfilled" and there are contraindications for injecting additional volume [1]. Fractional micro-needle radiofrequency combines two techniques - micro-needling (MN) and radiofrequency - to take advantage of their synergistic effects and achieve better results. Micro-needling alone has many indications, including the treatment of scars, and can produce amazing results. Other indications for MN include skin rejuvenation, skin tightening, including treatment of stretch marks, scar remodeling on the face and body, and hair growth through transdermal collagen induction [2, 22]. When it comes to radiofrequency (RF) alone, the RF treatment has been shown to be useful and produce significant improvements in the treatment of acne, scars, or facial rhytids. Wrinkle reduction, skin tightening, neocollagenesis, neoelastinogenesis, facial contouring (due to targeting the adipose tissue), scars remodeling, producing new collagen and softening scars are the effects to be expected by choosing RF technology [3]. The combination of MN and RF can deliver energy below the epidermal surface, meanwhile avoiding epidermal damage and subsequent dyspigmentation [2]. Understanding the mechanism of action and assessing the safety, effectiveness, and potential side effects of fractional microneedle radiofrequency are crucial for making treatment results optimal and delivering patient satisfaction.

## **Materials and methods**

The search was conducted using the Pubmed, Medline, and Google Scholar databases to identify the literature related to fractional microneedle radiofrequency, focusing on papers that provide insight into the mechanism of action and assessment of safety, effectiveness in the treatment, and possible side effects. The authors screened the databases mentioned above. A thorough search was conducted for each individual database, with search terms applied line by line and consistently replicated across all sources. The following terms were used for the search: “fractional micro-needle radiofrequency” in combination with terms such as “side effects”, “mechanism of action”, “safety”, “effectiveness”, “treatment”, and “Morpheus8”. We established our criteria by considering papers published after 2015, with an emphasis on ensuring that the percentage of these papers exceeded 75%. Ultimately a summary of reports available in publications and scientific studies posted in medical information databases and book positions was created.

## **Mechanism of RFM**

FMRD uses micro-needles to penetrate the skin to a depth of up to 4.5 mm and deliver radiofrequency current in a fractional manner. The device automatically regulates the amount of energy delivered and the depth to which this energy is to be delivered. [4] Microneedling by forming microchannels and microscopic wounds induces inflammation at the level of the dermis, breaks down dense collagen, stimulates fibroblasts to remodel skin structure, and induces the wound healing process. This makes the skin firmer and reduces the appearance of scars or calluses [2]. Radiofrequency (RF) technology produces electromagnetic waves with low frequency, which generates thermal heat in the dermis and induces an increase in collagen production, elastin formation, and the production of new blood vessels, all of which play an important role in the healing process [1]. Both penetration depth (MN component) and thermal injury (RF component) can be specifically controlled, on the basis of tissues' impedance to electrical currents caused by tissue density and water content, devices can be adjusted using specific parameters depending on what tissue is to be targeted [5]. Worthy of attention, is the fact that the use of the RFM method does not carry the limitation of what skin types are and the mechanism is not dependent on skin chromophores, which does not carry as high risk of the consequences of epidermal damage and post-regenerative hyperpigmentation [6,7]. The RFM procedure provides fractional treatment of the skin, which means micro-injuries induction to the skin in fractions while leaving surrounding areas of skin untreated to shorten recovery time [6,8].

## **Safety of use**

The appropriate choice of treatment parameters is very important for safety and efficacy. [8] Some Articles indicate that the safety of RFM in comparison to other energy-based devices remains unclear. [9] In other articles it is noted that by delivering energy bypassing the epidermis, damage to the epidermis and subsequent dyspigmentation can be avoided. [10, 2] In addition RFM is safe in all skin types. It is easy for doctors to use, has a short recovery time and long-lasting results [1]. The appropriate choice of treatment parameters is very important for safety and efficacy. All patients before RFM treatment must have their skin cleaned with ethyl alcohol or isopropyl and receive anesthesia. In most cases, local anesthesia was applied in the area, which was planned to be treated. After treatment using sun protection, moisturizing the skin, and sometimes topical antibiotic therapy is advised. In some cases, people with a history of herpes were introduced to antiviral medication prophylactically two days before the procedure and continued for six days afterwards and then every other month for a year. [1, 11- 15, 20-22]

## **Side effects**

In the literature, no severe side effects were reported. Of note in the literature is the fact that post-inflammatory hyperpigmentation appeared in 30% of cases and resolved on its own or with the help of topical whitening creams. During the MN or RFM procedure, the adverse events that were reported by the majority of study papers included intra-procedure pain and bleeding, and post-procedure sensation of pain, discomfort or burning, erythema, and swelling. The most severe adverse effect that may occur is connected with the MN component and it is “railroad” or “tramtrack” scarring, especially during more “aggressive” treatment [2]. A less common side effect, but one worth noting and remembering, is an allergic reaction to the nickel contained in the device's needles [16].

## **Conclusions**

Minimally invasive methods of skin rejuvenation are a growing area of interest. RF micropuncture is a solution to many aesthetic and dermatological defects in various patients who do not wish to undergo plastic surgery intervention. [17] RFM, due to the combined action of two techniques, can solve many aesthetic problems effectively and with minimal risk. The method is gaining more and more attention and covers more and more indications, showing great effectiveness. Among others, RFM is indicated in skin rejuvenation, acne scars, melasma, thinning hair, and dermatological conditions such as acne vulgaris and rosacea. The

method is also highly regarded in treatments for parts of the body other than the head and neck area, being used in the treatment of cellulite, striae, and hyperhidrosis [9,18]. Distinctive from other available methods in aesthetic medicine are following the ability to control the penetration depth and target tissue that undergoes micro-injuries, no limitations in terms of the device's application in different skin types (according to Fitzpatrick's division), and low risk of severe adverse effects. Although the gold standard treatment for skin laxity remains the surgical facelift, a notable alternative may be the use of RFM [19], which produces noticeable results and carries fewer procedural risks and faster recovery time. With the growing interest in the FRM method, more and more scientific papers are reporting on the efficacy and effectiveness of this treatment, also highlighting its safety and ease of use. FRM is an attractive match for people's desires for a less invasive method of skin rejuvenation. Further research in this area is needed to optimize the parameters of the treatment to achieve the best results.

## **Disclosures**

### **Supplementary Materials**

Not applicable.

**Author's contribution:** Conceptualization, A. N. (Aleksandra Nowak) and A. N. (Alicja Nowak); methodology, N. B. ; software, K. B.; check, W. S., M. M. and P. M. ; formal analysis, Ł. C. ; investigation, P. M. and A. B. ; resources, A. B.; data curation, M. M. ; writing - rough preparation, A. N. (Aleksandra Nowak) and A. N. (Alicja Nowak) and K. B. ; writing - review and editing, Ł. C. and W. S. ; visualization, N. B. ; supervision, A. N. (Aleksandra Nowak); project administration, A. N. (Alicja Nowak); All authors have read and agreed with the published version of the manuscript.

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### **Conflicts of Interest**

The author declares no conflict of interest.

### **References:**

- [1] Hendricks, A. J., & Farhang, S. Z. (2022). Dermatologic facial applications of Morpheus8 fractional radiofrequency microneedling. *Journal of cosmetic dermatology*, 21 Suppl 1, S11–S19. <https://doi.org/10.1111/jocd.15231>
- [2] Juhasz, M. L. W., & Cohen, J. L. (2020). Microneedling for the Treatment of Scars: An Update for Clinicians. *Clinical, cosmetic and investigational dermatology*, 13, 997–1003. <https://doi.org/10.2147/CCID.S267192>
- [3] Austin, G. K., Struble, S. L., & Quatela, V. C. (2022). Evaluating the effectiveness and safety of radiofrequency for face and neck rejuvenation: A systematic review. *Lasers in surgery and medicine*, 54(1), 27–45. <https://doi.org/10.1002/lsm.23506>
- [4] Jung, J. M., Na, H. M., Kim, J. H., Yoon, J., Yang, H. J., Lee, W. J., Chang, S. E., Lee, M. W., & Won, C. H. (2022). The efficacy and safety of a fractional microneedle radiofrequency device for the treatment of axillary hyperhidrosis: clinical prospective pilot study. *Lasers in medical science*, 37(3), 1559–1566. <https://doi.org/10.1007/s10103-021-03404-z>
- [5] Kreindel, M., & Mulholland, S. (2022). The Basic Science of Radiofrequency-Based Devices. *IntechOpen*. doi: 10.5772/intechopen.96652

- [6] Dayan, E., Chia, C., Burns, A. J., & Theodorou, S. (2019). Adjustable Depth Fractional Radiofrequency Combined With Bipolar Radiofrequency: A Minimally Invasive Combination Treatment for Skin Laxity. *Aesthetic surgery journal*, 39(Suppl\_3), S112–S119. <https://doi.org/10.1093/asj/sjz055>
- [7] Dayan, E., Burns, A. J., Rohrich, R. J., & Theodorou, S. (2020). The Use of Radiofrequency in Aesthetic Surgery. *Plastic and reconstructive surgery. Global open*, 8(8), e2861. <https://doi.org/10.1097/GOX.0000000000002861>
- [8] Weiner S. F. (2019). Radiofrequency Microneedling: Overview of Technology, Advantages, Differences in Devices, Studies, and Indications. *Facial plastic surgery clinics of North America*, 27(3), 291–303. <https://doi.org/10.1016/j.fsc.2019.03.002>
- [9] Tan, M. G., Jo, C. E., Chapas, A., Khetarpal, S., & Dover, J. S. (2021). Radiofrequency Microneedling: A Comprehensive and Critical Review. *Dermatologic surgery : official publication for American Society for Dermatologic Surgery [et al.]*, 47(6), 755–761. <https://doi.org/10.1097/DSS.0000000000002972>
- [10] Howard J ‘Vampire facial’ at New Mexico spa tied to 2 HIV cases, health officials say. 2019. Available from: <https://www.cnn.com/2019/04/30/health/vampire-facial-hiv-cases-new-mexico-bn/index.html>. Accessed December4, 2020.
- [11] Sasaki G. H. (2017). Micro-Needling Depth Penetration, Presence of Pigment Particles, and Fluorescein-Stained Platelets: Clinical Usage for Aesthetic Concerns. *Aesthetic surgery journal*, 37(1), 71–83. <https://doi.org/10.1093/asj/sjw120>
- [12] El-Domyati M, Barakat M, Awad S, Medhat W, El-Fakahany H, Farag H. Microneedling Therapy for Atrophic Acne Scars: An Objective Evaluation. *J Clin Aesthet Dermatol*. 2015 Jul;8(7):36-42. PMID: 26203319; PMCID: PMC4509584.
- [13] Bhargava, S., Kumar, U., & Varma, K. (2019). Subcision and Microneedling as an Inexpensive and Safe Combination to Treat Atrophic Acne Scars in Dark Skin: A Prospective Study of 45 Patients at a Tertiary Care Center. *The Journal of clinical and aesthetic dermatology*, 12(8), 18–22.
- [14] Afra, T. P., Razmi T, M., Narang, T., Dogra, S., & Kumar, A. (2019). Topical Tazarotene Gel, 0.1%, as a Novel Treatment Approach for Atrophic Postacne Scars: A Randomized Active-Controlled Clinical Trial. *JAMA facial plastic surgery*, 21(2), 125–132. <https://doi.org/10.1001/jamafacial.2018.1404>
- [15] Minh, P. P. T., Bich, D. D., Hai, V. N. T., Van, T. N., Cam, V. T., Khang, T. H., Gandolfi, M., Satolli, F., Feliciani, C., Tirant, M., Vojvodic, A., & Lotti, T. (2019). Microneedling Therapy for Atrophic Acne Scar: Effectiveness and Safety in Vietnamese Patients. *Open access Macedonian journal of medical sciences*, 7(2), 293–297. <https://doi.org/10.3889/oamjms.2019.098>

- [16] Yadav, S., & Dogra, S. (2016). A Cutaneous Reaction to Microneedling for Postacne Scarring Caused by Nickel Hypersensitivity. *Aesthetic surgery journal*, 36(4), NP168–NP170. <https://doi.org/10.1093/asj/sjv229>
- [17] Magro, I., Kochhar, A., Arnaoutakis, D., & Karimi, K. (2022). Transcutaneous Radiofrequency Microneedling in the Facial Plastic Surgeon's Practice: A Review. *Facial plastic surgery & aesthetic medicine*, 24(S1), S3–S10. <https://doi.org/10.1089/fpsam.2022.0226>
- [18] Hurwitz, D. J., & Wright, L. (2020). Noninvasive Abdominoplasty. *Clinics in plastic surgery*, 47(3), 379–388. <https://doi.org/10.1016/j.cps.2020.03.005>
- [19] Alexiades-Armenakas, M., Rosenberg, D., Renton, B., Dover, J., & Arndt, K. (2010). Blinded, randomized, quantitative grading comparison of minimally invasive, fractional radiofrequency and surgical face-lift to treat skin laxity. *Archives of dermatology*, 146(4), 396–405. <https://doi.org/10.1001/archdermatol.2010.24>
- [20] el-Domyati, M., el-Ammawi, T. S., Medhat, W., Moawad, O., Brennan, D., Mahoney, M. G., & Uitto, J. (2011). Radiofrequency facial rejuvenation: evidence-based effect. *Journal of the American Academy of Dermatology*, 64(3), 524–535. <https://doi.org/10.1016/j.jaad.2010.06.045>
- [21] El-Domyati, M., El-Ammawi, T. S., Medhat, W., Moawad, O., Mahoney, M. G., & Uitto, J. (2012). Multiple minimally invasive Erbium: Yttrium Aluminum Garnet laser mini-peels for skin rejuvenation: an objective assessment. *Journal of cosmetic dermatology*, 11(2), 122–130. <https://doi.org/10.1111/j.1473-2165.2012.00606.x>
- [22] Doddaballapur S. (2009). Microneedling with dermaroller. *Journal of cutaneous and aesthetic surgery*, 2(2), 110–111. <https://doi.org/10.4103/0974-2077.58529>