Enlarged Facial Pores: An Update on Treatments

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PRACTICE **POINTS**

- The pathogenesis of enlarged facial pores is speculated to be associated with sebum production, skin aging and photodamage, and hair follicle size, among other factors.
- Current treatment modalities for enlarged facial pores target these factors and include topical retinoids, chemical peels, oral antiandrogens, lasers, radiofrequency, and ultrasound devices, with the latter devices offering the most novel and robust choices.
- New botanically derived topical treatments, specifically copper chlorophyllin complex sodium salt and tetra-hydro-jasmonic acid, are in development with initial positive results, though studies are still limited.

Enlarged facial pores remain a common dermatologic and cosmetic concern from acne and rosacea, among other conditions, that is difficult to treat due to the multifactorial nature of their pathogenesis and negative impact on patients' quality of life. Enlarged facial pores are primarily treated through addressing associative factors, such as increased sebum production and cutaneous aging. We review the current treatment modalities for enlarged or dense facial pores, including topical retinoids, chemical peels, oral antiandrogens, and lasers and devices, with a focus on newer therapies.

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Enlarged facial pores are superficial skin structures that are visualized as small openings on the skin corresponding to the openings of the pilosebaceous apparatus. These openings may be impacted with horny follicular plugs consisting of sebaceous debris that appear as open comedones.[1] *Skin pores* is a lay term that is poorly defined in the medical literature and often is categorized in terms of arbitrary circular diameters determined through cosmetic skin analyzers.[2] The term refers to pilosebaceous follicular enlargements (with or without open comedonal horny impactions) that can be visualized by the naked eye, most commonly occurring on the face and scalp. These enlarged pores remain a pervasive cosmetic concern that impacts patient quality of life. Enlarged pores are difficult to treat, in part due to lack of knowledge of the pathophysiology; thus, we review the currently proposed causes of enlarged pilosebaceous openings and the treatments in the scope of this pathogenesis with a focus on therapeutic efficacy.

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Pathogenesis of Enlarged Facial Pores

It is now thought that seborrhea, loss of skin elasticity and tension, and hair follicle size are most clinically relevant to the pathogenesis of enlarged pores.[2] Other potential associated and causative factors include genetic predisposition, acne, comedogenic xenobiotics, chronic photodamage, chronic radiodermatitis, and vitamin A deficiency.[1,3]

The direct relationship between sebum output and pore size has been well established, particularly in men who generally have higher sebum output levels than women, which likely is testosterone driven.[4,5] However, there are contradictory data on whether sex affects pore size, as females also exhibit contributory hormonal factors. Sebum output and pore size increase substantially during the ovulation phase of the female

menstrual cycle, likely secondary to increased progesterone affecting sebaceous gland activity.[2,4]

The presence of acne also is associated with enlarged facial pores, though the extent of seborrhea as a confounding factor is unclear. Furthermore, acne severity does not correlate with increased pore size.[5] However, the processes of acne and facial pores are interlinked, given the frequent occurrence of open comedones within the pores.

Skin elasticity and tensile strength when defined visually and mechanically has shown a negative correlation with facial pore size and density.[5] It is well known that cutaneous aging and chronic photodamage cause perturbation in the collagen and elastin framework that allows for the skin to maintain its resilient properties.[6] Aged and photodamaged skin also demonstrates decreased expression of microfibril-associated glycoprotein-1 (MAGP-1), a crucial component in elastic fiber assembly and skin elasticity in the dermis and perifollicular/pore areas.[7]

Pore density and size appears to range diversely across ethnicities, though Chinese women exhibit notably lower pore size and density across all ages as compared to other ethnicities.[8] Black individuals have aberrant epidermal architecture, defined as the presence of stalagmitelike structures at the dermoepidermal junction, correlating with enlarged pore size compared to other ethnicities.[2,8]

Treating Enlarged Facial Pores

Treatments for enlarged facial pores primarily aim to decrease sebum production, rejuvenate skin, remove hair, and/or decrease follicular size. Evidence-based studies are limited, and many currently used therapies have not been studied with enlarged facial pores as a primary investigative outcome. Here, we include studies that report efficacy in decreasing pore size specifically. It is important to note the lack of a uniform and objective modality with which to report skin pore size. Studies use a wide range of techniques including patient self-reporting, physician observation, and software image analyzers.

Topical Therapies—Topical retinoids are vitamin A derivatives, and they are first-line therapies in reversing the aberrant collagen and elastin-associated epidermal and dermal changes that occur with chronological aging and photoaging. Tretinoin, isotretinoin, and tazarotene have shown efficacy in multiple parameters of skin rejuvenation, including facial pores, skin wrinkling, hyperpigmentation, skin laxity, and sebum production.[9] However, it is important to note that retinoids treat keratinocyte atypia in acne, and efficacy in facial pores is confounded by improvement in follicular keratinization. Because studies have not distinctly uncoupled this association, it is erroneous to conclude that retinoids reduce facial pore size and density irrespective of concomitant acne vulgaris.

Tazarotene has been evaluated for use in reducing facial pore size. In one investigation, 568 patients with moderate wrinkling or hyperpigmentation were randomized to receive tazarotene cream 0.1% or placebo once daily for 24 weeks and were evaluated for enlarged facial pores as a secondary outcome using a double-blinded physician 5-point scale.[10] At week 24, 42% of tazarotene-treated patients achieved improvement of at least 1 point compared to 20% of placebo-treated patients ($P<.001$). Adverse events were dermatitic, as can be expected of retinoids, leading to a 4% discontinuation rate in the tazarotene group compared to 1% in the placebo group.[10]

Tretinoin has long been used off label for antiaging treatments but has only recently shown efficacy for facial pores. In one study, 60 women who had previously sought antiaging procedures were treated with tretinoin cream 0.025% once daily and no other antiaging products or procedures for 90 days.[11] Facial pore evaluations were determined by a modified dermatoscope with a polarized analyzer for clinical scoring using a photonumeric scale. Patients improved from a baseline average score of 3.2 in facial pores to a posttreatment average score of 2.0 ($P<.05$) at day 84. This improvement was sustained from day 28 of treatment and corresponded to patient self-perception. Adverse events included xerosis, desquamation, burning, and erythema, which led to 3 premature discontinuations.[11]

Various chemical peel formulations are used in skin rejuvenation and have shown application in enlarged facial pores. Chemical peels act at the epidermal or dermal level to induce temporary breakdown and regeneration of healthier cells and improved skin matrix.[12] Twenty-two Japanese women applied glycolic acid (30% solution) every 2 weeks for a total of 5 treatments and exhibited reduced appearance of conspicuous, open, and dark pores, defined by surface area and shading as determined through dermatoscopic and software analysis, with mean improvement rates of 34.6%, 11%, and 34.3%, respectively. More than 70% of participants exhibited improvement in enlarged facial pores.[13] A study involving a 40% glycolic acid and vitamin C formulation demonstrated significant improvement in facial pores (28.3%; $P<.001$).[14]

The newest topical therapies studied for use in minimizing facial pilosebaceous openings are natural plant-derived copper chlorophyllin complex sodium salt (CHLcu) and tetra-hydro-jasmonic acid (LR2412). Clinical trials of these botanicals are

limited with small sample sizes but are included here as novel treatments requiring further investigation.

Chlorophyllin copper complex sodium salt is derived from chlorophyll, a green pigment found in plants, and has been investigated as a topical gel in liposomal dispersions for application in photodamaged and aged skin. Chlorophyllin copper complex sodium salt exerts in vitro hyaluronidase inhibitory activity to maintain hyaluronic acid in the extracellular matrix and counteract the structural breakdown of cutaneous aging.[15] Two small single-center pilot trials enrolled 10 participants each in a 3-week study of CHLcu 0.1% twice daily and an 8-week study of CHLcu 0.066% twice daily.[16,17] After 3 weeks, patients treated with CHLcu 0.1% exhibited a 22.2% improvement in facial pores by clinical assessment grading, though this improvement was not significant on software imaging analysis. Patients improved the most on parameters of facial seborrhea by clinical assessment.[16] After 8 weeks, patients treated with CHLcu 0.066% exhibited 25.3% improvement in facial pores by clinical assessment grading.[17] Treatments were reported to be well tolerated without noted adverse events in both studies.

Tetra-hydro-jasmonic acid is an analogue of jasmonic acid, a plant hormone derived from linoleic acid. Due to its favorable safety profile and bioavailability, penetration into epidermal and dermal layers, and potential effects in rejuvenating desquamation, LR2412 is currently being assessed for treatment of skin wrinkles, texture, and pores.[18] Its effect is thought to relate to stimulation of laminin-5, collagen IV, and fibrillin deposition at the dermoepidermal junction.[19] In an open-label trial of a topical preparation of LR2412, 15 participants were treated twice daily for 6 weeks and assessed through investigator clinical assessment scoring.[20] Investigator scoring of pores improved by 25.2% from baseline ($P<.05$) after 6 weeks of treatment. Improvement in pores was seen as early as days 1 and 3. No serious adverse events were reported, though 2 participants developed acne on follow-up.[20]

Tetra-hydro-jasmonic acid also is formulated with retinol (retinol 0.2%/LR2412 2.0%) and demonstrated cosmetic efficacy in a noninferiority trial with tretinoin cream 0.025%.[11] Sixty patients each were randomized to retinol/LR2412 or tretinoin at bedtime and treated for 90 days. At day 84, participants in the retinol/LR2412 group exhibited an improvement in investigator clinical assessment scoring from a baseline of 3.6 to 2.5 ($P<.05$). There were no significant differences in investigator-assessed efficacy between the treatment arms. Participants reported similar or better results and fewer side effects with retinol/LR2412 on self-questionnaires. Eight participants treated with retinol/LR2412 and 15 participants treated with tretinoin reported various incidences of skin irritation, burning, and desquamation.[11]

Oral Therapies—The most commonly used oral therapies for enlarged pores are antiandrogens, such as combined oral contraceptives, spironolactone, and cyproterone acetate, which modulate sebum production due to the presence of androgen receptors within sebaceous glands.[21] Forty-four white women in an open-label, phase 4 study were treated with combined oral contraceptives containing chlormadinone acetate–ethinyl estradiol for 6 menstrual cycles, with standardized photography taken before and after the treatment period for software analysis. After 6 treatment cycles, 9.1% (4/44) of participants had visibly enlarged pores of the forehead and cheeks compared to 43.2% (19/44) of participants at baseline ($P<.0001$).[22] The effects of other antiandrogens on facial pores have not been studied in this capacity.

Lasers, Radiofrequency, and Ultrasound Devices—The development of various devices that can deliver targeted thermal or ultrasound energy to the skin offers the newest and most robust modality in cosmetic therapy. The mechanism of their efficacy may be due to a combination of induced remodeling of collagen fibers near pilosebaceous openings to increase skin elasticity and decrease sebum production.[2,23]

Devices with established antiaging effects have been extensively reviewed and include the gold particle 800-nm diode laser, 1450-nm diode laser, microneedle apparatuses, fractional radiofrequency devices, 2790-nm erbium:YAG laser, nonablative 1410-nm fractionated erbium-doped fiber laser, and nonablative 1440-nm fractional laser.[2]

Literature on the use of these devices for minimizing facial pore size is limited. One treatment of intense focused ultrasound using a 3-mm transducer successfully improved overall pore appearance in 91% of sites at 6-week follow-up on a clinical grading scale.[24] Three sessions of nonablative 1410-nm fractionated erbium-doped fiber laser treatments yielded facial skin pore minimization of greater than 51% in 14 of 15 participants.[25]

The nonablative 1440-nm diode fractional laser received 510(k) clearance by the US Food and Drug Administration in 2011 for aesthetic use in chronologically aged and photoaged skin. Twenty participants treated for 2 weeks and a total of 6 facial treatments with this laser system showed a 17% average improvement in facial pore score on software analysis ($P\leq.002$). Adverse events were mild and included erythema and xerosis.[26]

Conclusion

The reliability of available literature on efficacy of various treatments in diminishing facial skin pores has been challenging given that most studies are low in power, lack control groups, use nonuniform methods of reporting outcomes, and do not report complete adverse events. Thus, all results should be interpreted with caution.

Overall, it is clear that the pathogenesis of enlarged facial pores is multifactorial and complex, necessitating a similar approach to therapeutics. Topical treatments offer a range of diverse therapies with proven benefit in facial pore reduction. The advent of lasers and devices offers constantly evolving therapeutic options with diffuse antiaging effects. Despite the numerous topical, oral, and device-oriented options, enlarged facial pores remain a challenging cosmetic concern. More robust efficacy studies on new treatments are necessary.

REFERENCES

1. Uhoda E, Pierard-Franchimont C, Petit L, et al. The conundrum of skin pores in dermocosmetology. *Dermatology*. 2005;210:3-7.
2. Lee SJ, Seok J, Jeong SY, et al. Facial pores: definition, causes, and treatment options. *Dermatol Surg*. 2016; 42:277-285.
3. Pierard GE, Pierard-Franchimont C, Marks R, et al. EEMCO guidance for the in vivo assessment of skin greasiness. The EEMCO Group. *Skin Pharmacol Appl Skin Physiol*. 2000;13:372-389.
4. Roh M, Han M, Kim D, et al. Sebum output as a factor contributing to the size of facial pores. *Br J Dermatol*. 2006;155:890-894.
5. Kim BY, Choi JW, Park KC, et al. Sebum, acne, skin elasticity, and gender difference-which is the major influencing factor for facial pores? *Skin Res Technol*. 2013;19:E45-E53.
6. Uitto J. The role of elastin and collagen in cutaneous aging: intrinsic aging versus photoexposure. *J Drugs Dermatol*. 2008;7(2 suppl):S12-S16.
7. Zheng Q, Chen S, Chen Y, et al. Investigation of age-related decline of microfibril-associated glycoprotein-1 in human skin through immunohistochemistry study. *Clin Cosmet Investig Dermatol*. 2013;6:317-323.
8. Sugiyama-Nakagiri Y, Sugata K, Hachiya A, et al. Ethnic differences in the structural properties of facial skin. *J Dermatol Sci*. 2009;53:135-139.
9. Mukherjee S, Date A, Patravale V, et al. Retinoids in the treatment of skin aging: an overview of clinical efficacy and safety. *Clin Interv Aging*. 2006;1:327-348.
10. Kang S, Krueger GG, Tanghetti EA, et al; Tazarotene Cream in Photodamage Study Group. A multicenter, randomized, double-blind trial of tazarotene 0.1% cream in the treatment of photodamage. *J Am Acad Dermatol*. 2005;52:268-274.
11. Bouloc A, Vergnanini AL, Issa MC. A double-blind randomized study comparing the association of retinol and LR2412 with tretinoin 0.025% in photoaged skin. *J Cosmet Dermatol*. 2015;14:40-46.
12. Fischer TC, Perosino E, Poli F, et al. Chemical peels in aesthetic dermatology: an update 2009 [published online September 8, 2009]. *J Eur Acad Dermatol Venereol*. 2010;24:281-292.
13. Kakudo N, Kushida S, Tanaka N, et al. A novel method to measure conspicuous facial pores using computer analysis of digital-camera-captured images: the effect of glycolic acid chemical peeling. *Skin Res Technol*. 2011;17:427-433.
14. Kim WS. Efficacy and safety of a new superficial chemical peel using alpha-hydroxy acid, vitamin C and oxygen for melasma. *J Cosmet Laser Ther*. 2013;15:21-24.
15. McCook JP, Dorogi PL, Vasily DB, et al. In vitro inhibition of hyaluronidase by sodium copper chlorophyllin complex and chlorophyllin analogs. *Clin Cosmet Investig Dermatol*. 2015;8:443-448.
16. Stephens TJ, McCook JP, Herndon JH Jr. Pilot study of topical copper chlorophyllin complex in subjects with facial acne and large pores. *J Drugs Dermatol*. 2015;14:589-592.
17. Sigler ML, Stephens TJ. Assessment of the safety and efficacy of topical copper chlorophyllin in women with photodamaged facial skin. *J Drugs Dermatol*. 2015;14:401-404.
18. Alexiades M. Jasmonates and tetrahydrojasmonic acid: a novel class of anti-aging molecules. *J Drugs Dermatol*. 2016;15:206-207.
19. Tran C, Michelet JF, Simonetti L, et al. In vitro and in vivo studies with tetra-hydro-jasmonic acid (LR2412) reveal its potential to correct signs of skin ageing. *J Eur Acad Dermatol Venereol*. 2014;28:415-423.
20. Alexiades M. Clinical assessment of a novel jasmonate cosmeceutical, LR2412-Cx, for the treatment of skin aging. *J Drugs Dermatol*. 2016;15:209-215.
21. Lam C, Zaenglein AL. Contraceptive use in acne. *Clin Dermatol*. 2014;32:502-515.
22. Kerscher M, Reuther T, Bayrhammer J, et al. Effects of an oral contraceptive containing chlormadinone and ethinylestradiol on acne-prone skin of women of different age groups: an open-label, single-centre, phase IV study. *Clin Drug Investig*. 2008;28:703-711.
23. Schmults CD, Phelps R, Goldberg DJ. Nonablative facial remodeling: erythema reduction and histologic evidence of new collagen formation using a 300-microsecond 1064-nm Nd:YAG laser. *Arch Dermatol*. 2004;140:1373-1376.
24. Lee HJ, Lee KR, Park JY, et al. The efficacy and safety of intense focused ultrasound in the treatment of enlarged facial pores in Asian skin. *J Dermatolog Treat*. 2015;26:73-77.
25. Suh DH, Chang KY, Lee SJ, et al. Treatment of dilated pores with 1410-nm fractional erbium-doped fiber laser. *Lasers Med Sci*. 2015;30:1135-1139.
26. Saedi N, Petrell K, Arndt K, et al. Evaluating facial pores and skin texture after low-energy nonablative fractional 1440-nm laser treatments. *J Am Acad Dermatol*. 2013;68:113-118.