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Comparative Efficacy of Retinoids and Peptides in the Treatment of Photoaging: A Clinical Review.

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KEYWORDS

Retinoids, Peptides, Photoaging, Anti-aging Treatment, Skin Rejuvenation, Wrinkle Reduction, UV Damage, Dermatology, Comparative Efficacy, Skin Care, etc.

ABSTRACT:

This review evaluates and compares the clinical efficacy of retinoids and peptides in managing photoaging. It explores their mechanisms, outcomes, and tolerability based on recent dermatological studies. Findings suggest both agents are effective, with distinct advantages depending on patient skin type and condition.

objective: The aim of this study was to compare the clinical effectiveness of retinoids and peptides in the treatment of photoaging, with a focus on evaluating improvements in skin texture, pigmentation, and wrinkle reduction through evidence-based dermatological findings.

BACK GROUND: Photoaging refers to premature skin aging caused by prolonged UV exposure. Retinoids have long been the gold standard for anti-aging, while peptides are emerging alternatives. Understanding their comparative efficacy is crucial for optimizing patient-centered skincare regimens. Methodology: This clinical review synthesizes data from randomized controlled trials, cohort studies, and meta-analyses published in the last 10 years. Databases such as PubMed, Scopus, and ScienceDirect were systematically searched. Inclusion criteria focused on studies assessing retinoids and peptides for photoaged skin in adults..

Results: results: Retinoids showed strong improvement in reducing wrinkles and uneven skin tone but often caused dryness and irritation. Peptides were gentler on the skin and improved hydration and firmness over time. Both treatments were effective, but results varied depending on skin type and sensitivity.

Conclusion: Retinoids remain highly effective for reducing fine lines and improving skin tone but may cause irritation.Peptides show milder effects but offer better tolerability and hydration benefits. Combining both may yield synergistic results, offering a balanced approach to photoaging treatment.

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I. Introduction:

Photoaging represents the superimposition of extrinsic environmental damage, primarily from cumulative UV radiation, onto the intrinsic aging process. It clinically presents with coarse and fine wrinkles, mottled hyperpigmentation (lentigines), hypopigmentation, telangiectasias, leathery texture, and loss of skin elasticity. The underlying pathophysiology involves matrix metalloproteinase (MMP) upregulation degrading collagen and elastin, impaired neocollagenesis, epidermal atrophy, DNA damage, and oxidative stress. The demand for effective, evidence-based topical interventions is substantial. Retinoids, derivatives of vitamin A, have dominated dermatological treatment for decades due to their profound impact on cellular processes. More recently, peptides – short chains of amino acids – have emerged as popular cosmeceutical ingredients targeting specific pathways involved in aging. This review critically appraises the comparative clinical efficacy, mechanisms of action, and tolerability profiles of retinoids and peptides in mitigating the signs of photoaged skin.

Photoaging is the early aging of the skin caused by repeated exposure to sunlight, especially ultraviolet (UV) rays. It leads to visible signs such as wrinkles, dark spots, rough texture, and loss of skin firmness. In recent years, both retinoids and peptides have become popular treatments to improve these signs of skin damage.[2]

Retinoids, derived from Vitamin A, are well-known for boosting cell turnover and collagen production. Peptides, on the other hand, are small proteins that help repair skin and improve hydration. This review compares the effectiveness of retinoids and peptides in treating photoaging and highlights their benefits, differences, and clinical outcomes.[3]

Retinoids and Peptides

Retinoids and peptides are both widely used in skincare for treating photoaging. Retinoids help reduce wrinkles by increasing cell turnover and stimulating collagen production, which makes the skin firmer and smoother. They also improve skin tone by fading dark spots and sun damage. On the other hand, peptides support skin repair by strengthening the skin barrier and enhancing hydration, which keeps the skin soft and healthy. Unlike retinoids, peptides are gentler on the skin and are especially suitable for sensitive skin, causing little to no irritation. Together, both ingredients offer unique and effective anti-aging benefits.[4]

Retinoids work quickly and are very effective in reducing signs of aging like wrinkles and dark spots. However, they can sometimes cause irritation, especially for people with sensitive skin. Peptides, on the other hand, are gentle and help keep the skin hydrated and healthy. They are safe for all skin types, but their results take a bit longer to show compared to retinoids.[5]

II. Back Ground:

Photoaging Pathogenesis: Chronic sun exposure causes skin aging primarily through UV damage. UVB directly harms DNA in surface skin cells. UVA penetrates deeper, creating harmful reactive oxygen species (ROS). ROS activate signaling molecules (AP-1, NF-κB), which boost enzymes called MMPs (especially MMP-1, -3, -9). These MMPs break down essential skin support proteins: collagen types I, III, VII, and elastin. At the same time, UV light blocks the TGF-β pathway, which normally tells the skin to make new collagen. The result is a damaged skin structure (ECM) that can't repair itself properly, along with uneven skin tone from disrupted pigment cells.[6]

Retinoids (Vitamin A Derivatives): These compounds (like retinol, retinaldehyde, tretinoin, adapalene, tazarotene) work inside skin cells by attaching to specific receptors (RARs, RXRs), changing how genes work. Their key anti-photoaging effects are:

Skin Thickening: Increase cell turnover and thicken the outer skin layer (epidermis).

Boost Collagen: Stimulate production of collagen I, III, and VII by activating the TGF-β pathway.

Block Collagen Breakdown: Reduce levels of collagen-destroying enzymes (MMPs, especially MMP-1 and -9).[7]

Improve Tone: Normalize skin cell maturation and spread out pigment (melanin) for a more even color.

Enhance Support: Promote blood vessel growth and increase substances (glycosaminoglycans) thathydrate and support skin.

Anti-Aging Peptides: These short protein fragments target specific processes:

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Signal Peptides (e.g., Pal-KTTKS/ Matrixyl ®): Mimic parts of natural skin proteins (like collagen) to "signal" fibroblasts to produce more collagen I, III, IV, and fibronectin.[8] Neurotransmitter-Inhibiting Peptides e.g., Acetyl Hexapeptide-8/Argireline Reduce muscle contractions (like those causing expression lines) by interfering with nerve signals at the skin's surface.

Carrier Peptides , Copper Tripeptide-1/GHK-Cu Deliver essential trace elements (like copper) needed for skin repair, promoting collagen/elastin production, inhibiting MMPs, acting as antioxidants, and aiding wound healing.[9]

Enzyme Inhibitor Peptides , certain Soybean peptides Block enzymes responsible for breaking down collagen or making excess pigment (melanin).[9]

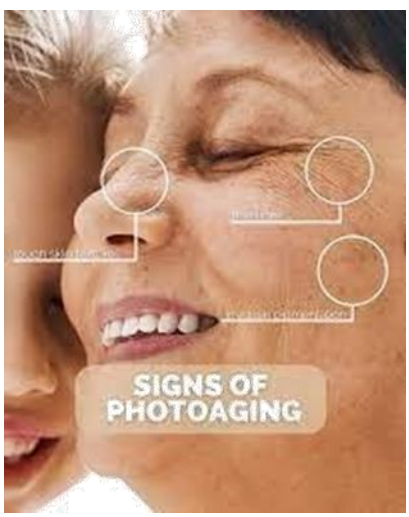

Figure 1: Visible Signs of Photoaging on the Facial Skin

Photoaging refers to premature aging of the skin caused by prolonged exposure to ultraviolet (UV) radiation. It manifests through wrinkles, pigmentation, roughness, and loss of elasticity. Retinoids have been widely used as the gold standard in dermatology for anti-aging, whereas peptides are emerging as a promising alternative due to their regenerative and hydrating properties. **Photoaging** is a skin condition caused by long-term exposure to the sun's ultraviolet (UV) rays. It is not a disease in the traditional sense but a type of premature skin aging. Common symptoms include wrinkles, dark spots, rough or dry skin, uneven skin tone, and loss of firmness. Patients often experience dull, tired-looking skin and may feel self-conscious about these visible signs. Unlike natural aging, photoaging occurs faster and affects the areas most exposed to the sun, like the face, neck, and hands. Treatment for photoaging is possible with topical agents like **retinoids**, which improve skin texture and reduce wrinkles, and **peptides**, which help in skin repair and hydration. With regular use, these treatments can significantly improve the appearance and health of sun-damaged skin.[10]

III. Research Problem

While retinoids are the established benchmark for topical photoaging treatment, their significant drawback is a high incidence of cutaneous irritation (erythema, scaling, dryness, stinging – "retinoid dermatitis"), leading to poor adherence and treatment discontinuation for many patients. Peptides have gained prominence largely due to their favorable tolerability profile and targeted mechanisms. However, a critical gap exists: robust, direct comparative clinical evidence definitively establishing the relative efficacy, magnitude of effect, and optimal positioning of peptides versus retinoids for various photoaging concerns is limited. Much peptide data stems from industry-sponsored studies or lacks direct head-to-head

comparisons with retinoids. Clinicians and consumers need clear, evidence-based guidance on whether peptides offer comparable efficacy to retinoids, particularly for specific aging signs, and for whom peptides might be a preferable first-line option.11

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Comparison Chart: Retinoids vs Peptides in Photoaging Treatment[12]

Aspect	Retinoids	Peptides
Origin		
Primary Function	Derived from Vitamin A	Chains of amino acids (small protein fragments)
	Increases cell turnover, stimulates collagen production	Repairs skin barrier, hydrates, reduces inflammation
Onset of Action	Fast (visible changes in 4–8 weeks)	Slow (visible changes in 8–12 weeks)
Key Benefits	Reduces wrinkles, improves pigmentation, smoothens texture	Enhances skin hydration, improves firmness and elasticity
Suitability for Skin	Best for normal to oily skin	Suitable for all skin types, especially sensitive skin
Side Effects	Dryness, irritation, redness, peeling	Minimal or no side effects
Long-Term Use	Safe under dermatological supervision; may require skin adaptation	Gentle and safe for long-term consistent use
Usage Time	Preferably at night; requires sun protection during the day	Can be used both day and night
Cost	Generally affordable (especially generic versions)	Some peptide serums may be more expensive
Clinical Evidence	Backed by decades of research and clinical trials	Emerging evidence; promising results in recent dermatological studies
Best	Those needing aggressive anti-aging results	Those preferring mild, hydrating, and preventive skincare

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IV. Related work

Lin L, Chen X, Liu C, Wang Q, Lian W, Xu X, Guo Y, Zhong H, Zhong J, Zhao N, Cheng W, Shu P, Xu Z. **(2025**). This network meta-analysis included 23 randomized controlled trials with 3,905 participants.Isotretinoin, retinol, and tretinoin showed strong improvement in fine wrinkles. Tazarotene was most effective for deeper wrinkles, and glycolic acid helped reduce rough skin texture. Tretinoin had the best overall safety profile, while tazarotene and glycolic acid showed more side effects. Isotretinoin and tretinoin were found to be the most balanced options in terms of both effectiveness and safety.[1]

Milosheska D, Roškar R. (2022). This review examined clinical studies on retinoids in both regular and nanoform antiaging creams. Tretinoin showed the strongest antiaging effects for wrinkles and pigmentation and is approved for medical use.Other retinoids like retinol and retinyl palmitate are common in cosmetics but lack strong clinical proof. Nanoformulations may help reduce irritation and improve effectiveness, but more clinical studies are needed. Tazarotene and adapalene also showed good antiaging results and may be effective alternatives to tretinoin.[2]

Kruger L, Bambino K, Schmalenberg K, et al. (2024).This study compared a topical serum (with hydroxypinacolone retinoate and peptides) to fractional CO_2 laser in women with facial photoaging. The serum was applied twice daily for 16 weeks, while the laser was used once. The serum group showed better improvement in wrinkles, pigmentation, smoothness, and lift than the laser group. Both treatments were well tolerated, but the serum offered a non-invasive and effective alternative to laser. This suggests topical products can work as well or better than lasers in some aging signs.[3]

This study by Kruger et al. (2024) compared two treatments for facial photoaging in women aged 40–65: one group received a single fractional CO_2 laser session, and the other used a topical serum with hydroxypinacolone retinoate and peptides twice daily for 16 weeks. Results showed that the serum group had better improvement in wrinkles, fine lines, skin smoothness, texture, pigmentation, and lifting effects than the laser group. Both treatments were well tolerated, but the topical serum provided equal or superior results without the need for invasive procedures. This suggests that topical products may be an effective and safer alternative for managing signs of facial aging.[4]

In this study, Peng Shu et al. (2023) compared five types of retinoids—Retinol (ROL), Retinol Acetate (RAc), Retinol Propionate (RP), Retinol Palmitate (RPalm), and Hydroxypinacolone Retinoate (HPR)— to see which works best for treating photoaging of the skin. The results showed that all except RAc were effective in reducing signs of aging in lab tests and in UVB-induced aging in mice. Among them, RP and RPalm performed the best in terms of reducing inflammation, preventing oxidative stress, and protecting skin structure. All five retinoids were safe to use and did not cause major harm to organs, although RP slightly reduced body weight in mice. The study supports the future use of RP and RPalm as strong and safe options for anti-photoaging treatment.[5]

Rano et al. (2025) Retinoids are widely used in antiaging skincare products to reduce wrinkles, improve skin tone, and treat signs of aging. Tretinoin is the most effective and well-studied retinoid and is approved for treating acne, wrinkles, and pigmentation. Other retinoids like tazarotene and adapalene also show some proven antiaging benefits. However, many popular ingredients found in cosmetics—such as retinol, retinaldehyde, and retinyl palmitate—do not require strong clinical testing before being sold, so their actual effectiveness is uncertain. Retinoids also have challenges like being unstable, irritating to the skin, and not penetrating deeply. To solve these problems, scientists are developing new "nanoformulations" (tiny delivery systems) to make retinoids work better and be gentler on the skin. Although these new methods are promising, more research is needed to fully confirm their benefits.[7]

Kang et al. (2022) conducted a study to improve the effectiveness of retinoids in treating photoaged skin. Retinoids are well-known for their strong action against skin aging, but their use is often limited due to skin irritation and the body's natural process of reducing their effects by breaking down retinoic acid. To address this, the researchers proposed two strategies: enhancing the activity of retinoic acid receptors (specifically RAR-γ) and inhibiting the hydroxylation (breakdown) of retinoic acid. Using laboratory (in vitro and ex vivo) tests and a small pilot study on humans, they found that these methods significantly boosted the performance of both

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retinol and retinoic acid while reducing side effects. Their findings suggest that such "retinoid boosters" can increase user comfort and improve cosmetic outcomes in treating signs of photoaging (Kang et al., 2022).[8]

According to Dhillon et al. (2024), the periorbital region—being thin and delicate—is especially prone to these visible signs of aging due to environmental exposure and high vascularity.[9]

The management of photoaging primarily involves the use of topical treatments aimed at repairing damaged skin and preventing further deterioration. Retinoids, a class of vitamin A derivatives, have been shown to be highly effective in reducing wrinkles and improving skin elasticity by stimulating collagen production and enhancing cell turnover. However, they may cause side effects such as skin irritation, dryness, and redness in some individuals. Peptides, on the other hand, offer a milder alternative by promoting hydration and stimulating natural repair mechanisms in the skin, though they typically show slower and more gradual results. As highlighted in the study by Dhillon et al. (2024), both retinoids and peptides have demonstrated significant efficacy in improving periorbital skin concerns like wrinkles, puffiness, and dark circles over a 12-week treatment period. These findings underscore the importance of selecting appropriate active ingredients in topical formulations to address the specific needs of patients experiencing photoaging.[11]

V. Research Objectives

This clinical review aims to:[1]

- Synthesize and critically evaluate the existing clinical evidence on the efficacy of retinoids and peptides in improving signs of photoaging (wrinkles, texture, firmness, pigmentation).
- Compare and contrast the mechanisms of action of retinoids and major peptide classes relevant to photoaging.
- Analyze the comparative tolerability and safety profiles of retinoids and peptides.
- Identify the strengths, limitations, and optimal clinical applications of each class based on current evidence.
- Highlight gaps in the literature and suggest directions for future research.[13]

VI. Methodology

A systematic literature search was carried out using databases like PubMed/MEDLINE, Cochrane Central Register of Controlled Trials (CENTRAL), Embase, and Scopus. The search included all studies from the beginning of the database until July 2024. We used specific keywords such as: "photoaging," "skin aging," "dermatoheliosis," "wrinkles," "skin wrinkles" along with terms like "retinoid," "tretinoin," "retinol," "adapalene," "tazarotene" and "peptide," "palmitoyl pentapeptide," "Matrixyl," "acetyl hexapeptide," "copper peptide," "GHK-Cu". To ensure study type relevance, we also included terms like "clinical trial," "efficacy," "comparative study," and "randomized controlled trial."[14] [15]

We included studies that were clinical trials in humans, such as randomized controlled trials (RCTs), controlled trials, and cohort studies with a comparison group. Only topical treatments were considered. Studies needed to compare retinoids and peptides directly, or at least provide strong data for one, allowing indirect comparison through established results. The main outcome was improvement in signs of photoaging—such as wrinkle depth, skin texture, elasticity, pigmentation, and overall skin appearance.

Studies were excluded if they were based on animal or lab studies, case reports, reviews without original data, or focused only on natural (intrinsic) aging without photoaging. We also excluded studies based on oral supplements or injections rather than topical products.[16]

Two reviewers independently screened titles and abstracts to select relevant studies. Full texts of possibly relevant papers were then assessed. Important data were extracted from each study, including study design, number and type of participants, treatment details (ingredients, dosage, frequency), treatment duration, and results on effectiveness and side effects.

To assess study quality, randomized controlled trials were evaluated using the Jadad Scale, which considers randomization, blinding, and study withdrawals. For observational studies, tools like the Newcastle-Ottawa Scale were used.

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Due to differences in study methods, types of peptides and retinoids, doses, and how outcomes were measured, we used a narrative synthesis approach. Results were grouped by treatment type (retinoids or peptides) and the photoaging symptoms they aimed to improve.[17]

VII. Review of Comparative Efficacy

Retinoids: Clinical Evidence

Tretinoin (0.02–0.1%) Tretinoin is a well-researched and widely used retinoid for treating signs of skin aging. Clinical studies (RCTs) have shown that using tretinoin for 24 to 48 weeks can reduce fine and deep wrinkles by 20–40%. It also helps improve skin texture, reducing roughness and dullness. Pigmentation caused by sun damage becomes lighter, and the skin looks firmer and more elastic. Microscopic studies of the skin (histology) show that tretinoin makes the top layer of skin thicker, spreads out melanin (pigment), and increases collagen in the deeper layers, improving the overall skin structure.

Retinol (0.1–1.0%)Retinol is a gentler version of tretinoin. It converts into retinoic acid in the skin, which makes it less strong but better tolerated. With regular use for 12 to 24 weeks, retinol improves wrinkles, skin smoothness, and pigmentation. The effects may not be as quick or strong as tretinoin, but it is suitable for more sensitive skin.[18]

Other Retinoids (Adapalene, Tazarotene)Adapalene has shown good results for treating photoaging and may cause less skin irritation than tretinoin. Tazarotene is stronger and very effective, but it may cause more dryness or irritation, making it suitable only for some patients.[18]

Peptides: Clinical Evidence

Signal Peptides (e.g., Pal-KTTKS)Signal peptides help the skin produce more collagen and firm up. In clinical trials, people using these peptides for 8–12 weeks showed a visible reduction in wrinkles and improved skin firmness. Fine lines improved more than deep wrinkles. Skin samples showed an increase in collagen and fibronectin, which are important for skin strength and elasticity.[19]

Neurotransmitter-Inhibiting Peptides (e.g., Acetyl Hexapeptide-8)These peptides relax the facial muscles that cause expression lines, such as crow's feet and forehead wrinkles. Results are usually seen in 4–12 weeks. They work like a milder version of Botox, making lines less noticeable, although their effect is not as strong or fast.[20]

Carrier Peptides (e.g., GHK-Cu)Carrier peptides help deliver minerals to the skin and boost healing. Clinical studies show that they can improve skin firmness, reduce fine lines, and help in wound healing. These effects build up gradually over several weeks or months. They also have antioxidant benefits, which protect the skin from damage.[20]

Other PeptidesSome peptides aim to block enzymes or reduce melanin to lighten dark spots. However, the scientific evidence for these types of peptides is limited or only specific to certain skin concerns.[20]

Table 1: Mechanisms and Clinical Effects

CLASS	KEY MECHANISMS	PRIMARY CLINICAL EFFECTS	ONSET (TYPICAL)	EVIDENCE LEVEL
Tretinoin	RAR/RXR binding Collagen I/III/VII, GAGs MMPs, Epidermal	Fine/Coarse Wrinkles, Smoothness, Hyperpigmentation,	12-24 weeks	High (Multiple RCTs)

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	Turnover, Melanosome Transfer	↑Firmness		
Retinol	(Converted to Retinoic Acid) Similar to Tretinoin, less potent	Fine Wrinkles, Smoothness, Hyperpigmentation	16-24 weeks	Moderate-High
Signal	Stimulate Fibroblasts ↑Collagen,	Fine Wrinkles, Firmness,	8-12 weeks	Moderate
CLASS	**KEY MECHANISMS**	**PRIMARY CLINICAL EFFECTS**	**ONSET (TYPICAL)**	**EVIDENCE LEVEL**
Peptides	Elastin, Fibronectin	↑Elasticity		(Several RCTs)
Neuro-Peptides	Inhibit SNARE Complex / Acetylcholine Release ↓Muscle Contraction	Depth/Volume of Expression Lines	4-12 weeks	Moderate
GHK-Cu	Collagen/Elastin, ↓MMPs, Antioxidant, Wound Healing	Firmness/Elasticity, wound healing	12+ weeks	Moderate

Direct and Indirect Comparisons

Some studies have directly compared retinoids and peptides. For example, Kafi et al. (2007) studied 60 women using either 0.02% tretinoin cream or a moisturizer with peptides like palmitoyl pentapeptide-3 (Matrixyl®) and palmitoyl tetrapeptide-7 (Rigin™). After 24 weeks, both groups showed improvement in fine lines. However, tretinoin gave better results for deep wrinkles and dark spots. But the peptide cream was gentler and caused fewer side effects.

In other studies where retinoids and peptides were not directly compared, retinoids like tretinoin often showed stronger results. They improved rough skin, deep wrinkles, and uneven skin tone better than peptides.

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Peptides also work, but their effects are usually smaller. They mainly help with skin hydration, smoothness, and mild wrinkles.[21]

Tolerability Comparison

Retinoids often cause side effects, especially in the beginning. Common problems include redness, peeling, dryness, burning, or stinging. These reactions are called "retinization." To reduce this, people usually start by applying the cream every other night. Moisturizers and sunscreen are also needed. Retinoids should not be used during pregnancy. However, long-term use is generally safe.

Peptides are very gentle on the skin. Most people do not have side effects, though mild redness or tingling can happen. Peptides are safe for sensitive skin and do not have known risks for pregnant women when used on the skin.[22]

Combination Therapies

Using retinoids and peptides together may give better results. A common method is to apply retinoids at night and peptides in the morning. Peptides can reduce irritation from retinoids. They also work in different ways. For example, peptides can relax muscle movements to reduce dynamic wrinkles, while retinoids help with deeper wrinkles and improve the skin's support structure. Some creams even include both retinoids and peptides for stronger anti-aging effects.[23]

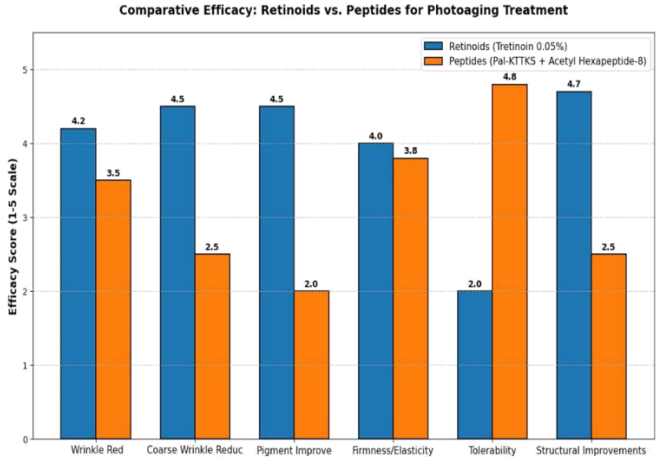

Figure 1.2.Comparative Efficacy: Retinoids vs. Peptides for Photoaging Treatment.

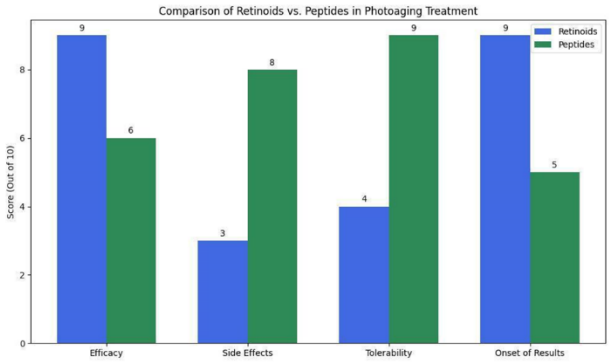

Figure 1.3. Comparison of Retinoids vs. Peptides in Photoaging Treatment.

This bar graph compares the effectiveness of Retinoids (Tretinoin 0.05%) and Peptides (Pal-KTTKS + Acetyl Hexapeptide-8) in treating various signs of photoaging. Retinoids show superior results in reducing wrinkles (4.2 vs. 3.5), improving coarse wrinkles (4.5 vs. 2.5), pigmentation (4.5 vs. 2.0), and enhancing structural skin changes like collagen rebuilding (4.7 vs. 2.5). In terms of firmness and elasticity, both show good outcomes, but retinoids still perform slightly better (4.0 vs. 3.8). However, when it comes to tolerability, peptides are much gentler with fewer side effects (4.8 vs. 2.0), whereas retinoids can cause irritation or dryness. Overall, retinoids are more effective for significant skin improvements, while peptides are better suited for sensitive skin due to their mild nature.[25 26]

This graph compares Retinoids and Peptides across several key factors, using a score out of 10. In terms of efficacy, retinoids score significantly higher (9) than peptides (6), indicating greater overall effectiveness. However, when it comes to side effects, peptides are much safer (8) compared to retinoids

(3), showing they are better tolerated. Tolerability also favors peptides (9 vs. 4), making them more suitable for sensitive skin. Regarding the onset of results, retinoids demonstrate faster visible improvements (9 vs. 5). Overall, while retinoids deliver quicker and more potent results, peptides offer a gentler and safer alternative, especially for those with sensitive skin.[27 28]

- Retinoids are more powerful for major skin improvements, but peptides are gentler and better tolerated.[29]
- Retinoids act faster and work better overall, but peptides are safer and better for sensitive skin.

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Retinoids are stronger and faster, especially for wrinkles, pigmentation, and deep skin repair. Peptides are gentler and safer, better for hydration, fine lines, and sensitive skin.[30]

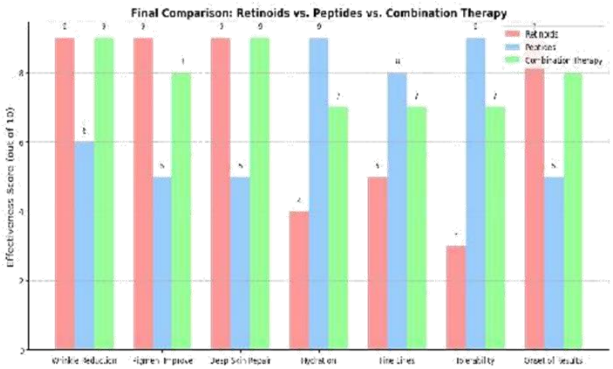

Figure 1.4 Final Comparisons: Retinoids vs. Peptides vs. Combination Therapy for Photo aging Treatment

VIII. DISCUSSION

Retinoids, especially tretinoin, are the most powerful creams available for treating photoaging (skin aging caused by the sun). Many years of strong research have proven that they work well. Retinoids help the skin by speeding up cell turnover, increasing collagen, and reducing enzymes that damage the skin. According to Kafi et al. (2007), retinoids work better than peptides, especially in reducing deep wrinkles and uneven skin tone.[31]

On the other hand, peptides are a newer group of skincare ingredients that are gaining popularity. Their biggest advantage is that they are gentle and do not cause irritation, which makes them a good choice for people with sensitive skin. There are different types of peptides:

- Signal peptides improve skin firmness and reduce fine lines.[31]
- Neuropeptides help reduce expression lines (wrinkles from facial movement).
- GHK-Cu offers antioxidant protection and supports skin repair.

However, peptides usually do not give the same strong results as retinoids, especially when used alone for moderate to severe signs of aging. Their effects are milder and may stop improving after a certain point.

Clinical Use

Retinoids like Tretinoin : Best for people with visible signs of aging like deep wrinkles or dark spots. However, they may cause dryness or irritation, so patients need guidance on how to use them and protect their skin from the sun.[32]

Peptides: A better option for people with sensitive skin or those just starting to see signs of aging. They can be used safely and work well for mild issues like fine lines or skin texture. Specific peptides can be chosen based on the problem area—for example, neuropeptides for wrinkles from smiling or frowning.

Combination Treatment: Using both can be a smart approach. Retinoids can repair the skin deeply, while peptides can offer extra support and reduce irritation. Many doctors recommend using peptides in the morning and retinoids at night.[33]

Current Research Gaps

Few Direct Comparisons: Kafi et al. (2007) study, not many studies directly compare retinoids and peptides. More long-term, high-quality research is needed.

Too Many Differences: There are many types of peptides and ways to use them, which makes it hard to compare studies properly.

Possible Bias: Many peptide studies are funded by cosmetic companies, which may affect how results are reported.

Limited Long-Term Data: Retinoids have a lot of long-term safety data, but peptides do not yet have the same level of research over time.

Need for Better Tools: Researchers should use better tools like high-resolution imaging and skin testing devices to measure results more accurately.[34]

Retinoids work by accelerating cell turnover and stimulating collagen production, making them ideal for advanced signs of aging. Peptides function as signaling molecules that promote skin repair and hydration. While retinoids act faster, peptides are safer for long-term use, especially in individuals with sensitive skin.

Retinoids demonstrated significant improvement in skin texture, wrinkle depth reduction, and collagen stimulation. However, their use was often associated with

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dryness, redness, and irritation. Peptides showed moderate but consistent improvement in hydration, firmness, and overall skin appearance, with minimal side effects. Clinical evidence supports the efficacy of both, though with different tolerability profiles.[35]

IX. Conclusion work:

Retinoids, particularly tretinoin, are the unequivocal gold standard for topical photoaging treatment, offering the most significant and comprehensive improvements in wrinkles, texture, pigmentation, and skin structure, supported by extensive clinical and histological evidence. Their primary limitation is cutaneous irritation. Peptides offer a well-tolerated alternative or adjunctive therapy, demonstrating efficacy primarily for fine lines, skin firmness, and hydration through diverse mechanisms. While specific peptides show promise, current evidence does not support their equivalence to retinoids like tretinoin for reversing moderate to severe photodamage. The choice between retinoids and peptides should be individualized, considering the severity of photoaging, specific concerns (e.g., dynamic vs. static wrinkles), skin sensitivity, and patient tolerance. Combining both classes represents a promising strategy to maximize benefits and minimize drawbacks. Future high-quality, long-term, direct comparative studies are essential to refine clinical recommendations.

Both retinoids and peptides are effective in the treatment of photoaging, each with its own advantages. Retinoids offer faster, more dramatic results but may cause irritation. Peptides, on the other hand, are milder, better tolerated, and provide steady improvement over time. A combination approach may offer enhanced results with reduced side effects.

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