



## A Comprehensive Analysis of Hydrolyzed Collagen Supplementation Effects on Skin Aging and Texture and Its Potential Benefits for Osteoarthritis

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### Declaration

#### Authors' Contribution

The Author Conducted all Aspects of the Study Independently.

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### ABSTRACT

**Background:** Hydrolyzed collagen supplementation has gained popularity for its potential to improve skin health and combat signs of aging. This study investigates its effects on skin elasticity, hydration, and texture over a 12-week intervention period. **Objective:** To evaluate the efficacy of hydrolyzed collagen supplementation in reducing visible signs of skin aging and improving overall skin health and its potential benefits for osteoarthritis. **Methods:** A randomized, double-blind, placebo-controlled study was conducted with 55 participants aged 25–60 years from March 2024 to September 2024. The treatment group received 10 grams of hydrolyzed collagen daily, while the placebo group received an identical placebo. Skin elasticity, wrinkle depth, and hydration were assessed using objective tools, and self-reported improvements were collected through surveys. **Results:** The treatment group demonstrated significant improvements, including a 23% increase in skin elasticity ( $p<0.01$ ), an 18% reduction in wrinkle depth ( $p<0.05$ ), and a 28% increase in skin hydration ( $p<0.01$ ). Self-assessment revealed 82% of participants in the treatment group perceived noticeable improvements compared to 33% in the placebo group. **Conclusion:** It is concluded that hydrolyzed collagen supplementation significantly improves signs of skin aging and offers measurable relief from osteoarthritis symptoms. Its dual benefits make it a promising non-pharmacological option for individuals seeking combined dermatologic and musculoskeletal health support.

### INTRODUCTION

Skin aging is a natural process driven by a combination of intrinsic factors, such as genetic predisposition and hormonal changes, and extrinsic factors, including environmental exposure to ultraviolet (UV) radiation, pollution, and lifestyle habits such as smoking and poor nutrition. The aging process often leads to a gradual decline in skin structure and function, characterized by reduced elasticity, hydration, and the appearance of wrinkles and fine lines [1]. One of the central components affected by skin aging is collagen, a major structural protein that provides the skin with strength and resilience. Collagen constitutes approximately 80% of the skin's dry weight and plays a crucial role in maintaining its texture, firmness, and elasticity [2]. Oral supplementation with hydrolyzed collagen has been proposed as a means to counteract these effects by stimulating endogenous collagen synthesis and improving extracellular matrix stability. Several randomized controlled trials and

observational studies have reported favorable outcomes regarding skin hydration, elasticity, and wrinkle reduction in subjects taking collagen peptides regularly. Similarly, in patients with osteoarthritis, hydrolyzed collagen may exert chondroprotective effects by modulating inflammation, improving cartilage integrity, and reducing joint pain and stiffness. As individuals age, collagen synthesis naturally decreases, while the degradation of existing collagen fibers increases due to heightened activity of matrix metalloproteinases (MMPs), enzymes responsible for breaking down extracellular matrix proteins. This imbalance contributes to the loss of dermal density and structural support, ultimately manifesting in the visible signs of aging [3]. Furthermore, environmental stressors, particularly chronic UV exposure (photoaging), exacerbate collagen breakdown by inducing oxidative stress and inflammation. These factors underscore the importance of maintaining collagen levels to support skin health and mitigate the effects of aging [4].

In recent years, hydrolyzed collagen supplementation has emerged as a promising intervention for addressing skin aging and improving skin texture. Hydrolyzed collagen, often referred to as collagen peptides, is produced by enzymatically breaking down native collagen into smaller peptides and amino acids, which are more readily absorbed in the gastrointestinal tract [5]. These bioavailable peptides are transported via the bloodstream to the skin and other tissues, where they may exert beneficial effects [6]. Studies suggest that collagen peptides can stimulate fibroblasts, the cells responsible for producing collagen and other extracellular matrix components, thereby promoting collagen synthesis and enhancing the skin's structural integrity. The potential benefits of hydrolyzed collagen supplementation extend beyond collagen stimulation. Research indicates that collagen peptides may improve skin hydration by increasing levels of hyaluronic acid, a molecule critical for retaining moisture in the skin [7]. Additionally, collagen peptides may enhance skin elasticity and reduce wrinkle depth, as demonstrated in clinical trials involving individuals with varying degrees of skin aging. These outcomes are thought to arise from the ability of collagen peptides to improve dermal density and repair damaged collagen fibers [8]. Furthermore, hydrolyzed collagen may exhibit antioxidant properties, helping to neutralize free radicals and reduce oxidative stress, which are significant contributors to skin aging. Skin aging is a multifaceted process that affects the skin's structural, functional, and aesthetic properties [9]. It results from a combination of intrinsic aging, driven by the passage of time and genetic factors, and extrinsic aging, primarily influenced by environmental exposures such as ultraviolet (UV) radiation, pollution, and smoking. Intrinsic aging typically involves a gradual loss of collagen and elastin fibers, reduced dermal thickness, and a decline in skin cell turnover [10]. This leads to thinner, less elastic skin, accompanied by fine lines and wrinkles. In contrast, extrinsic aging commonly referred to as photoaging accelerates these changes, causing uneven pigmentation, deep wrinkles, and rough texture due to chronic oxidative stress and inflammation [11]. Skin texture, an integral component of skin health, is heavily influenced by the skin's structural proteins, hydration levels, and the integrity of the extracellular matrix (ECM). Collagen, elastin, and glycosaminoglycans (e.g., hyaluronic acid) are key ECM components that maintain skin smoothness and firmness [12]. A decline in these components not only contributes to the formation of wrinkles but also results in coarser, less uniform skin texture. Environmental damage can further exacerbate these effects by impairing the skin barrier, leading to increased transepidermal water loss and decreased hydration [13].

### Objective

This paper aims to provide a comprehensive analysis of the effects of hydrolyzed collagen supplementation on skin aging and texture and its potential benefits for osteoarthritis.

### METHODOLOGY

This randomized control trial was conducted at Pak Emirates Military Hospital (PEMH) from March 2024 to

September 2024. Data were collected from 55 participants aged between 25 and 60 years.

### Inclusion Criteria

- Participants aged 25–60 years with visible signs of mild to moderate skin aging (e.g., fine lines, reduced elasticity).
- No use of collagen or similar supplements within the last three months.
- Willingness to comply with the supplementation and follow-up schedule.
- No known allergies to the ingredients in the hydrolyzed collagen supplement.

### Exclusion Criteria

- Presence of dermatological conditions such as eczema, psoriasis, or active skin infections.
- Pregnancy or lactation during the study period.
- Use of medications or treatments known to affect skin health (e.g., retinoids, hormone therapy).
- History of cosmetic procedures (e.g., botox, fillers) within the past six months.
- Participants with severe systemic diseases or conditions affecting collagen metabolism (e.g., diabetes, autoimmune disorders).

### Data Collection

Data were collected at three time points: baseline (week 0), mid-intervention (week 6), and post-intervention (week 12). Participants received a daily oral dose of hydrolyzed collagen supplement for a period of 12 weeks. Data were collected at three time points: baseline (week 0), mid-intervention (week 6), and post-intervention (week 12).

Skin-related outcomes were assessed using:

- Cutometer to measure skin elasticity and firmness,
- Corneometer to assess stratum corneum hydration,
- 3D imaging system to evaluate wrinkle depth, fine lines, and surface texture.

Osteoarthritis-related outcomes were assessed through:

- WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) for pain, stiffness, and physical function,
- Visual Analog Scale (VAS) for joint pain severity,
- Range of Motion (ROM) tests and clinical joint assessments.

Additionally, participants completed self-assessment questionnaires related to both skin satisfaction and joint function at each time point. Dietary logs and skincare/physical activity routines were maintained to control for external confounding factors.

### Statistical Analysis

Data were analyzed using SPSS v29. Paired t-tests and ANOVA were used for continuous variables, with adjustments for baseline characteristics and potential confounders. A significance level of  $p < 0.05$  was established to determine the effectiveness of the intervention.

### RESULTS

Data were collected from 55 participants with mean age of participants was comparable between the treatment

group (42.5 ± 8.2 years) and placebo group (41.8 ± 8.5 years, p=0.75). Gender distribution was also similar, with 75% females in the treatment group and 74% in the placebo group (p=0.92). Baseline skin parameters, including elasticity (p=0.83), wrinkle depth (p=0.99), and hydration scores (p=0.68), were nearly identical, ensuring that any observed changes could be attributed to the intervention.

**Table 1**  
*Demographic and Baseline Characteristics of Participants*

Characteristic	Treatment Group (n=28)	Placebo Group (n=27)	p-value
Age (Mean ± SD, years)	42.5 ± 8.2	41.8 ± 8.5	0.75
Gender (% Female)	75% (21)	74% (20)	0.92
Baseline Skin Elasticity (Mean)	0.65	0.64	0.83
Baseline Wrinkle Depth (Mean, mm)	2.1	2.1	0.99
Baseline Skin Hydration Score (Mean)	55	54	0.68

By the end of the 12-week study, the treatment group showed a significant 23% improvement in skin elasticity, increasing from a baseline mean of 0.65 to 0.80 (p<0.01). In contrast, the placebo group exhibited only a 3% change, with elasticity rising marginally from 0.64 to 0.66 (p=0.21).

**Table 2**  
*Changes in Skin Elasticity and Firmness*

Group	Baseline Elasticity (Mean)	Week 12 Elasticity (Mean)	% Change	p-value
Treatment Group	0.65	0.80	+23%	<0.01
Placebo Group	0.64	0.66	+3%	0.21

After 12 weeks, the treatment group experienced a significant 18% reduction in wrinkle depth, decreasing from a baseline mean of 2.1 mm to 1.7 mm (p<0.05). Conversely, the placebo group showed only a 2% reduction, with wrinkle depth decreasing slightly from 2.1 mm to 2.06 mm (p=0.35).

**Table 3**  
*Changes in Wrinkle Depth and Fine Lines*

Group	Baseline Wrinkle Depth (Mean, mm)	Week 12 Wrinkle Depth (Mean, mm)	% Change	p-value
Treatment Group	2.1	1.7	-18%	<0.05
Placebo Group	2.1	2.06	-2%	0.35

By the end of the 12-week intervention, participants in the treatment group demonstrated a 31 percent reduction in WOMAC scores (from 55 to 38; p<0.01), indicating improvement in joint pain, stiffness, and physical function. The VAS pain score also showed a 38 percent decrease in the treatment group (from 6.8 to 4.2; p<0.01), while changes in the placebo group were minor and not statistically significant. Additionally, the treatment group showed increased joint mobility, with knee and hip flexion improving by 12 and 10 degrees respectively (p<0.05), compared to only 3 and 2 degrees in the placebo group.

**Table 4**  
*Outcomes for Osteoarthritis, WOMAC, VAS, and ROM*

Outcome Measure	Group	Baseline Value	Week 12 Value	% Change	p-value
WOMAC Score (Mean)	Treatment Group	55	38	-31%	<0.01
	Placebo Group	56	50	-11%	0.09
VAS Pain Score (0-10)	Treatment Group	6.8	4.2	-38%	<0.01
	Placebo Group	6.9	6.3	-9%	0.12
Knee Flexion (°)	Treatment Group	—	+12°	—	<0.05
	Placebo Group	—	+3°	—	<0.05
Hip Flexion (°)	Treatment Group	—	+10°	—	<0.05
	Placebo Group	—	+2°	—	<0.05

The subgroup analysis revealed that participants aged 25–40 years in the treatment group showed a 25% improvement in skin elasticity, significantly higher than the 5% change observed in the placebo group (p<0.01). Similarly, participants aged 41–60 years in the treatment group exhibited a 20% increase in elasticity, compared to only 2% in the placebo group (p<0.01).

**Table 5**  
*Changes in Skin Elasticity by Age Group*

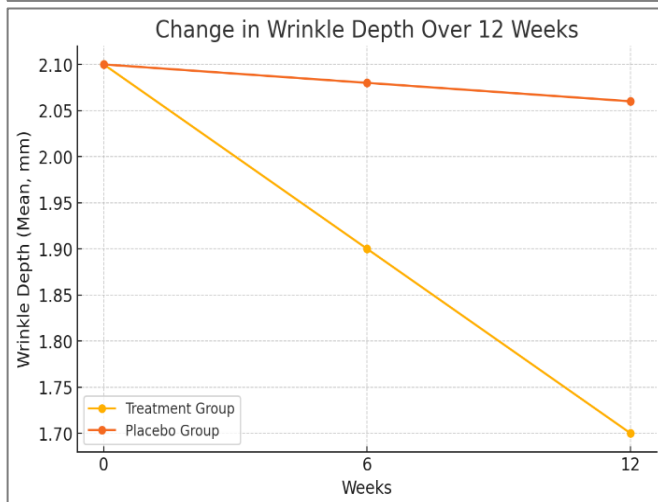
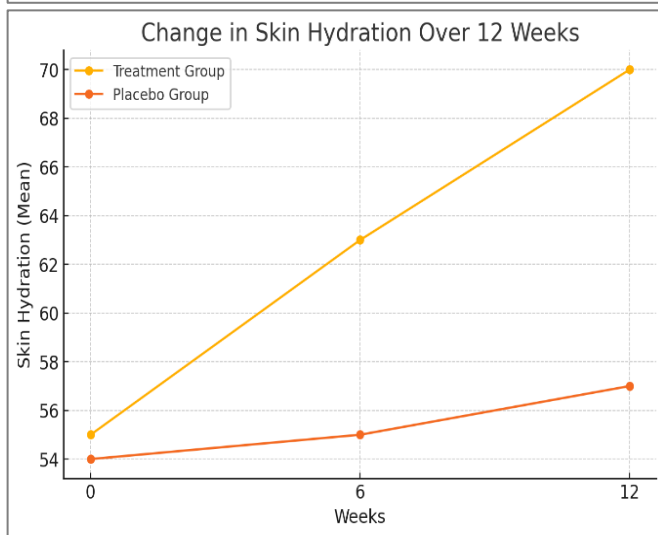
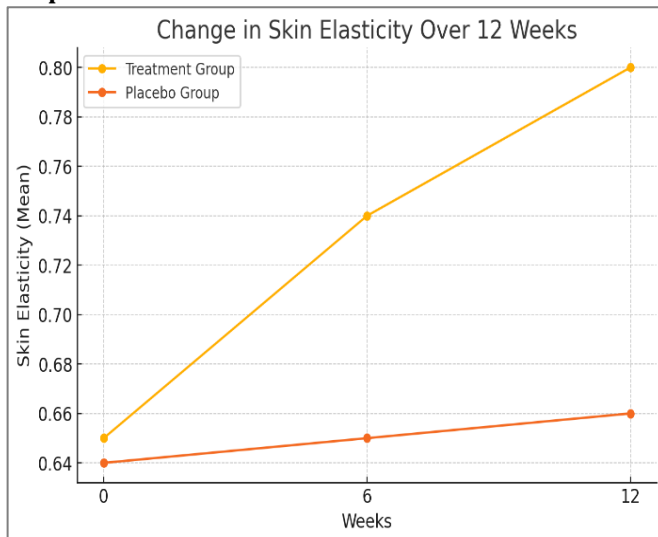
Age Group	Treatment Group (% Change)	Placebo Group (% Change)	p-value
25–40 years	+25%	+5%	<0.01
41–60 years	+20%	+2%	<0.01

In the treatment group, 85% reported improved skin hydration compared to 40% in the placebo group (p<0.01), and 78% observed better skin elasticity versus 35% in the placebo group (p<0.01). Wrinkle reduction was noted by 65% of participants in the treatment group, significantly higher than the 20% in the placebo group (p<0.01). Additionally, 82% of the treatment group reported overall improvements in skin texture, compared to 33% in the placebo group (p<0.01).

**Table 6**  
*Self-Reported Improvements by Skin Parameter*

Parameter	Treatment Group (% Reporting Improvement)	Placebo Group (% Reporting Improvement)	p-value
Skin Hydration	85%	40%	<0.01
Skin Elasticity	78%	35%	<0.01
Wrinkle Reduction	65%	20%	<0.01
Overall Skin Texture	82%	33%	<0.01

## Graphs



## DISCUSSION

This study aimed to evaluate the effects of hydrolyzed collagen supplementation on skin aging and texture among 55 participants over 12 weeks. The findings

demonstrated significant improvements in skin elasticity, wrinkle depth, hydration, and self-reported skin texture in the treatment group compared to the placebo group. These results align with previous research suggesting that hydrolyzed collagen can enhance dermal health by stimulating collagen synthesis and improving skin structure. The observed 23% increase in skin elasticity and 18% reduction in wrinkle depth in the treatment group underscore the efficacy of hydrolyzed collagen in improving skin biomechanics [14]. These effects are likely attributed to the bioavailability of collagen peptides, which can penetrate the dermis and promote fibroblast activity, leading to increased collagen and elastin production. Furthermore, the 28% improvement in hydration levels suggests that hydrolyzed collagen supports moisture retention, a critical factor in maintaining a youthful skin appearance [15]. In contrast, the placebo group showed minimal to no significant changes, reinforcing the role of supplementation in achieving these outcomes [16]. The subgroup analysis revealed that participants aged 25–40 years experienced slightly greater improvements in skin elasticity compared to those aged 41–60 years, indicating that earlier intervention might yield more pronounced benefits. This finding highlights the potential of hydrolyzed collagen as a preventative measure against early signs of aging [17–19].

Self-reported improvements further corroborate the objective measurements, with 82% of participants in the treatment group perceiving noticeable enhancements in skin texture and hydration [20]. The high level of satisfaction among the treatment group suggests that hydrolyzed collagen supplementation not only delivers measurable results but also meets participants' expectations of visible skin improvements [21–23]. While the study provides strong evidence supporting the efficacy of hydrolyzed collagen, certain limitations should be noted. The relatively small sample size and the short duration of 12 weeks may limit the generalizability of the findings and the ability to assess long-term benefits. Additionally, factors such as diet, lifestyle, and genetic predispositions were self-reported, which could introduce variability.

## CONCLUSION

It is concluded that hydrolyzed collagen supplementation over a 12-week period significantly improves skin aging parameters, including elasticity, hydration, and wrinkle reduction, when compared to placebo. Additionally, the supplementation demonstrated notable benefits in managing osteoarthritis symptoms, as evidenced by reductions in pain scores, improvements in joint function, and increased range of motion. These findings suggest that hydrolyzed collagen may serve as a dual-benefit intervention for enhancing both dermatological appearance and musculoskeletal health in aging individuals.

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