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ORIGINAL CONTRIBUTION

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Oral supplementation with specific bioactive collagen peptides improves nail growth and reduces symptoms of brittle nails

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Summary

Background: Brittle nail syndrome is a common problem among women and refers to nails that exhibit surface roughness, raggedness, and peeling.

Aim: The goal of this study was to investigate whether daily oral supplementation with collagen peptides alleviates the symptoms of brittle nails and improves nail growth rate.

Methods: In this open-label, single-center trial, 25 participants took 2.5 g of specific bioactive collagen peptides (BCP, VERISOL®) once daily for 24 weeks followed by a 4-week off-therapy period. Nail growth rate and the frequency of cracked and/or chipped nails as well as an evaluation of symptoms and global clinical improvement score of brittle nails were assessed by a physician during treatment and 4 weeks after discontinuation.

Results: Bioactive collagen peptides treatment promoted an increase of 12% nail growth rate and a decrease of 42% in the frequency of broken nails. Additionally, 64% of participants achieved a global clinical improvement in brittle nails, and 88% of participants experienced an improvement 4 weeks post-treatment. The majority of participants (80%) agreed that the use of BCP improved their nails' appearance, and were completely satisfied with the performance of the treatment.

Conclusions: This study demonstrated that the daily ingestion of BCP increased nail growth and improved brittle nails in conjunction with a notable decrease in the frequency of broken nails.

KEYWORDS

bioactive collagen peptides, brittle nails, collagen hydrolysate, dietary supplements, fragile nails, nail growth

1 | INTRODUCTION

Brittle nail syndrome is a disorder characterized by the increased fragility of the nail plate, exhibiting surface roughness, raggedness (fraying of the distal edge), and peeling.[1,2] It affects about 20% of the population, and women are affected twice as often as men.[2] Patients usually complain that their nails are soft, dry, weak, easily breakable, and incapable of growing long.[2]

The pathogenesis of brittle nails is usually related to an impaired water-binding capacity. This may reflect an abnormality in keratin, keratin-associated proteins, and/or lipid content.[2] The treatment of brittle fingernails has been a big challenge for dermatologists.[3]

Several topical and systemic therapies have been tried.[1,4,5] Dietary supplements, nail moisturizers, nail strengtheners, etc., have been used, but there is no evidence-based data proving their effectiveness.[1]

Collagen peptides have long been used as a food source and/or supplement.[6] Interestingly, food-derived collagen peptides have not only been demonstrated to reach the blood stream,[7-9] but also to notably stimulate the dermal cellular metabolism, improving the biosynthesis of extracellular matrix proteins and, consequently, restoring the dermal structure.[6,10-13] In two prospective randomized placebo-controlled clinical trials, Proksch et al[14,15] showed improvement in skin elasticity, decrease in wrinkle volume, and increase in the collagen I and elastin content in the skin of women who ingested, during 8 weeks, 2.5 g/d of the bioactive collagen peptides (BCP) used in the present study. Although nail assessments were not the objective of those studies, an improvement in nail quality among the study participants was noticed as a positive side effect (Proksch E, Schunck M, Zague V, Segger D, Degwert J & Oesser S, 2014, unpublished data).

Additionally, there is a long-standing belief among consumers that the ingestion of collagen peptides is good for nails. There is, however, no scientific-based evidence that it is effective for this purpose. For this reason, we investigated whether the daily ingestion of 2.5 g of a specific BCP for 6 months could have a positive influence on the symptoms of brittle nails and promote nail growth and strength.

2 | MATERIALS AND METHODS

2.1 | Investigational product

The BCP used in this study present high safety profile and derive from a complex multistep procedure by the degradation of porcine type I collagen (VERISOL®, Gelita AG, Eberbach, Germany). The product is clearly defined by a matrix-assisted laser desorption ionization mass spectrometry mass peaks fingerprint with specific collagen peptides of an average molecular weight of 2.0 kD. It should be dissolved preferably in water and ingested everyday according to the instructions given by the investigator.

2.2 | Study design

This was an open, single-center clinical trial carried out in the Brazilian Center for Studies in Dermatology, Porto Alegre, Brazil. The Ethics Committee of the Hospital Moinhos de Vento, Porto Alegre, Brazil, approved the study. All the patients gave written informed consent before the study.

2.3 | Subjects

Twenty-five healthy women were enrolled in the study for treatment with a daily dose of 2.5 g of BCP for 6 months followed by a 4-week observation period off therapy.

Participants were aged from 18 to 50 and displayed at least one of the following signs of brittle nails: lamellar splitting of the free edge (lamellar peeling), fissuring of the distal nail plate (edge irregularities), and longitudinal ridging/grooves (nail roughness).

The main exclusion criteria were pregnancy or lactation; menopause; smoking; acute skin diseases; diseases, medications, products or procedures that could interfere with the results; nail-biting habit; taking vitamins and other supplements; food allergies against the ingredients of the test products; gastrointestinal diseases; changes in lifestyle or eating habits during the study. Moreover, subjects were advised to retain their daily occupational and nail care routines, and to avoid long-term exposure to water, use of abrasive or aggressive products, and trimming cuticles.

2.4 | Measurement time points

At the screening visit (4 weeks before baseline), an experienced dermatologist clinically evaluated all the patients and collected data on demographic characteristics. Photographs and markings on the nails for subsequent growth measurements were also performed.

Photographs, clinical assessments, nail growth rate, and frequency of broken nails were performed at baseline (t_0), after 12 and 24 weeks (t_{12} and t_{24}) of daily product intake, and 4 weeks after the last intake (washout phase). Adverse events, compliance, and tolerance to the product were assessed during the study. The satisfaction questionnaire was conducted at the last visit.

2.5 | Clinical assessments

The dermatologist evaluated the brittle nail symptoms and overall improvement of the nails at each visit. The assessment of the brittle nail symptoms included nail peeling, edge irregularities, and nail roughness,[1,16,17] and was performed according to the grading system proposed by Sherber et al[16]: none, slight, moderate, and severe.

The global improvement was defined as excellent, good, fair, no improvement, or worse,[16] as described in the subjective 5-point scale suggested by Sherber et al[16] The investigator compared the photographs of each participant's nails taken at baseline (t_0) to those taken at each of the following visits.

2.6 | Frequency of cracked and/or chipped nails

The subjects received a form in which they should record daily how many times their nails had been cracked or chipped on each hand.

2.7 | Nail growth assessment

The nails of the middle fingers were marked at the edge of the lunula 4 weeks before the baseline (t_0) to ascertain the basal growth rate of each participant. The investigator measured the distance from the edge of the lunula to the marked point at each visit and confirmed the results with Mirror-DPS 7.02® software (Canfield Scientific Inc., Fairfax, NJ, USA).

2.8 | Satisfaction questionnaire

A satisfaction questionnaire assessed patient satisfaction with the treatment on a 5-point scale (very satisfied, satisfied, neither satisfied nor unsatisfied, unsatisfied, and very unsatisfied). Patients were also asked to rate the overall improvement of their nails from 0 to 10, and to answer the following questions: (i) Do you think your nails are stronger? (ii) Do you think your nails are growing faster?

2.9 | Statistical analysis

One-way ANOVA with the multiple comparisons Fischer post-test method was used to compare numerical variables. Significance was defined as $P < .05$ using the data analysis software Minitab, version 15.1.1.0 (Minitab Inc, State College, PA, USA). Each value was expressed as mean ± standard deviation (SD). The categorical variables were represented by a percentage.

3 | RESULTS

Twenty-five participants were enrolled in the study, but one participant withdrew prior to the last visit. The data of the 24 subjects who completed the study were included in the analysis. The participants' mean age ± SD was 39.3 ± 7.6 years (range: 26-50 years). No adverse reactions related to the product intake were reported.

3.1 | Clinical assessments

After 12 weeks of treatment, the number of participants displaying "severe" or "moderate" nail peeling halved (16 to 8 out of 24), and those with the score "slight" doubled (8 to 16 out of 24). The most noticeable results were measured after 24 weeks, when only 6 of 24 participants (25%) had the score "severe" or "moderate," and 8% of the participants showed no symptoms. The positive results continued after the washout phase (Figure 1A).

The positive results on the longitudinal split of the free edge appeared after 24 weeks of treatment with BCP, where only 4% of participants scored "severe." After the washout phase, none of the participants had the score "severe," and the percentage of "slight" scores increased from 17% to 38% (Figure 1B). No clinically relevant changes were observed before and after treatment with BCP for nail roughness (Figure 1C).

Of all the 24 participants analyzed, 13 participants (54%) had fair improvement on nail symptoms at week 12 compared with baseline (Figure 2). At week 24, 64% achieved notably global improvement (excellent/good/fair). After the washout phase, 21 participants (88%) showed excellent/good/fair improvement (Figure 3).

3.2 | Frequency of cracked and/or chipped nails

Before starting the treatment, the participants' frequency of broken nails were on average 10 times/mo (10.5 ± 8.4). It significantly ($P < .05$) decreased to 6 times/mo (6.4 ± 4.9) after 24 weeks of treatment, representing a reduction of 42%. This improvement continued during the washout phase (Figure 4).

3.3 | Nail growth

The basal nail growth rate of the participants was on average 2.65 ± 0.42 mm/mo. After 12 weeks of treatment with BCP, the growth rate improved significantly ($P < .05$) to 2.90 ± 0.47 mm/mo. These results showed an improvement in nail growth of 10% after 12 weeks of BCP intake. This increased to 12% after 24 weeks, and to 15% 4 weeks after the last intake (Figure 5).

3.4 | Satisfaction questionnaire

The majority of participants (80%) agreed that the use of BCP had improved their nails' appearance and were totally satisfied or satisfied with the performance of the treatment. In contrast, only 20% were indifferent about or unsatisfied with the treatment. The overall improvement was in average 7.3 ± 2.9 scale points on the 0-10 scale as assessed by the participants. Of the 24 participants who completed the study correctly, 11 rated the overall improvement with 9 or 10 scale points (46% of all study participants). Moreover, 75% of patients perceived their nails as stronger, and 71% felt that their nails were growing faster and longer.

4 | DISCUSSION

The present authors investigated whether the daily ingestion of specific BCP for 24 weeks could positively influence the symptoms of brittle nails and improve nail growth and strength. We detected a considerable clinical improvement, an increase in nail growth rate, and a significant decrease in the frequency of broken nails. In accordance with these findings, most participants perceived their nails as stronger and were satisfied with the treatment. To the best of our knowledge, no data have been reported regarding the effects of BCP intake on nails, and the present study is the first clinical trial demonstrating the efficacy of a specific dosage (2.5 g/d) of VERISOL® on nail growth and brittle nails syndrome.

In this study, the daily intake of BCP clearly attenuated the symptoms of brittle nails after 24 weeks: 64% of women showed clinical global improvement. And it was even more pronounced after the 4-week washout period, when 88% of participants showed clinical global improvement, suggesting a positive effect of BCP treatment is likely caused by the direct effect of BCP on the nail matrix and nail bed.

When administered orally, BCP are absorbed in the form of small collagen peptides and free amino acids.[7-9,18] Free amino acids provide building blocks for the formation of dermal extracellular matrix proteins and for the epidermal structure, whereas collagen peptides act as bioactive messengers, activating different signaling pathways and stimulating dermal and epidermal metabolism.[10,13,19] Hence,

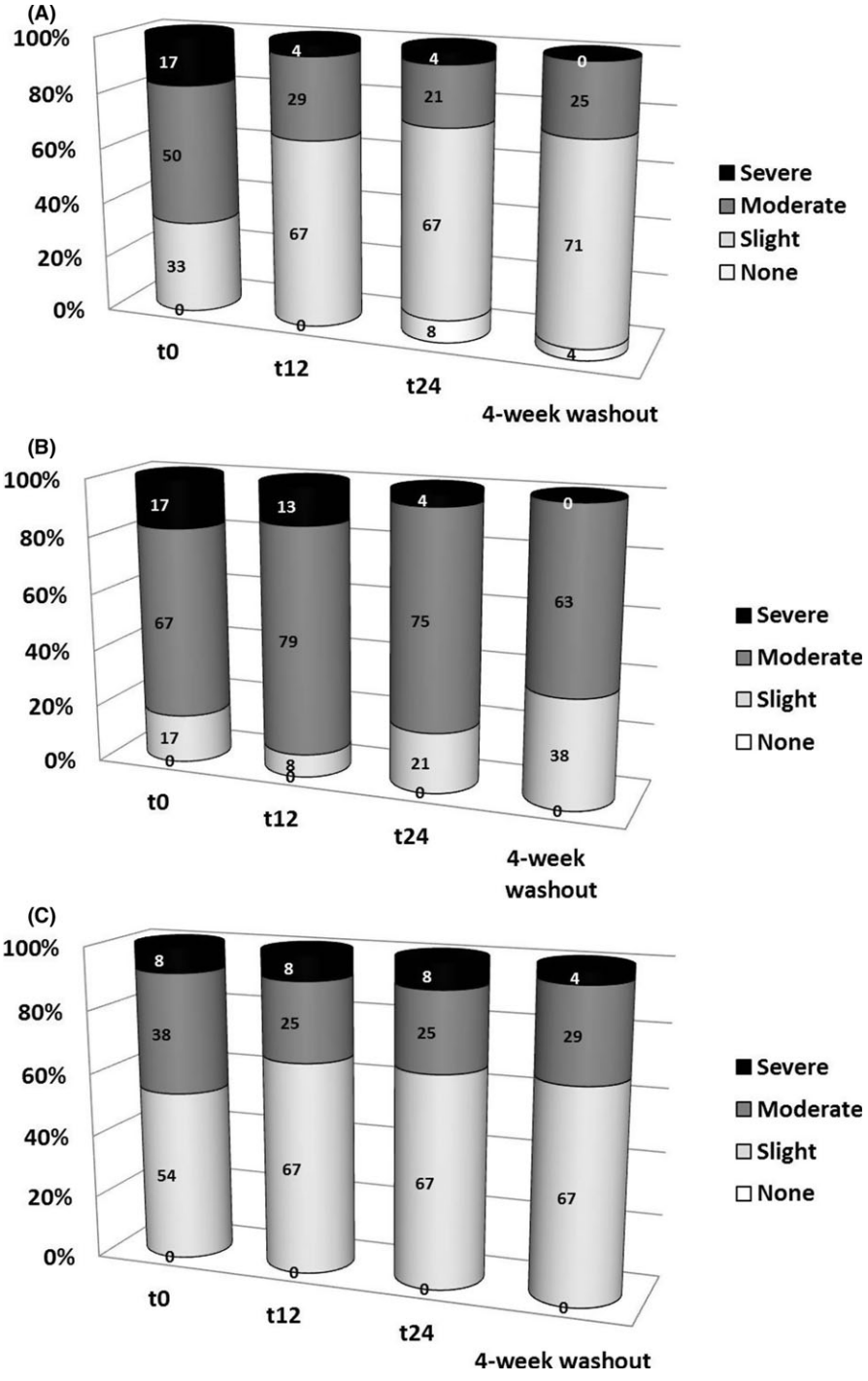

FIGURE 1 Clinical improvement of brittle nail symptoms after 24 wk of oral supplementation with bioactive collagen peptides, followed by 4-wk washout period. A. Lamellar peeling. B. Fissuring of the distal nail plate (edge irregularities). C. Longitudinal ridging/grooves (nail roughness)

clinical improvements in brittle nails symptoms observed in the present study may not only be a consequence of the protein intake, but also due to the stimulatory effects of specific collagen peptides on epidermal and dermal metabolism.

Patients who perceive nail fragility usually complain about slower nail growth, which may prolong the exposure of the nail plate to external damaging factors that worsen brittle nail syndrome.[17] The nails show a continuous growth over a lifetime, controlled by a variety of cell-cell, cell-matrix, and cell-tissue interactions as well as signaling factors, many of which are not yet clearly defined.[20] It also depends on age, blood supply, nutrients, environmental, and occupational factors.[17]

The formation of the nail plate requires epidermal proliferation and nail matrix differentiation.[1] Le Vu et al[19] revealed that collagen peptides supplementation was associated with the development of the epidermis with a 5.3-fold enrichment. It does so by upregulating genes such as Gprc, Krt, and Krtap, which code for structural components of epidermis and skin appendages such as hair, hair follicles, and nails. These findings suggest the potential benefits of BCP treatment on nail growth.

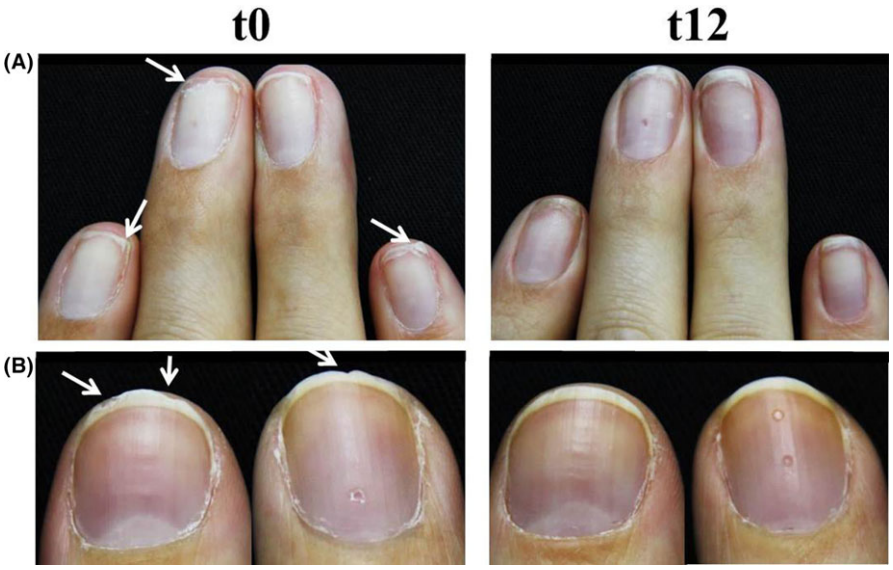

FIGURE 2 Exemplary pictures of participants before (t_0) and after 12 wk (t_{12}) of oral supplementation with bioactive collagen peptides (BCP). A. The distal portion of the nail plate showed a lamellar exfoliation into fine horizontal layers and triangular pieces could easily be torn from the free margin at baseline visit (t_0). After 12 wk (t_{12}) lamellar splitting improved notably. B. Isolated split at the free edge, which sometimes extended proximally, was visible at baseline visit (t_0) and evidently attenuated after 12 wk (t_{12})

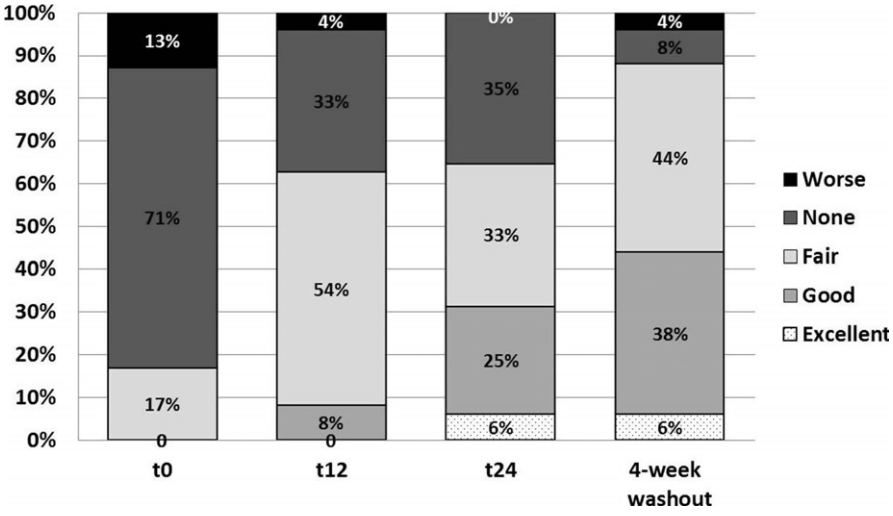

FIGURE 3 Global clinical improvement of brittle nail syndrome after 24 wk of daily oral supplementation with bioactive collagen peptides, followed by 4-wk washout period

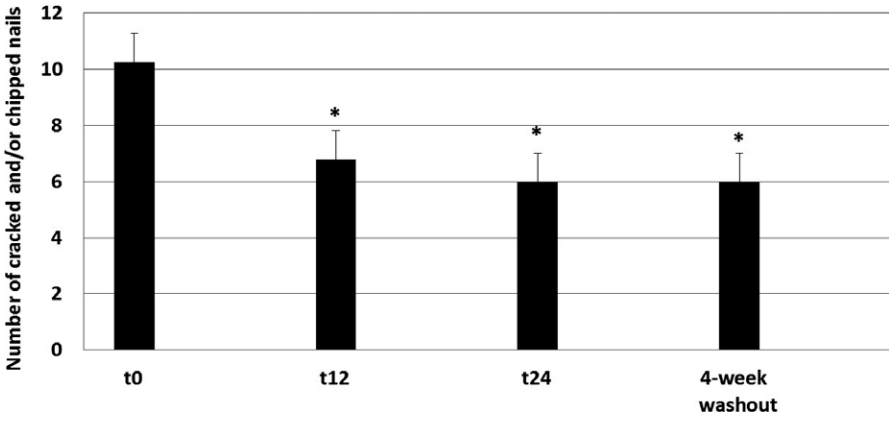

FIGURE 4 Frequency of cracked and/or chipped nails after daily treatment with bioactive collagen peptides for 24 wk, followed by 4-wk washout period. (mean ± SEM; n = 24; *$P < .05$)

Nail fragility is also determined by the nail plate's water content. Experimental trials have shown that BCP may improve the synthesis of important proteins for the epidermal barrier, turnover, and moisture. Treatment of epidermal skin cells (keratinocytes) led to an up-regulation of filaggrin, loricrin, and involucrin, cornified envelope proteins which are important for a healthy epidermal skin barrier and skin moisturizing (Collagen Research Institute's data; not published). Data from clinical[15,21] and animal[22,23] trials have also demonstrated

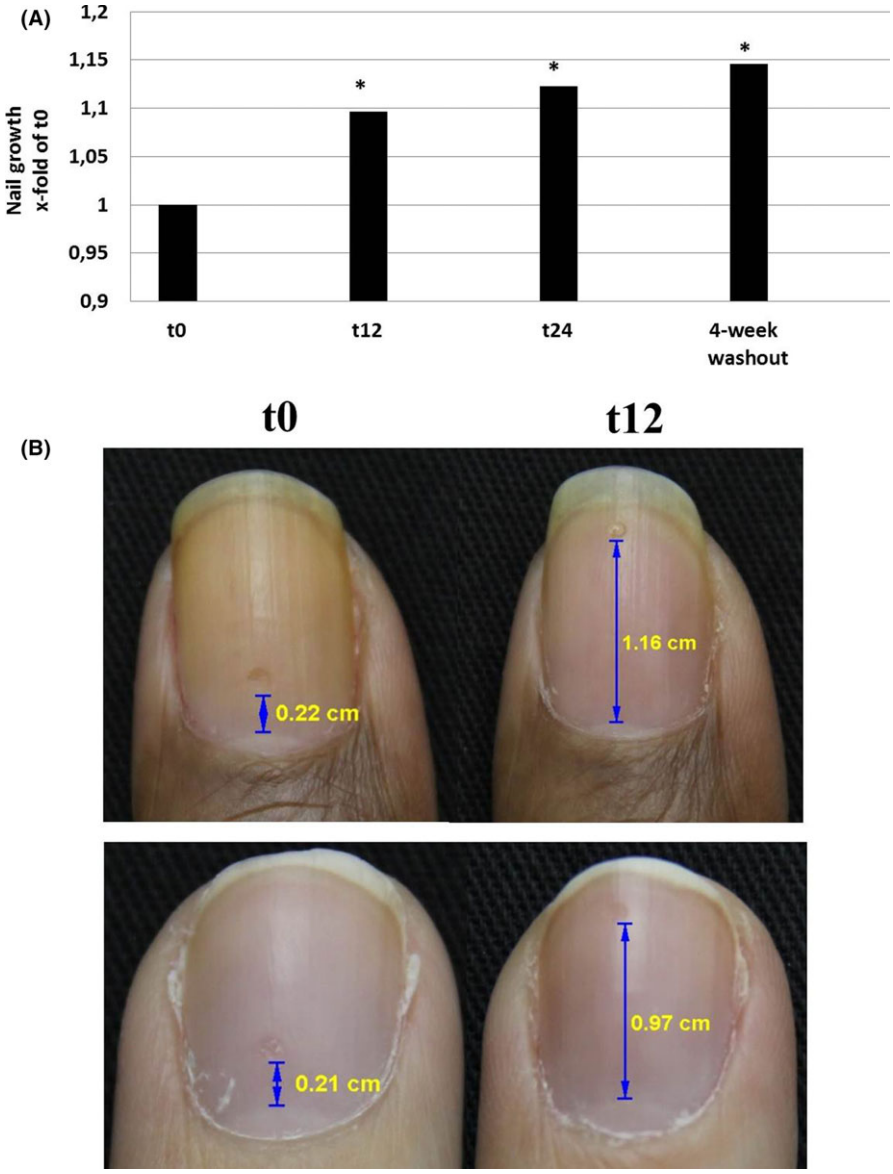

FIGURE 5 Nail growth improvement after daily oral supplementation with bioactive collagen peptides. A. The nail growth rate increased significantly at 12 wk and was even more pronounced at 24 wk in contrast to baseline (mean ± SEM; n = 24; *$P < .05$). B. Exemplary pictures of participants' nail growth before (t0) and after 12 wk of treatment (t_{12}) (the nail growth rate at week 12 was calculated by subtracting the baseline value and dividing by 3). A respective improvement in nail growth of 41% (top) and 20% (bottom) is shown in the representative pictures

the improvement of the epidermal barrier and moisture after collagen peptides supplementation. Therefore, the improvement of nail strength demonstrated in this trail may be a result of the increased water-binding capacity of brittle nails promoted by BCP supplementation. It might help to explain the positive effects even after treatment ceased.

As an open, noncontrolled trial, the results presented herein should have the inherent biases considered. It can be assumed that the positive effect is based on the supplementation of VERISOL; however, a certain influence of behavioral changes of some participants could not be fully excluded.

With many different measurements taken at each visit, perhaps the most telling result is the high participant satisfaction. Interestingly, most participants reported they previously tried other treatments without success. Both the physician and the participants noticed a clear improvement and were satisfied with the treatment.

The ingestion of specific BCP led to a pronounced global clinical improvement in brittle nails, a significant increase in nail growth rate, and a decrease in the frequency of cracked or chipped nails in the present trial. Further research with larger samples and prolonged treatment is needed to explore the mechanism of action that leads brittle nails improvements, and larger, placebo-controlled studies are required to confirm the observed results.

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