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Colloidal Silicic Acid for Oral and Topical Treatment of Aged Skin, Fragile Hair and Brittle Nails in Females

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In an open study, women with biologically aged skin and fragile or thin hair, or brittle nails were treated orally with 10 ml colloidal silicic acid (Silicol®) once daily for 90 days and applied colloidal silicic acid to the face for 10 min twice daily. Of the 50 subjects treated, three withdrew from treatment after 30 days because of excessive drying of the facial skin due to topical application. In the remaining 47 subjects there was statistically significant improvement in the thickness and turgor of the skin, wrinkles and condition of the hair and nails. The number of mottles also declined, but the change was not statistically significant. Ultrasound measurements did not detect any statistically significant change in the thickness of the epidermis or elasticity of the skin, but there was a significant increase in the thickness of the dermis.

Im Rahmen eines offenen Studiums wurden Frauen mit biologisch gealteter Haut und brüchigem oder dünnem Haar oder brüchigen Nägeln über eine Spanne von 90 Tagen täglich einmal 10 ml kolloidale Kieselsäure (Silicol®) oral verabreicht. Die Frauen trugen zudem zweimal täglich kolloidale Kieselsäure auf das Gesicht auf. Von den 50 Behandelten brachen drei die Behandlung aufgrund eines übermäßigen Austrocknens der Gesichtshaut durch äusserliche Änwendung nach dreißig Tagen ab. Bei den

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Treatment of skin, hair and nails with colloidal silicic acid

restlichen 47 Behandelten wurde eine statistisch wesentliche Verbesserung der Dicke und des Turgors der Haut, der Falten und der Beschaffenheit von Haar und Nägeln verzeichnet. Auch die Anzahl der Hautflecken nahm ab, aber die Änderung war statistisch unbedeutend. Ultraschallmessungen ergaben keine statistisch bedeutende Änderung der Dicke der Epidermis oder der Elastizität der Haut, die Dicke der Dermis hatte aber wesentlich zugenommen.

KEY WORDS: COLLOIDAL SILICIC ACID; ORAL AND TOPICAL APPLICATION; BIOLOGICALLY AGED SKIN; FRAGILE HAIR; THIN HAIR; BRITTLE NAILS

INTRODUCTION

Silicon, after oxygen, is the most prevalent element on Earth and crystalline silica in the form of quartz is the most abundant mineral in the Earth's crust. Silicon has been found in ash produced from most plants and animal tissues but the amounts are usually so small that it was thought, until quite recently, that the element was not physiologically important in higher plants and animals.

The fact that all plants grown in soil contain silicon has led to the suggestion that silicon may be an essential element for plants. As yet, little is known of the function of silicon in plants and more information is required on the forms and concentrations in which it occurs. It has been established, however, that the variation in silicon content between species can be considerable: for example, cereal grains rich in fibres have a much higher silicon content than low-fibre grains.

Values for the silicon content of tissues reported by some early French and German workers varied considerably because of the problems of eliminating interference due to phosphorus during the microdetermination of silicon in biological tissue;[1] early work on the silicon levels has been reviewed by King and Belt.[2] Improved analytical methods have become available and all tissues assayed for silicon by one group of workers were found to contain traces of the element at least and, in many instances, the amounts were of the order of those of other mineral elements that have been recognized as being normal tissue constituents.

In human tissues, epidermis and hair contain relatively high concentrations of silicon. Silicic acid in the human normal diet is readily absorbed across the intestinal wall and excreted in the urine: the daily silicon output is approximately 9 mg. The element accumulates in the cornified epidermis on the surface of the skin and in the epicuticle of hair, as well as in the wool and feathers of other animals, in an alkali-insoluble component constituting 0.4 – 1.7% of the total tissue weight.[3,4] By contrast, the normal human blood concentrations of silicon are

Silicol® is the trademark of Saguna GmbH, Germany.

less than 5 ppm.[6] Connective tissues also appear to be rich in silicon according to studies in several animal species. In the rat, for example, the aorta, trachea and tendons are four to five times richer in silicon compared with other tissues such as liver, heart and muscles. Connective tissues consist of a complex of cells, fibrous structures and an amorphous ground substance or matrix comprising mainly of mucopolysaccharides. Fibrillar and ground substance materials, which are present in large amounts, give connective tissues their main characteristics.[6]

A series of experiments has helped in establishing that silicon is an essential element,[7] beginning with *in vitro* studies on the calcification processes in young bone followed by *in vivo* studies, which demonstrated an effect of silicon on the extent of bone mineralization. Of particular importance, however, was the establishment of the fact that a deficiency of silicon in the diet resulted in abnormal growth, whereas growth was normal when a diet supplemented with silicon was fed.[7]

Silicon, therefore, appears to meet the two criteria for an essential element: dietary supplements of the element result in repeated and significant favourable responses in terms of growth and health; and a deficiency state develops when diets that are otherwise adequate and satisfactory lack this element.[8] In the case of silicon, the nature of the symptoms that arise when fed a silicon-deficient diet give indications of its metabolic role and site of action.

Evidence from biological studies indicates that elements other than calcium, phosphorus and magnesium play a role in bone metabolism:[9] for example, fluorine and zinc are now widely recognized, it being shown that small amounts of fluorine can bring about changes in the properties of bone apatite. McConnell[7] has demonstrated in mineralogical studies that phosphorus can be substituted by sodium, potassium, manganese, strontium, magnesium and carbon in natural fluorapatite. Furthermore, in the mineral ellastadite, a crystalline isomorph of apatite, silicon and/or sulphur can completely replace phosphorus.[10]

Silicon has been shown to be localized in active growth areas of the bones of young mice.[11] The amount of silicon present in very restricted areas within these active growth areas appears to be related to the 'maturity' of the bone. In general, embryonic or rapidly growing tissues have much higher mucopolysaccharide concentrations than adult or ageing tissue. It is not surprising, therefore, that a relationship exists between silicon and ageing of certain tissues, because silicon has been shown to be a component of the mucopolysaccharides.[5] The silicon content in the aorta, skin and thymus has been found to decline significantly with age in contrast to other tissues analysed, which showed little or no change.

Premature ageing of the skin either due to excessive exposure to sunlight or biological reasons is an increasing problem. Aged skin is a clinical entity, which includes thinning of the skin, laxity, wrinkles, mottling and leathery dryness with variable premalignant and malignant neoplasms.

Histologically aged skin shows different structural changes. Accumulation of tangled, thickened and abnormal elastic fibres are observed.[12,13] There is a simultaneous great loss of collagen and an increase in ground substance glucosaminoglycans.[14] In the end-stage the dermal matrix is almost completely degenerated into an amorphous mass. The dissolution of the collagen and elastin net causes laxity and loss of resilience.

In the present study the combined effect of an oral and topically applied colloidal silicic acid on aged skin in females was investigated.

PATIENTS AND METHODS

PATIENTS

A total of 50 females with signs of ageing of their facial skin and with fragile and thin hair, and/or brittle nails were enrolled in the study. The mean age of the study population was 48 years (range 38 – 64 years) and the mean duration of skin changes was 9 years (range 3 – 20 years). All study subjects were in good health and did not use any concomitant medication, which was judged to potentially influence the study results. All study subjects gave informed oral consent prior to the start of the study.

STUDY DESIGN

The purpose of the study was to evaluate the effect of a once-daily oral dose (10 ml) of colloidal silicic acid (Silicol®) and twice-daily topical application of colloidal silicic acid for 10 minutes. The investigation was carried out as an open, uncontrolled study and the treatment period was 90 days.

All the treated females were examined at baseline and after 30, 60 and 90 days of treatment. At each visit the following parameters were clinically evaluated and graded using a four-point scale (0 = absent, 1 = mild, 2 = moderate, 3 = severe). At each visit the epidermal and dermal thicknesses were measured by using a Dermascan C scanner (Cortex Ltd, Denmark).[15] Skin turgor was measured with Dermaflex A equipment (Cortex Ltd, Denmark) using a negative pressure of 250 mmHg.[16] In addition, subjective comments regarding the treatment results, as well as possible adverse effects or unexpected events, were recorded.

STATISTICAL ANALYSIS

For statistical analysis a two tailed Student's *t*-test and signed test were used.

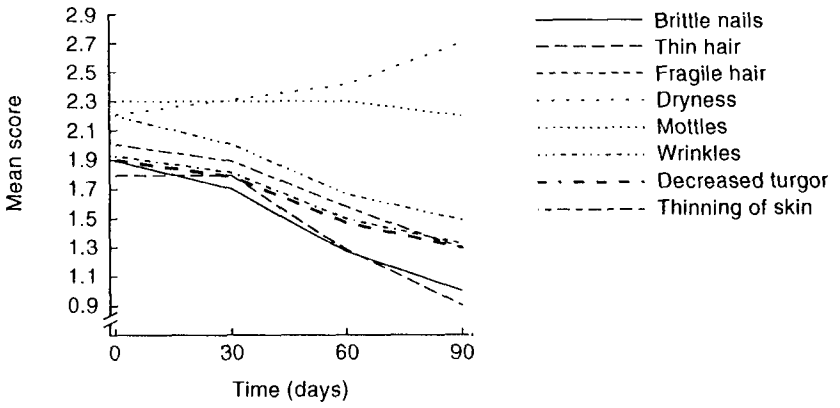
RESULTS

After 30 days' treatment three women withdrew because of excessive drying of the skin due to topical application. These patients were excluded from analysis of the treatment efficacy. The remaining 47 females completed the treatment in accordance with the study protocol and it was possible to evaluate them for both the efficacy and adverse reactions of the treatment.

The results of the clinical evaluations are illustrated in Fig. 1. At baseline, with the exception of one patient, all had reduced skin thickness (mean score 2.0) or decreased turgor (mean score 1.9). After 90 days' treatment, the mean score for both parameters had decreased to 1.3; both changes reached statistical significance ($P < 0.01$). Mottles occurred in 35 (74.5%) patients at baseline with a mean score of 2.3 which after 90 days had declined to a mean score of 2.0; this difference was not statistically significant. Wrinkles could be observed in all patients at baseline (mean score 2.2) and in 32 subjects after 90 days; the difference was statistically significant ($P < 0.05$). Approximately half of the patients evaluated had dry skin before treatment (mean score 2.3) and seven had dry facial skin after topical treatment (mean score 2.7); the difference was not statistically significant. The hair was fragile prior to silicon treatment in 15 patients at baseline (mean score 1.9) and in seven patients after treatment (mean score 1.3) ($P < 0.1$). Thin hair could be observed in 17 patients before treatment (mean score 1.8) and in seven after treatment (mean score 0.9, $P < 0.01$). Brittle nails occurred in 21 patients (mean score 1.9) before treatment and in 10 after treatment (mean score 1.0, $P < 0.01$).

Changes in epidermal and dermal thickness are presented in Table 1. The mean epidermal thickness increased by 0.03 mm, (19%) and the dermal thickness by 0.26 mm

FIGURE 1



Changes in skin, nails and hair measured on a four-point scale (0 = absent, 3 = severe) in 47 patients with biologically aged skin treated orally with 10 ml colloidal silicic acid once daily and who applied colloidal silicic acid twice daily to the face for 90 days.

TABLE 1

Changes in skin thickness and elasticity in 47 patients with biologically aged skin treated orally with 10 ml colloidal silicic acid and who applied colloidal silicic acid twice daily to the face for 90 days

Time	Total skin thickness (mm)	Epidermal thickness (mm)	Dermal thickness (mm)	Elasticity index (%)
Baseline	1.06 ± 0.08	0.16 ± 0.03	0.90 ± 0.07	55 ± 2
Day 30	1.13 ± 0.04	0.16 ± 0.02	0.97 ± 0.07	54 ± 1
Day 60	1.22 ± 0.05	0.17 ± 0.01	1.05 ± 0.06	57 ± 2
Day 90	1.35 ± 0.07	0.19 ± 0.03	1.16 ± 0.08[a]	60 ± 1
Change	21%	19%	29%	9%

[a] $P < 0.01$ compared with baseline.

(29%) and after 90 days the elasticity index increased from 55% to 60%. The changes in epidermal thickness and elasticity index were not significant but the increase in dermal thickness was significant ($P < 0.01$). The only adverse effect observed was drying of the topically treated skin areas in seven patients. This adverse event did not result in any patients withdrawing from the study.

DISCUSSION

Leslie *et al.*[17] found a decline in silicon content with age in rat skin compared with other

tissues, such as brain, liver, spleen, lung and femur, where the silicon content increased. In muscles and tendon no significant changes in silicon content with age were detected in rats. In human skin the silicon content of the dermis has been reported to diminish with age.[18] It has also been reported by French investigators[19] that the silicon content of the normal human aorta decreased considerably with age in contrast to an earlier finding and that the concentrations of silicon in the arterial walls declined with the development of atherosclerosis.[19] It is especially interesting that studies by other French workers on the changes in absorption and resulting concentrations of silicon showed that silicon levels in the blood and intestinal tissue of rats varied with age, sex and various endocrine glands.[20] It was concluded that the decline in hormonal activity in senescense could well account for the modifications in silicon observed in aged animals.[20]

The present study showed that an oral dose of colloidal silicic acid, which is all natural, non-toxic and dermatologically tested product when combined with topical use had a beneficial effect on biologically aged skin structure, when used for 90 days. This is probably due to the biological effects of silicic acid as well as to the good intestinal absorption of colloidal silicic acid.

In the current study the application of colloidal silicic acid brought about an improvement in the skin, hair and nails of the women treated. Although excessive drying of the facial skin was observed in some subjects, no further adverse effects could be detected; thus suggesting that colloidal silicic acid may provide a useful alternative for the treatment of biologically aged skin. Treatment results with colloidal silicic acid in this study indicated the added advantage that, after 90 days, the hair was significantly thicker and less fragile and the patients' nails were less brittle.

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