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Evaluation of changes in skin sebum and moisture content with treatment in children with atopic dermatitis

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ABSTRACT

Aims: Since the deterioration of the skin barrier plays a role in the development of atopic dermatitis, it is necessary to investigate the moisture and sebum content of the skin. In this context, our study aimed to evaluate the change of skin sebum and moisture content with treatment in children with atopic dermatitis.

Methods: This study is a cohort study. Patients aged 0-18 years, diagnosed with atopic dermatitis, and those who did not have any accompanying skin disease were included. Skin moisture and sebum levels were measured with a portable pen-shaped LCD Display Digital Skin Moist Oil Analyzer (Reyoung-Beauty, Guangdong, China) digital skin moisture and sebum measurement device from the cubital fossa before and 1 month after the treatment. Skin sebum and moisture were obtained as percentages.

Results: The median values of skin moisture and sebum content before treatment in 55 atopic dermatitis patients were 30.0% (10.0-55.0) and 24.0% (16.0-49.0), respectively. The percentages of skin moisture and sebum content after treatment were 38.0% (15.0-60.0) and 28.0% (18.0-50.0), respectively. In atopic dermatitis patients, the increase in skin moisture and sebum percentages was statistically significant for both ($p<0.001$ and $p=0.022$, respectively)

Conclusion: Skin moisture and skin sebum contents improved significantly with treatment in children with atopic dermatitis. This situation highlights the importance of adherence to treatment and continuity of selected treatments in patients.

Keywords: Atopic dermatitis, skin moisture, skin sebum, treatment

INTRODUCTION

Atopic dermatitis (AD) is one of the most common, inflammatory, chronic skin diseases and it has a recurrent feature.[1] The number of patients with AD is increasing.[2] In addition, the frequency of AD generally decreases with advancing age.[3] The prevalence of AD has been reported to be approximately 14% in adults and 20% in children.[4,5] According to a systematic review in the literature, 17.1% of adults and 22.6% of children have a diagnosis of AD.[6]

The skin has important functions such as reducing water loss. With this function, it contributes to the body's thermoregulation. The structure and cellular composition of the skin provide the protection from external physical and chemical exposures.[7] The most important function of the skin is to form a barrier between the internal and external environment of the body.[8] It is very important to protect the barrier function of the skin, as it prevents the entry of microorganisms, allergens, and mechanical and chemical irritants into the body.[8-10] There is an impaired skin barrier in the pathophysiology of AD.[8,11]

The barrier function of the skin is affected by features such as oil content in the skin, hydration of the epidermis, transepidermal water loss and skin pH.[10] Factors such as age, gender, race, amount of perspiration, skin and ambient temperature, and ambient humidity affect the amount of oil and moisture required for the barrier property of the skin.[12,13] When the sebum and moisture balance in the skin cannot be achieved, the symptoms of dryness and itching on the skin, which are common in AD, occur.[14] In a study conducted in children with AD in our country; the skin moisture and skin sebum ratios of

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children with AD were found to be lower than those of healthy children.[15] In a similar study, skin sebum in AD patients was reported to be lower than other individuals.[14]

Most treatments for AD focus on increasing skin moisture and protecting the skin from bacterial infections and irritation.[16] Topical and systemic treatments can be used in the pharmacological treatment of AD. Moisturizers, topical corticosteroids and calcineurin inhibitors are topical treatment options used in AD treatment.[17]

Since the deterioration of the skin barrier plays a role in the development of AD, it is extremely important to evaluate the moisture and sebum content necessary for the barrier function of the skin. In this context, our study aimed to evaluate the change of skin sebum and moisture content with treatment in children with AD.

METHODS

Ethics

The study was carried out with the permission of the University of Health and Sciences, Ümraniye Training and Research Hospital Clinical Researches Ethics Committee (Date: 20/06/2023, Decision No: 196). All procedures were carried out in accordance with the ethical rules and the principles.

Study Type, Design and Population

The study is a cohort type study. Patients aged 0-18 years, diagnosed with AD, and those who did not have any accompanying skin disease were included in the study. Those who took a bath in the last 24 hours, who used drugs such as local steroids on the day of the examination, and those who used topical products such as moisturizer and additional products (soap, shampoo, detergent, etc.) on the examination day were excluded from the study as they may have an effect on the skin barrier. Considering the outpatient clinic appointment records, it was aimed to include 50 patients in the study.

Measures

Skin moisture and sebum levels were measured with a portable pen-shaped LCD Display Digital Skin Moist Oil Analyzer (Reyoung-Beauty, Guangdong, China) digital skin moisture and sebum measurement device from the cubital fossa before and one month after the treatment. The device measures moisture and sebum levels with the bioimpedance method, which is a non-invasive method. Measurements were made by placing the device probe on bare skin for a few seconds in the antecubital fossa of the non-dominant upper extremity. Sebum and moisture were obtained as percentages. Sebum and moisture content were considered as moist between 46% and 43%, normal between 42% and 38%, dry between 37% and 34%, and very dry between 33% and below.[15] In addition, children's sociodemographic characteristics (such as age, gender), eosinophils, total IgE values, allergy tests, SCORAD (SCORing Atopic Dermatitis) scores before and after treatment were also evaluated.

SCORAD (SCORing Atopic Dermatitis) is a scoring system used to measure the severity of AD and the response to treatment. It is the subjective evaluation of the patients' findings such as itching and the evaluation of the objective findings such as redness and dryness determined by physical examination. And it also evaluates the distribution of the lesions in the body. In other words, the SCORAD index contains three criteria: the distribution of the lesions (percentage of effected skin surface), intensity (redness, edema, papules, the outcome of itching, crust appearance, lichenification, dryness), and subjective symptoms (itching and insomnia).[18] SCORAD is scored with a numerical evaluation. A higher score reflects more severe disease. AD severity according to SCORAD is also categorized as mild, moderate, severe. If the total score is less than 25, it is classified as mild, between 25-50 as moderate and above 50 as severe AD.[19]

Patients with moderate or severe AD with a SCORAD score greater than 25 were included in our study. All patients were given medium or high potency topical corticosteroids in active therapy. In proactive treatment, patients who received pimecrolimus or tacrolimus treatment were included in the study. Treatments were chosen by the clinician in accordance with the guidelines according to the clinical features of the patients. In the study, skin moisture and sebum measurements were also evaluated according to the treatment groups.

Statistical Analysis

SPSS (Statistical Package for Social Sciences for Windows 25.0 program was used for data analysis and recording. Median, minimum, maximum values, numbers and percentages (%) were used for descriptive data. Conformity of continuous variables to normal distribution was examined by visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/ Shapiro-Wilk tests). To evaluate the difference between two repeated measurements (pre- and post-treatment skin moisture, sebum, and SCORAD measurements) Wilcoxon test was used since the difference between the two measurements was not normally distributed. Analyzes with a p value below $0<0.05$ were considered statistically significant.

RESULTS

In our study, 55 children with AD were evaluated. While 50.9% (n=28) of the patients diagnosed with AD were female, 49.1% (n=27) were male. The median age

of patients with AD was 6 years (2-16). While 67.3% (n=37) of the atopic dermatitis patients had severe AD, 32.3% (n=18) had moderate AD. There were no patients classified as mild AD (Table 1).

Table 1. Gender, clinical classification and age distribution of atopic dermatitis patients

	Median (min-max)
Age (years)	6 (2-16)
	n (%)
Gender	
Female	28 (50.9)
Male	27 (49.1)
SCORAD classification	
Severe AD	37 (67.3)
Moderate AD	18 (32.3)

AD: Atopic dermatitis, SCORAD: SCORing Atopic Dermatitis

Eosinophil, total IgE values and allergy test positivity of AD patients were evaluated. The median values of absolute eosinophil and eosinophil (%) parameters were 405.0 103/µL (40.0-1840.0), 4.8% (0.5-23.7), respectively. The median total IgE value was 134.0 IU/mL (2.0-11052.0). The allergens to which the patients were sensitive were evaluated according to the skin prick test and/or the allergen-specific IgE values in the blood. House dust mite allergy was observed in 54.5% (n=30) of the patients. Egg and cat allergy positivity was 21.8% (n=12) for both. Pollen sensitivity was present in 14.5% (n=8) of the children. Nut and milk allergies were seen in 12.7% (n=7) and 9.1% (n=5) of children, respectively (Table 2).

Table 2. Eosinophil, total IgE values and allergy test positivity in atopic dermatitis patients

Laboratory parameters	**Median (min-maks)**
Eosinophil (absolute) (10^3/uL)	405.0 (40.0-1840.0)
Eosinophil (%)	4.8 (0.5-23.7)
Total IgE (IU/mL)	134.0 (2.0-11052.0)
Allergy test positivity	**N (%)**
House dust mite	30 (54.5)
Cat	12 (21.8)
Pollen	8 (14.5)
Egg	12 (21.8)
Nuts	7 (12.7)
Milk	5 (9.1)

The median values of skin moisture and sebum content before treatment in AD patients were 30.0% (10.0-55.0) and 24.0% (16.0-49.0), respectively. The percentages of skin moisture and sebum content after treatment were 38.0% (15.0-60.0) and 28.0% (18.0-50.0), respectively. In AD patients, the increase in skin moisture and sebum percentages after treatment was statistically significant for both (p<0.001 and p=0.022, respectively) (Table 3).

SCORAD scores of AD patients were also evaluated before and after treatment. The median SCORAD score before treatment was 67.7 (25.0-96.0) and 10.0 (5.0-40.0) post-treatment. The decrease in SCORAD score after treatment was statistically significant (p<0.001) (Table 3).

Table 3. Skin moisture, sebum and SCORAD score before and after treatment in atopic dermatitis patients

	Median (min-maks)	P value
Moist (%)- before treatment Moist (%)-after treatment	30.0 (10.0-55.0) 38.0 (15.0-60.0)	<0.001
Sebum(%)- before treatment Sebum (%)- after treatment	24.0 (16.0-49.0) 28.0 (18.0-50.0)	0.022
SCORAD- before treatment SCORAD- after treatment	67.7 (25.0-96.0) 10.0 (5.0-40.0)	<0.001

AD: Atopic dermatitis, SCORAD: SCORing Atopic Dermatitis

Moderate potency topical corticosteroid or high potency topical corticosteroid was used for active treatment in AD patients. While there were 27 patients using moderate potency topical corticosteroids, 28 patients used high potency topical corticosteroids. Skin moisture, sebum and SCORAD scores of patients using moderate potency and high potency topical corticosteroids were evaluated before and after treatment. The median percentage of skin moisture of patients using moderate potency topical corticosteroids was 31.0% (12.0-55.0) before treatment, while this value was 38.0% (16.0-60.0) after treatment. This increase in skin moisture after treatment was statistically significant (p<0.001). The median percentage of skin sebum before treatment was 25.0% (16.0-49.0), while this value was 26.0% (18.0-48.0) after treatment. This increase in skin sebum after treatment was not statistically significant (p=0.517). The SCORAD scores of patients receiving moderate potency topical corticosteroids were also compared. Median scores for SCORAD scores before and after treatment were 60.0 (25.0-89.6) and 10.0 (5.0-30.0), respectively. This decrease in SCORAD score after treatment was statistically significant (p<0.001) (Table 4).

The median percentage of skin moisture of patients using high potency topical corticosteroids was 30.0% (10.0-45.0) before treatment, while this value was 38.5% (15.0-59.8) after treatment. This increase in skin moisture after treatment was statistically significant (p<0.001). While the median percentage of skin sebum was 23.5% (16.0-49.0) before treatment, this value was 30.0% (19.1-50.0) after treatment. This increase in skin sebum after treatment was statistically significant (p<0.001). When the SCORAD scores of patients receiving high potency topical corticosteroids were also compared, the median SCORAD score values before and after treatment were 70.0 (25.0-96.0) and 17.5 (5.0-40.0), respectively. This decrease in SCORAD score after treatment was statistically significant (p<0.001) (Table 4).

Table 4. Pre- and post-treatment skin moisture, sebum and SCORAD values in moderate potency and high potency topical corticosteroids

	Moderate potency TC (n=27)	P value	High potency TC (n=28)	P value
	Median (min-max)		Median (min-max)	
Moist (%)- before treatment Moist (%)-after treatment	31.0 (12.0-55.0) 38.0 (16.0-60.0)	<0.001	30.0 (10.0-45.0) 38.5 (15.0-59.8)	<0.001
Sebum(%)- before treatment Sebum (%)- after treatment	25.0 (16.0-49.0) 26.0 (18.0-48.0)	0.517	23.5 (16.0-49.0) 30.0 (19.1-50.0)	0.012
SCORAD- before treatment SCORAD- after treatment	60.0 (25.0-89.6) 10.0 (5.0-30.0)	<0.001	70.0 (25.0-96.0) 17.5 (5.0-40.0)	<0.001

TC: Topical corticosteroids, SCORAD: SCORing Atopic Dermatitis

Pimecrolimus or tacrolimus was used for proactive treatment in patients with AD. While there were 28 patients using pimecrolimus, 27 patients used tacrolimus. Skin moisture, sebum and SCORAD scores of patients using pimecrolimus and tacrolimus were evaluated before and after treatment. The median percentage of skin moisture in patients using pimecrolimus was 30.5% (10.0-55.0) before treatment, while this value was 37.3% (15.0-60.0) after treatment. This increase in skin moisture after treatment was statistically significant (p<0.001). While the median skin sebum percentage in patients was 24.5% (16.0-49.0) before the treatment, this value was 26.0% (19.0-48.0) after the treatment. This increase in skin sebum after treatment was not statistically significant (p=0.170). The SCORAD scores of the patients receiving pimecrolimus were also compared. Median scores for SCORAD scores before and after treatment were 68.9 (25.0-90.0) and 15.0 (5.0-40.0), respectively. This decrease in SCORAD score after treatment was statistically significant (p<0.001) (Table 5).

The median percentage of skin moisture in patients using tacrolimus was 30.0% (11.0-45.0) before treatment, while this value was 40.0% (15.0-57.0) after treatment. This increase in skin moisture after treatment was statistically significant (p<0.001). While the median value of skin sebum percentage was 24.0% (16.0-49.0) before treatment, this value was 30.0% (18.0-50.0) after treatment. This increase in skin fat after treatment was not statistically significant (p=0.060). When SCORAD scores of patients receiving tacrolimus were also compared, the median SCORAD scores before and after treatment were 65.7 (25.0-96.0) and 10.0 (5.0-40.0), respectively. This decrease in SCORAD score after treatment was statistically significant (p<0.001) (Table 5).

DISCUSSION

With the treatments given in chronic diseases, it is aimed to control the clinical symptoms of the patients and to improve the prognosis. Atopic dermatitis is a chronic disease frequently seen in children accompanied by allergic mechanisms and inflammation. Uncontrolled symptoms constitute a significant burden of disease in children.[20] The clinical findings of AD can negatively affect the quality of life in children, causing sleep disorders and absenteeism from school.[21,22] For all these reasons, AD symptoms should be controlled with an effective treatment and skin moisture and sebum balances should be maintained in children with AD. In this context; according to the results of our study, the skin moisture and skin sebum values of the children increased significantly after the treatment. Besides, the SCORAD scores of our patients decreased significantly after treatment compared to before treatment.

Aerosol allergens originating from house dust mites can cause AD. House dust mite allergens, with their enzymatic activities, destroy tight junctions in the skin in patients with AD and impair the barrier function of the skin.[23] When the barrier function of the skin is impaired, allergen proteins penetrate the epidermis and then an allergic systemic inflammatory response begins. This situation causes the severity of AD to worsen.[24] In our study, house dust mite allergy was observed in more than half (54.5%) of AD patients. Cat allergy positivity was seen in 21.8% of the children, and pollen allergy positivity was observed in 14.5% of the children. The decreased skin sebum and moisture contents in our AD patients may also be due to the destruction of the skin barrier by aerosol allergens. In addition to

Table 5. Skin moisture, sebum and SCORAD values before and after treatment in patients receiving pimecrolimus and tacrolimus

	Receiving Pimecrolimus (n=28)	P value	Receiving Tacrolimus (n=27)	P value
	Median (min-max)		Median (min-max)	
Moist (%)- before treatment Moist (%)-after treatment	30.5 (10.0-55.0) 37.3 (15.0-60.0)	<0.001	30.0 (11.0-45.0) 40.0 (15.0-57.0)	<0.001
Sebum (%)- before treatment Sebum (%)- after treatment	24.5 (16.0-49.0) 26.0 (19.0-48.0)	0.170	24.0 (16.0-49.0) 30.0 (18.0-50.0)	0.060
SCORAD- before treatment SCORAD- after treatment	68.9 (25.0-90.0) 15.0 (5.0-40.0)	<0.001	65.7 (25.0-96.0) 10.0 (5.0-40.0)	<0.001

SCORAD: SCORing Atopic Dermatitis

pharmacological treatments such as moisturizers, topical steroids and calcineurin inhibitors, protection from environmental allergens is necessary for the control of the disease in AD patients. Necessary information should be given to families and children in this regard, and the awareness of the family and the child on environmental precautions should be increased.

The SCORAD score is frequently used in evaluating the clinical severity of the disease and following the prognosis of the disease in patients with AD.[25] All AD patients included in our study were moderate or severe AD patients. After the treatment, the SCORAD scores of the patients were significantly lower than before the treatment. A study in the literature showed a decrease in SCORAD scores of moderate to severe AD patients after topical corticosteroids, similar to our study.[26] In another study in the literature, a significant decrease in SCORAD scores was observed after methotrexate treatment in moderate to severe AD patients.[27] The results in the literature and the results of our study show that SCORAD is an important objective marker in evaluating response to treatment. In our study, the measurement of SCORAD scores before and after the treatment, apart from skin moisture and sebum, enabled us to associate the changes in the moisture and sebum content of the skin with the change in the clinic of AD. In other words, symptoms such as itching and dry skin, which developed with allergic and inflammatory mechanisms in AD patients, regressed in our patients after treatment, and this was reflected in SCORAD scores. At the same time, an increase in the skin moisture and skin sebum content of our patients was observed with the treatment. In this way, the barrier function of the skin can be improved and the function of the mechanisms that cause AD findings can be reduced.

Skin moisture and sebum in AD patients have been reported to be lower than those of healthy individuals.[28] In our study, it was possible to increase the amount of skin moisture and sebum with topical corticosteroid given to AD patients in the active period and then with topical calcineurin inhibitors given in the proactive period. In addition, while this increase was significant only in skin moisture in those receiving moderate potency topical corticosteroids in the treatment; statistically significant post-treatment increases in both skin moisture and skin sebum were seen in those receiving high potency topical corticosteroids. Topical corticosteroids show their effect in the treatment of AD by interacting with inflammatory cells and suppressing the release of pro-inflammatory cytokines.[29] It has been reported that higher potency topical corticosteroids heal faster in lesions.[30] In our study, it is expected to see a significant improvement in both skin moisture and skin sebum amounts in high potency topical corticosteroids.

Topical calcineurin inhibitors are used in the proactive treatment of AD. In our study, after the use of pimecrolimus or tacrolimus in proactive treatment in AD patients, an increase in skin moisture and skin sebum was observed. According to the literature, after the use of topical calcineurin inhibitors, the findings of AD patients improved.[31] Calcineurin inhibitors also act with mechanisms that suppress inflammation.[32] With the given treatment, inflammation as well as skin findings such as dryness, itching and skin damage are reduced in AD patients. Thus, it can be interpreted that the skin barrier, skin moisture and sebum content are also improved with the treatment.

Limitations and Strengths

The fact that our study was conducted in a single center creates a limitation in terms of the generalizability of the results. Another limitation of our study is that our patients with AD were moderate and severe patients according to the SCORAD score. For this reason, the change in skin moisture and sebum measurements of mild AD patients with treatment could not be evaluated within the scope of our study. This may be due to the fact that mostly moderate and severe AD patients applied to the hospital, since the clinic where the study was conducted was a tertiary hospital. The high probability of referral bias in our study also creates a limitation in terms of the generalizability of the study results. No study has been found in the literature evaluating the skin moisture and skin sebum changes in AD patients after treatment compared to before. This is the strength of our study. In our study, apart from skin sebum and skin moisture, the changes in SCORAD scores after treatment were also examined. Skin sebum and moisture were also evaluated according to the type of treatment received. Thus, our study contributes to the literature with a broad perspective.

CONCLUSION

According to the results of our study, the SCORAD scores of our patients with moderate and severe AD decreased significantly after treatment compared to before treatment. After the treatment, the skin moisture and skin sebum values of the children were statistically significantly higher than before the treatment. This increase was only significant in skin moisture in those receiving moderate potency topical corticosteroids in the treatment. There was a statistically significant increase in both skin moisture and skin sebum after treatment in high potency topical corticosteroids. While a significant increase in skin moisture was observed after the use of pimecrolimus and tacrolimus in proactive treatment, the increase in skin sebum was not statistically significant. According to the

results of our study, both the contents of skin moisture and sebum improved significantly after treatment in children with AD. This situation highlights the importance of adherence to treatment and continuity of selected treatments in patients. When the treatment is started by the physicians, the child and the family should be counseled with recommendations such as the importance of treatment and adherence to treatment, the use of medication, and avoidance of environmental allergens. There is a need for further multicenter studies with larger samples to support our study on this subject.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of the University of Health and Sciences, Ümraniye Training and Research Hospital Clinical Researches Ethics Committee (Date: 20/06/2023, Decision No: 196).

Informed Consent: Before participating in the study, participants and parents were informed about the study and their consent was obtained.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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