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Therapeutics

Clinical effectiveness of a silk fabric in the treatment of atopic dermatitis

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Summary

Background In children with atopic dermatitis (AD), eczema is easily aggravated by contact with irritant factors (e.g. aggressive detergents, synthetic and woollen clothes, climatic factors).
Objectives To evaluate the effectiveness of a special silk fabric (MICROAIR Derma*Silk*®) in the treatment of young children affected by AD with acute lesions at the time of examination.
Methods Forty-six children (mean age 2 years) affected by AD in an acute phase were recruited: 31 received special silk clothes (group A) which they were instructed to wear for a week; the other 15 served as a control group (group B) and wore cotton clothing. Topical moisturizing creams or emulsions were the only topical treatment prescribed in both groups. The overall severity of the disease was evaluated using the SCORAD index. In addition, the local score of an area covered by the silk clothes was compared with the local score of an uncovered area in the same child. All patients were evaluated at baseline and 7 days after the initial examination.
Results At the end of the study a significant decrease in AD severity was observed in the children of group A (mean SCORAD decrease from 43 to 30; $P = 0{\cdot}003$). At the same time, the improvement in the mean local score of the covered area (from 32 to 18·6; $P = 0{\cdot}001$) was significantly greater than that of the uncovered area (from 31 to 26; $P = 0{\cdot}112$).
Conclusions The use of special silk clothes may be useful in the management of AD in children.

Key words: atopic dermatitis, silk clothes, skin care

Atopic dermatitis (AD) is a chronic inflammatory skin disease which has become increasingly widespread over the last decades.[1] It usually starts during the first year of life and its pathogenesis is not completely understood. There are many factors known to worsen the disease, including food and inhalant allergy, climatic factors, and chemical or physical irritants. In early infancy triggering factors include cutaneous superinfection, particularly from *Staphylococcus aureus*, and skin exposure to allergens and/or irritants such as house dust mite, harsh textile fibres and clothing (particularly wool and synthetic fabrics), aggressive detergents, and climatic factors. An important role in the pathogenesis of AD has been ascribed to the defect of the skin barrier which presents an impaired permeability function,[2] causing the development of eczematous lesions after exposure to repeated irritants. The itching produced by direct contact with wool in patients with AD is characteristic and the irritation is likely to be caused by the 'spiky' nature of the fibres.

On account of the worsening of the disease due to harsh fabrics, parents have often been advised to use cotton clothes for their children. However, recent studies have suggested that cotton may also present a roughness that irritates the skin of children affected by AD.[3,4] Cotton is made up of many short fibres (1–3 cm) with flat and irregular sections: damp absorption and transfer occur by extension and contraction of the single fibres producing a movement that may irritate and scratch the skin. Silk, on the other hand, has a perfectly smooth fibre, without roughness, and for this reason is not irritant for the skin. The structure of silk fibre is quite similar to that of human hair (97% proteins, 3% fat and waxy substances), thus allowing its use in surgery and directly on scalded skin. Each silk

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thread is made up of many filaments more than 800 m long which are highly resistant, perfectly smooth and cylindrical and do not cause friction on the skin. Silk also helps to maintain the body temperature, by reducing the excessive sweating and moisture loss that can worsen xerosis.

A study performed by Sugihara *et al.* in Japan[5] examined the effects of a silk film on full-thickness skin wounds: it was found that the wounds dressed with silk film healed 7 days faster than those covered with traditional dressing. They reported that silk film as a skin dressing can be easily produced and sterilized, and also enhances collagen synthesis, reduces oedema and scarring due to inflammatory responses and promotes epithelialization. Moreover, silk has been used as suture thread for many years, especially in epidermal and ophthalmic surgery.[6] However, the type of silk fabric generally used for clothes is not particularly useful in the care and dressing of children with AD as it reduces transpiration and may cause discomfort when in direct contact with the skin.

A new type of silk fabric made of transpiring and slightly elastic woven silk is now commercially available (MICROAIR Derma*Silk*®) and may be used for the skin care of children with AD. This fabric also has antibacterial properties thanks to an exclusive water-resistant treatment with AEGIS AEM 5772/5, a durable antimicrobial finish for textile products that prevents odour and the survival of bacteria including *S. aureus*.[7] It is based on the compound alkoxysilane quarternary ammonium. These AEGIS antibacterial treatments are already utilized in the U.S.A. in many commercial products.

The aim of our study was to evaluate the effectiveness of this new silk fabric (MICROAIR Derma*Silk*®) in the treatment of young children affected by AD with a disease flare at the time of examination.

Subjects and methods

We studied 46 children aged between 4 months and 10 years (mean 2 years) who were referred to our Allergology and Immunology Paediatric Department between February and June 2002. All children were affected by AD in accordance with the Hanifin and Raijka criteria[8] and at the time of examination all were in a phase of disease exacerbation.

The clothes used in this study were produced by AL.PRE.TEC. (S. Donà di Piave, Venice, Italy) and were made from MICROAIR Derma*Silk*®, a pure form of silk consisting exclusively of fibroin, whereas the natural fibres of the silkworm are made up of two proteins: fibroin and sericin. During the manufacture of the new silk fabric the sericin is totally eliminated. To rule out the presence of sericin, two samples of the fabric were evaluated and tested by the Stazione Sperimentale per la Seta in Milan using a microchemical assay (internal method CH13, Optic Microscope Orthoplan Leitz). The analysis confirmed that the fabric was completely sericin free.

Study plan

The patients were divided into two groups: 31 children received products made of the above-mentioned silk (group A), and the other 15 children served as a control group (group B) and were dressed in cotton clothes. The two groups were homogeneous in age and clinical picture. Follow-up took place 7 days after the initial examination.

The 31 patients in group A were given the silk clothing during their first examination and topical emollients were prescribed. The 15 children in the control group (group B) were also treated with topical moisturizing therapy, but continued to wear cotton clothing. No pharmacological treatment with steroids and/or antibiotics was permitted in either group. Twice as many patients were enrolled in group A to compensate for a presumed high level of noncompliance.

Parents were informed of the main characteristics of the fabric and were asked to dress their children with the silk products all day long for the whole week after the initial clinical examination. Advice on the use of the clothing was given to group A parents by a member of the medical team who was not subsequently involved in evaluating the clinical score of patients, but whose role was limited to checking compliance. Parents were informed about the importance of continuous use of the silk products to obtain an improvement in the symptoms and skin lesions of their child.

On the basis of the cutaneous involvement of the disease, the following garments were distributed to the children: body suit for the trunk ($n = 6$), overall rompers for the whole body ($n = 11$), leggings for the lower limbs ($n = 5$), tubular bands for small parts of the arms and legs ($n = 6$), gloves for the hands ($n = 2$), and waist bands for the lower abdominal area near the napkin ($n = 2$).

At each examination (baseline and follow-up), two clinical parameters were evaluated: (i) the overall

severity of the AD using the SCORAD index (AD was considered mild, moderate and severe when the SCORAD index was < 20, between 20 and 40, and > 40, respectively); and (ii) the severity of a local skin lesion in an area covered by the silk fabric and the severity of another area in the same child similarly involved by lesions but uncovered; for this purpose the local scores of these two areas were compared by evaluating the skin lesion intensity as indicated by the SCORAD index model, i.e. on the basis of the presence of erythema, oedema/papulation, exudations/scabs, abrasions, lichenification and xerosis in these areas. The local score produced a value with a range between 1 and 63.

The investigator responsible for the clinical evaluation did not know to which group each child belonged or which body area had been covered by fabric or not, as the children were already undressed before examination. Throughout the study clinical evaluation was always made by the same investigator.

Statistics and ethical considerations

The Statistical Package for Social Science (SPSS/PC; SPSS Inc., Chicago, IL, U.S.A.) was used for statistical analysis. The χ^2 test and Student's *t*-test were used for comparison in the different phases of treatment.

Informed consent was obtained from the parents before the children were included in the study.

Results

All 31 children of group A returned to our department for the follow-up: 23 had correctly followed the instructions regarding the continuous use of the silk garments. All these children were re-evaluated according to the study plan described above. The remaining eight children were excluded from the study because they did not follow the instructions correctly. All 15 patients in the control group (group B) were also reassessed 7 days after the first examination.

Clinical evaluation at the first examination

At the first examination, the mean clinical score (SCORAD index) in group A was 43, while in group B it was 47, without any significant difference ($P = 0{\cdot}3$). Among the 23 patients of group A who completed the study, one child (4%) had mild AD, nine children (39%) moderate, and the remaining 13 (57%) had severe AD. Within the control group (group B), at the first examination six children (40%) had moderate AD and nine (60%) had severe AD.

Follow-up

Seven days later, the mean clinical score (SCORAD index) of group A was 30. This decrease in eczema severity was statistically significant ($P = 0{\cdot}003$). The mean clinical score of group B was 46, which was not significantly different from the first examination ($P = 0{\cdot}886$).

Of the 23 children who had used the silk fabric, eight (35%) now had mild AD, 11 (48%) moderate, and four (17%) severe. Of the 15 patients in the control group, six (40%) continued to have moderate AD and nine (60%) severe AD. The general SCORAD severity modifications before and after treatment in the two groups are shown in Figure 1.

For each patient we calculated the difference in the SCORAD index value between the first and the second examination; we subsequently calculated the increase/decrease in SCORAD index value as a percentage. The disease was considered as worsening when the SCORAD index increased; stable when it decreased by $< 20\%$; improved when it decreased by between 20% and 40%; and much improved when it had decreased by $> 40\%$.

Of the 23 children of group A, none (0%) showed a worsening at the second examination; four (17%) were stable; 15 (66%) had improved; and four (17%) had much improved. In the control group, four children (27%) showed a worsening at the second examination; 11 (73%) were stable; and none (0%) had improved or much improved.

The local score (one skin lesion covered by the silk and one similarly involved skin lesion not covered by the silk fabric in the same child) was assessed in 18 of the 23 children of group A. In five children a comparative evaluation was not possible because the skin lesions were only in the areas covered by the silk cloth. At baseline, the mean local scores of the covered and uncovered areas were 32 and 31, respectively.

At the second examination, the mean local score of the covered area was seen to have significantly decreased to 18·6 ($P = 0{\cdot}001$) (Fig. 2). None of the 18 children showed a worsening or a stable situation of the lesions in the area covered by the silk; these lesions showed improvement in 11 children (61%) and were much improved in seven (39%).

At the second examination the mean local score of the uncovered area decreased from 31 to 26, which

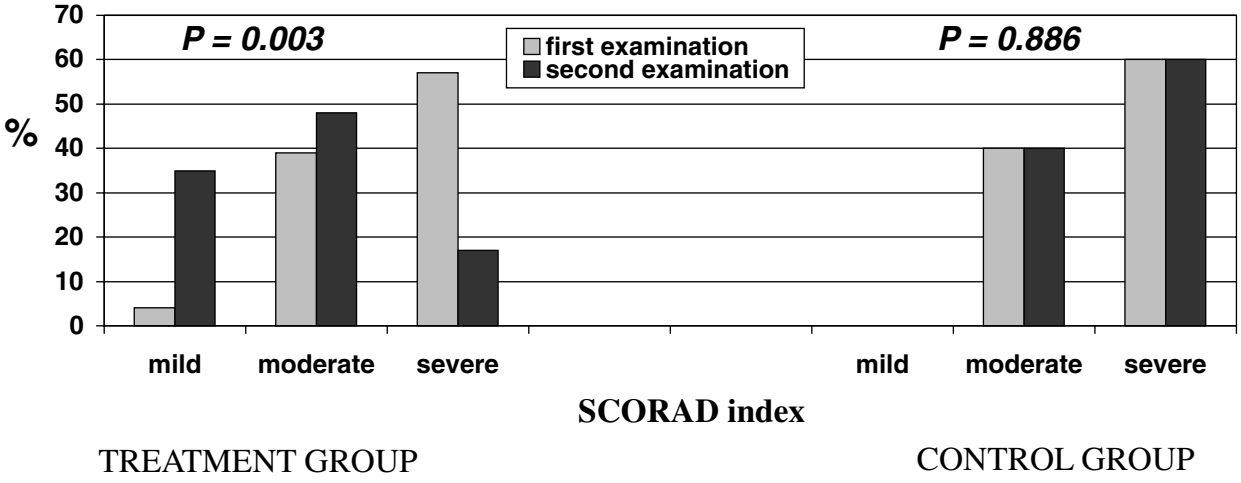

Figure 1. Evaluation of effectiveness of Derma*Silk*® clothes in two groups of children affected by atopic dermatitis (AD) with reference to the SCORAD index evaluation. Comparison of percentage of patients with mild, moderate and severe AD at first and second examinations in the treatment group and in the control group.

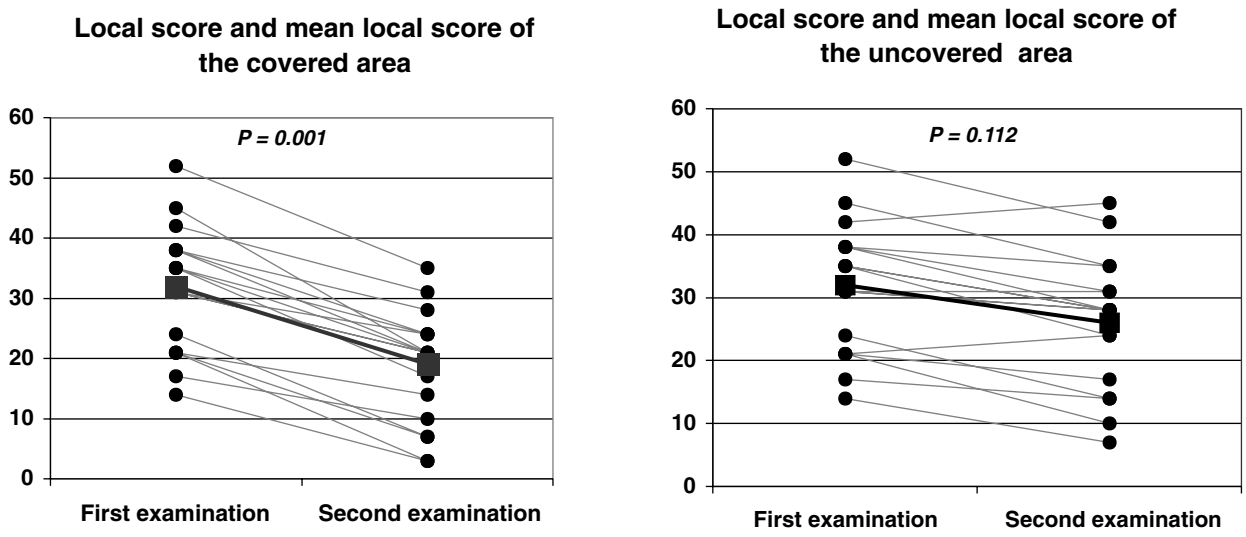

Figure 2. Evaluation of the effectiveness of Derma*Silk*® clothes in the treatment of children affected by atopic dermatitis with reference to the improvement of the local score of the covered area compared with the local score of the uncovered area in the same child. The mean local score is shown in bold: mean local score of the covered area at first examination vs. second examination $P = 0{\cdot}001$; mean local score of the uncovered area at first examination vs. second examination $P = 0{\cdot}112$ (not significant).

was not statistically significant ($P = 0{\cdot}112$) (Fig. 2). The lesions of the uncovered area showed a worsening in two children (11%), were stable in 10 (55%), showed an improvement in three cases (17%) and were much improved in the remaining three (17%).

Discussion

The skin of children affected by AD is quite sensitive and may worsen after exposure to various irritant factors. Some fabrics used as dressings may, for example, produce a worsening in the skin conditions of these children due to their rough fibres. Acute and cumulative irritation, allergic contact dermatitis, exacerbation of AD and contact urticaria have been reported to have been caused by textile fibres (e.g. nylon can cause allergic contact dermatitis and contact urticaria; wool can cause acute and cumulative irritant dermatitis and aggravate AD).[9] Cotton clothes have been used in conjunction with topical

treatments in other countries (e.g. Lohmann® clothes in Germany).

In recent years silk has been increasingly used in medical treatment thanks to its unique properties. The smoothness of silk is of considerable importance. A recent study[10] has assessed the beneficial effects of softened fabrics on atopic skin, suggesting that softened fabric is less aggressive to the skin than unsoftened fabric. Furthermore, in the case of irritated skin, the recovery of the skin was significantly faster when in contact with softened rather than unsoftened fabrics.

The clothes used in the present study are made of woven silk where the special properties of silk are enhanced: the fabric allows the skin to breathe and the sensation does not bother the wearer; it also has a high capacity to absorb sweat and serous exudates (up to 30% of its weight without becoming damp): this is important in maintaining the water balance of the skin through its emollient and soothing action.

In our study the children wearing woven silk showed a statistically significant improvement of their symptoms ($P = 0{\cdot}003$), while those dressed in cotton showed no significant improvement. In addition, we saw an improvement in the skin area covered by the silk fabric ($P = 0{\cdot}001$), while the similar but uncovered area in the same child remained predominantly stable. Furthermore, the children's parents reported an improvement in the cutaneous lesions of their children, as well as in scratching and itching, even though the latter parameters remain subjective. The use of this new type of woven silk fabric would therefore appear to be useful in the skin care of children with AD.

However, it should be stressed that the silk dressing is effective only if the garments are worn all day long, ensuring that contact with the skin is as close as possible. It is not easy for parents to follow this regimen strictly: eight children were excluded from the present study for inadequate compliance. Silk in its natural state consists of a single thread secreted by the silkworm and is made up of a double filament of protein material (fibroin) glued together with sericin, an allergenic gummy substance that is normally extracted during the processing of the silk threads.[11,12] Silk allergy among workers in the silk industry has been recognized for some time, whereas allergic reactions of consumers on a large scale have been described only rarely,[13,14] as the final textile products of silk are mostly nonallergenic.[15] In our study no adverse and/or allergic reactions were observed and to the best of our knowledge no reactions have been reported in the literature to this new silk fabric.

To rule out the presence of sericin, the silk garments used in the present study were certified by the Stazione Sperimentale per la Seta in Milan. After the removal of sericin, the remaining protein, fibroin, has a low allergenic potential and, to the best of our knowledge, only one case of recurrent granulomas with remarkable infiltration of eosinophils has been reported in the literature, which may have resulted from an IgE-mediated hypersensitivity reaction to silk fibroin.[16] Although clothes made of washed silk are generally safe for the consumer, the unprocessed silk threads that are broken during reeling (silk waste) are used in China to fill bed quilts, clothes, toys and mattresses,[15] and may continue to be allergenic for the consumers.

In conclusion, the use of sericin-free silk products would appear to alleviate the symptoms of AD in children and as such may represent a useful tool in the management of AD. Further studies are needed to investigate the antibacterial properties of this fabric.

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