



Atopic Dermatitis > Silk Fabrics in the Management of Atopic Dermatitis

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Silk Fabrics in the Management of Atopic Dermatitis

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ABSTRACT

Many factors may worsen atopic dermatitis (AD) including sweating, skin infections, food, inhalant allergens, climatic conditions, stress, and chemical or physical irritants. Especially in children, clothing can be an effective barrier against flare-inducing factors and persistent scratching, allowing more rapid improvement of the eczematous lesions. On the contrary, some fabrics used for clothing may exacerbate skin conditions due to their rough fibers, such as wool and nylon. Conventional silk has smooth fibers that are generally woven for textiles in the manufacturing of clothes, but this material is not particularly useful in the management of children with AD since it reduces transpiration and may cause discomfort. Herein, we evaluate the data concerning a special silk fabric (MICROAIR DermaSilk®) shown to be suitable for patients with AD. The unique properties of this knitted silk allow the skin to breathe and lack irritative potential. Moreover, this fabric is treated with a water-resistant antimicrobial finish known as AEGIS AEM 5772/5. This novel knitted silk fabric appears to be useful in managing children with AD due to its non-irritating and antibacterial features. Additionally, a synthetic silk-like fabric (DermaTherapy®) has received US FDA clearance as a Class I medical device and is commercially available as bedding; their use by AD patients has shown interesting results.

Key Words:

antibacterial activity, atopic dermatitis, child, eczema, fabric, silk

Introduction

Atopic dermatitis (AD) is the most frequent chronic inflammatory skin disease of childhood. AD usually starts during the first few years of life, commonly following a chronically relapsing course. Many factors are known to worsen or trigger the disease, including perspiration, food and inhalant allergens, climatic factors, skin infections due to *Staphylococcus aureus* (*S. aureus*), stress, and chemical or physical irritants¹. Recent investigations have shown

that one of the most important pathogenetic factors is skin barrier impairment due to alteration of structural proteins (e.g., filaggrin) or enzyme imbalance (e.g., protease and antiprotease).¹⁻³

In the management of AD, an effective therapeutic program requires a multifaceted approach that incorporates control of skin inflammation, identification and elimination of triggering factors, and implementation of strategies aimed at improving the alterations/defects of the skin barrier

Clothing can be an effective barrier against persistent scratching, allowing more rapid improvement of the eczematous lesions and limiting exposure to bacterial pathogens that can cause skin infections. On the contrary, certain fabrics used for clothing can exacerbate AD in some patients, which may be attributable to their rough fibers (e.g., wool and nylon), whereas silk fibers are generally smooth. However, conventional silk fabric used for the manufacturing of clothing is not particularly practical in managing children with AD, since it reduces transpiration and may cause discomfort or irritation when in direct contact with the skin.⁴

The Silk

Silk, in its natural state, consists of single long threads secreted by the silkworm *Bombyx mori* 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. Each silk thread is comprised of filaments that are more than 800 meters in length. Thread fibers are strong, perfectly smooth, and cylindrical, therefore, minimizing friction on the skin. Degumming represents a key process in the manufacturing of silk threads, whereby the sericin is completely removed and the silk fibers gain their characteristic sheen, softness, and flexibility.

Management of AD with DermaSilk®

A new type of silk fabric made of breathable and slightly elastic knitted silk is commercially available (MICROAIR DermaSilk®, thereafter referred to as DermaSilk) and may be beneficial in children with AD. Moreover, this fabric is treated with a durable water-resistant antimicrobial finish that prevents odors and inhibits bacteria survival, including *S. aureus*.^{5,6}

In a previous blind study⁶ we recruited 46 children experiencing AD in acute phase: 31 patients received special silk clothes that were worn for 1 week but changed daily; another 15 children (the control group) wore cotton clothing. Moisturizing creams or emulsions were the only topical treatment permitted in both groups. The overall severity of AD was evaluated using the SCORAD index (SCORing Atopic Dermatitis, a clinical tool for assessing AD severity). In addition, the local score of an area covered by the silk clothing was compared with the local score of an uncovered area in the same child. All patients were evaluated at baseline and ⁷ days after. At the end of the study, a significant decrease in AD severity was observed in the children who wore the silk garments (mean SCORAD decrease from 43 to 30; $P=0.003$); the mean clinical score of the control group was not significantly different from the first examination (SCORAD score changed from 47 to 46). In contrast, the improvement in the mean local score of the covered area (from 32 to 18.6; $P=0.001$) was significantly higher than that of the uncovered area (from 31 to 26; $P=0.112$). At the second examination, the mean local score of the uncovered area was not statistically significant, decreasing from 31 to 26. In summary, the lesions in the uncovered area worsened in 2 children (11%), were stable in 10 (55%), improved in 3 cases (17%), and much improved in the remaining 3 (17%). Similar results were demonstrated later by Koller et al.⁷

In a subsequent investigation⁸ we attempted to evaluate in vivo the antibacterial properties of this special fabric treated with AEGIS AEM 5572/5 (AEGIS), which had already been shown in vitro to exhibit antibacterial activity.⁵ The study population consisted of 12 children affected by AD with symmetrical eczematous lesions on the antecubital areas and 4 patients without any cutaneous disease served as controls. Children were asked to wear for 7 days

two tubular garments that were changed daily. Microbiological examinations were conducted through samples obtained with standard culture swabs and by means of quantification of bacterial agents using agar plates at baseline, after 1 hour, and after 7 days. A significant improvement in mean value of the clinical SCORAD index was observed in both the covered skin areas compared with the values obtained at baseline. These decreases in values were from 7.3 to 4.4 ($P=0.002$) after 7 days in the area covered by the treated fabric and from 7.1 to 5 ($P=0.019$) in the symmetrical area covered by the untreated fabric. Reductions in the mean number of CFU/cm² (number of colony forming units per cm² of surface area) occurred but were similar in both areas.

The data confirmed that the reduction in bacterial colonization is associated with a clinical improvement of eczema. However, our analysis showed that even though the silk fabric treated with AEGIS exhibited *in vitro* antibacterial properties, we were unable to demonstrate such activity *in vivo*. A possible explanation may be the difficulty in maintaining sufficient adhesion between the fabric and the skin or that bacterial colonization is strongly influenced by the integrity of the skin barrier and the use of antiseptics.

Another investigation that evaluated the efficacy of antimicrobial silk clothing in the treatment of AD observed comparable efficacy to topical corticosteroid treatment.⁹ In a bilateral comparison study, 15 children were recruited and instructed to wear clothing made of special silk fabric (DermaSilk) on the left side of the body and cotton on the right side. Only the right side of the body was treated daily with a topical corticosteroid (mometasone) for 7 days. The efficacy of these two treatments was measured with a modified Eczema Area and Severity Index (EASI) score and evaluation by the patients/parents, as well as physician assessment at baseline and after 7 and 21 days. No significant differences were noted between the skin of the right (DermaSilk-treated) and left (treated with cotton and topical corticosteroid) sides.

Another research group has explored the clinical efficacy of DermaSilk with and without AEGIS antimicrobial finish on eczema severity and pruritus.¹⁰

Thirty patients aged 3 to 31 years having active AD with eczematous lesions on the arms, but without any sign of infection, were enrolled in a randomized, double-blind study. Patients received a set of four pairs of knitted silk tubular sleeves distinguished by different colors of seams. Only one pair of sleeves was treated with AEGIS, which was unknown to patients/parents and investigators.¹⁰ Patients were evaluated at baseline and after 7, 14, 21, and 28 days using multiple methods (i.e., photographic assessment, local modified SCORAD index for the arm only, and patient/parent estimation of pruritus with a visual analogue scale). Study findings reported reductions in mean local SCORAD index scores (after 28 days) in both treatment groups, i.e., arms exposed to both DermaSilk and unmodified silk sleeves. However, the DermaSilk group showed a consistent decline in scores (mean SCORAD decreased from 47 to 36 in the first 2 weeks and to 26 after an additional 2 weeks), whereas the unmodified silk group experienced a significant reduction only in the first 2 weeks of the study (mean SCORAD changed from 47 to 38 in the first 2 weeks and to 36 after an additional 2 weeks). Also, the DermaSilk group exhibited greater reduction in pruritus.

Synthetic Silk-like Fabric (DermaTherapy®)

Due to the favorable data demonstrated by the use of special silk fabrics in AD management, a synthetic silk-like fabric has also been developed.

DermaTherapy® received 510(k) clearance from the US FDA as a Class I medical device for use by patients susceptible to or who have mild atopic dermatitis.¹¹ The manufacturer asserts the material is highly durable and provides therapeutic benefits that are attributable to its ability to minimize friction due to the smooth texture of the fibers, which are composed of approximately 50% polyester and 50% nylon. In addition, the fabric may inhibit bacterial growth by wicking away moisture from the surface of the bedding, resulting in drier conditions.¹² The threads are produced with continuous-filament fibers that create a planar surface, reducing skin irritation. Moreover, a durable antimicrobial finish is applied to the fabric to prevent bacterial infections. Kurz et al¹³ showed that the use of silk-like bedding in subjects

with mild to moderate AD reduced disease severity at 8 weeks, including pruritus scores, and partial improvements in the quality of life index were also observed.

Conclusion

The hypersensitivity of atopic skin may be improved or worsened with the use of certain textiles. The itching produced by direct contact with wool in patients with AD is a common source of irritation that is likely produced by the “spiky” nature of the fibers. In contrast, clothes made of knitted silk have unique beneficial properties that reduce friction, allow the skin to breathe, and absorb perspiration and serous exudates (up to 30% of its weight without becoming damp⁶), which may be an important factor in maintaining the moisture balance of the skin. The use of novel knitted silk fabrics appears to be a promising adjunct in the management of children with AD. As well, synthetic silklike bedding may offer therapeutic benefits that are attributable to their non-irritating and antibacterial properties. Further investigations to confirm the utility of these novel fabrics in AD are warranted.

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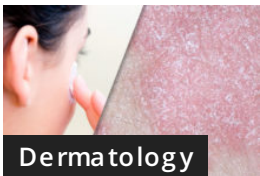
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