Dermatology

Review Article

Dermatology 2021;237:119–124
DOI: 10.1159/000501611

Received: May 14, 2019
Accepted: June 19, 2019
Published online: August 29, 2019

# Undergarment and Fabric Selection in the Management of Hidradenitis Suppurativa

Tiffany Y. Loh[a] Aleksi J. Hendricks[b] Jennifer L. Hsiao[c] Vivian Yan Shi[a]

[a]Division of Dermatology, University of Arizona, Tucson, AZ, USA; [b]University of Arizona College of Medicine, Tucson, AZ, USA; [c]Division of Dermatology, University of California Los Angeles, Los Angeles, CA, USA



**Keywords**
Hidradenitis suppurativa · Acne inversa · Management · Undergarments · Fabrics

**Abstract**
Hidradenitis suppurativa (HS) is a chronic inflammatory condition manifesting as recurrent and exquisitely painful nodules in intertriginous regions. The role of mechanical stress in HS pathogenesis is gaining attention, as factors including intertriginous distribution of lesions, obesity, sweating, and suboptimal clothing contribute to increased friction and exacerbation of disease. Undergarment and clothing selection are often-overlooked components of HS management and should be addressed with patients as practical lifestyle changes that can decrease the frequency of disease flares and reduce symptoms of pain and irritation at involved sites. Selection of breathable and absorbent fabrics can also aid in reducing microbial colonization, sweat retention, and odor. This discussion is based on expert recommendations and aims to provide practitioners with the rationale for appropriate undergarment and clothing selection for HS patients. We propose practical principles for choosing undergarment design and fabrics for breathability, absorbency, and skin pressure reduction.


## Introduction

Hidradenitis suppurativa (HS) is a chronic condition characterized by recurrent, inflammatory nodules classically involving the intertriginous regions [1, 2]. Although the exact etiology of HS remains unknown, a variety of factors are thought to contribute to disease pathogenesis, including hormonal changes, genetics, diet, smoking, immune system abnormalities, and obesity [1–3]. Due to a combination of these factors in predisposed patients, the folliculopilosebaceous unit (FPSU) becomes occluded, and over time, recurrent episodes of inflammation can lead to scarring, sinus tract formation, pain, disfigurement, and functional disability [1]. Current treatments include topical and oral antibiotics, oral contraceptives, corticosteroids, and tumor necrosis factor (TNF)-α inhibitors. However, the goal of HS treatment is often control of the disease rather than cure.

In the absence of cure and given the relapsing, multifactorial nature of HS, disease management often requires a multimodal approach using a combination of medical therapy and lifestyle changes. Specifically, clothing selection is an important but often overlooked component of HS management. As 70% of women have ill-fitting bras [4], strategic undergarment selection may

karger@karger.com
www.karger.com/drm


Vivian Y. Shi, MD
Assistant Professor of Medicine, Division of Dermatology
University of Arizona, 7165 N Pima Canyon Drive
Tucson, AZ 85718 (USA)
E-Mail vshi@email.arizona.edu

make a meaningful impact on quality of life. Recent North American and European guidelines give limited practical advice on this matter, and the evidence behind clothing choice in HS is lacking [5, 6]. Here we will discuss the rationale behind appropriate undergarment and fabric selection in HS based on our expert recommendations and highlight important clinical pearls in this aspect of disease management.

*Mechanical Stress in HS*

The initial event in HS pathogenesis appears to be occlusion of the follicular duct. It has been postulated that keratinocytes in predisposed patients exhibit an aberrant response to commensal bacteria, which leads to cytokine and adenosine monophosphate production [7]. This in turn results in recruitment of innate immune cells and T cells, leading to increased cytokine production of interleukin (IL)-1β, IL-17, IL-10, and TNF-α, which further drive the inflammatory cascade implicated in HS pathogenesis. In response, the follicular epithelium becomes hyperplastic, resulting in follicular occlusion and cyst formation [7].

The structure of the FPSU is thought to be inherently weaker in HS, which is supported by studies demonstrating the loss of periodic acid–Schiff-positive basement membrane in the pilosebaceous junction [8]. Therefore, the FPSU may be particularly prone to rupture, which likely occurs more readily when HS lesions are subjected to frictional forces. Mechanical stimuli have also been shown to promote keratinocyte differentiation and proliferation, thus contributing to epidermal thickening and retention of hair follicle debris [9]. In addition to these physical effects, friction has also been shown to contribute to the inflammatory cascade in HS through immunologic means. Mechanical stress increases matrix metalloproteinase 9 levels in keratinocytes, and several genes related to wound healing (connexin 43, laminin α5, interleukin α, endothelin 1, keratinocyte growth factor) are downregulated in response to mechanical stress [9]. Over time, through repeated cycles of inflammation, superimposed infection, and healing, patients can develop scarring, sinus tract formation, and significant disease progression.

Multiple large demographically heterogeneous population-based studies in the USA have found that 70% of HS patients are obese with a BMI >30 kg/m$^2$ [10, 11], a comorbidity that further contributes to the frictional component of their disease [1, 2]. As undergarments come in close contact with the body, especially in intertriginous areas where HS lesions are most often located, tight undergarments can greatly exacerbate the degree of inflammation in HS [9]. Therefore, appropriate undergarment and fabric selection is an important aspect of HS management.

*Sweat and Microbial Colonization in HS*

While bacterial colonization is not the cause of HS, microbial overgrowth in warm and damp intertriginous areas can contribute to odor, chronic skin irritation, and secondary infection. Microbial dysbiosis and biofilm formation have been implicated as potential factors in HS pathogenesis and contribute to chronicity of lesions [12, 13]. As HS commonly affects apocrine sweat gland-bearing skin, there is prolonged exposure to sweat and humidity in these regions that exacerbates HS lesions and associated pain and pruritus [14, 15]. Absorbing drainage from active lesions and sweat from affected areas is critical for wound healing and minimizing odor and irritation. Appropriate fabric choice for clothing and undergarments can allow for improved breathability and absorbency and reduce microbial colonization and sweat retention.

## Selection of Undergarments in the Management of HS

*Undergarment Design*

The goal of appropriate undergarment selection in HS management is to decrease mechanical stress, humidity, heat, and microbial colonization. Therefore, undergarments for HS patients in general should be loose-fitting and designed in a manner so as to minimize shearing forces.

As the inframammary and lateral breast regions are commonly involved in HS, choosing appropriate bras can have a significant impact on disease severity for female patients. Bra designs that can help offload pressure and prevent excessive friction in the inframammary area include sports bras or camisole tanks with built-in wireless bras. In addition, bra liners and breast pads can be helpful for reducing friction in this area, with the added benefit of absorbing drainage from active HS lesions. HS patients should be counseled to avoid bras with tight elastic, thin straps, or metal wires (Fig. 1), as all of these components can exert significant pressure and cause irritation, friction, and resulting inflammation.

As a large proportion of HS patients have comorbid obesity, the sub-pannus is also a region subject to friction and is often an area of significant disease involvement. Underwear frequently comes into contact with this friction-prone zone and, therefore, it is important to counsel patients on types of underwear that may help to minimize

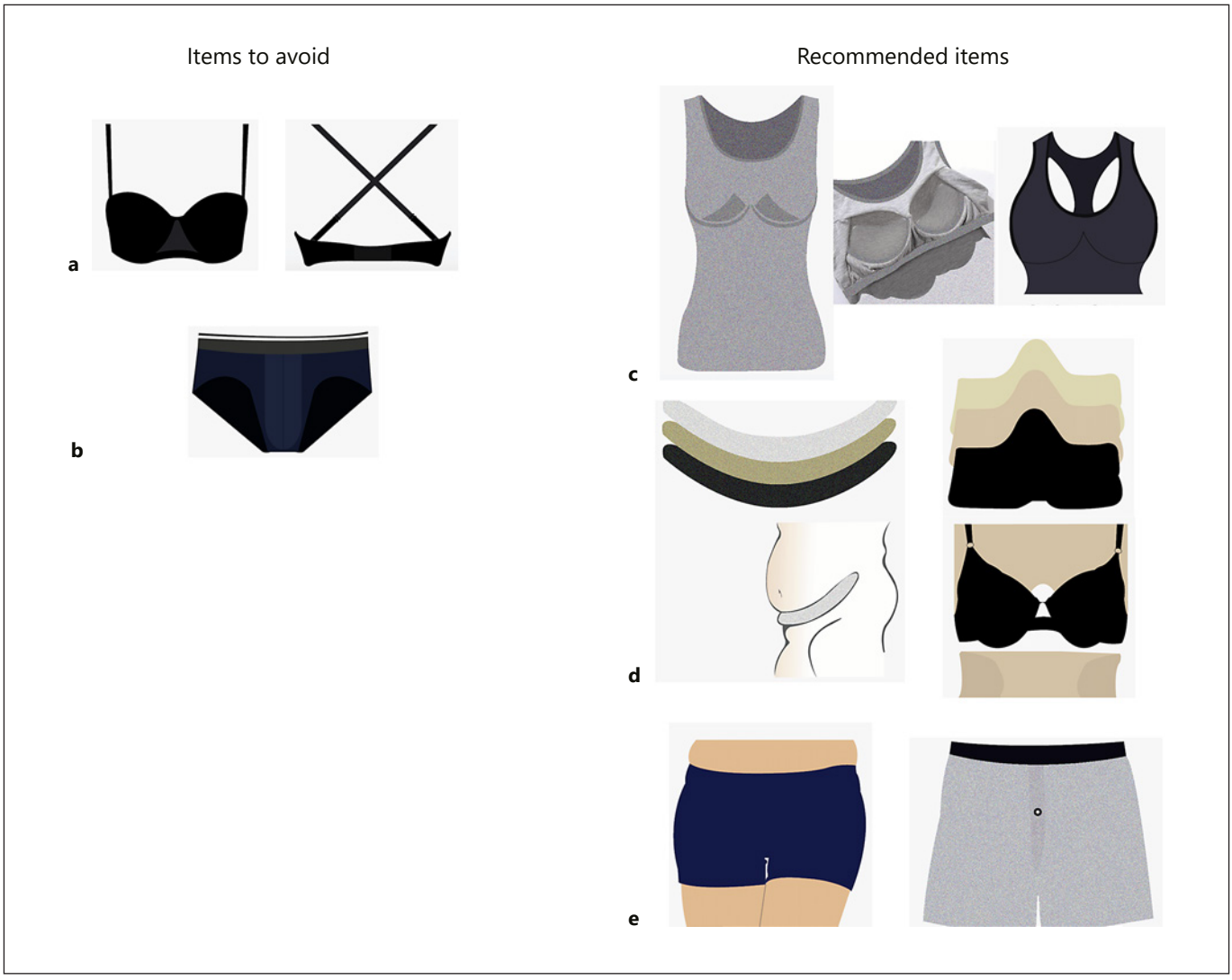


**Fig. 1.** Preferred undergarment designs for HS patients. Ideal bra designs are sports bras or camisole tanks with built-in bras that lack thin straps, tight elastic, and metal wires. Underwear should be loose-fitting without tight bands or seams in the inguinal folds or across the abdomen. Preferred fabrics are cellulose-derived rayon fabrics, bamboo fibers, moisture-wicking cloth, silver-impregnated fabric, and cotton. **a** Bras with thin straps or tight elastic can exacerbate HS. **b** Tight briefs may exert excessive friction in inguinal areas. **c** Camisole tanks with built-in wireless bras and sports bras may help offload pressure. **d** Abdominal and bra liners may help absorb drainage. **e** "Boy shorts" for women and loose boxers for men may minimize shearing.

irritation. For example, in women, designs that may help to decrease friction in the sub-pannus include "boy shorts", briefs, high-cut briefs, and "cheeky" underwear (Fig. 1). Seamless or laser-cut underwear lack elastic bands and can also be helpful for minimizing shearing forces. In addition, in patients experiencing HS flares or having significant drainage from the groin region, absorbent pads, sanitary pads, or mesh underwear may be beneficial. For men, the majority of loose boxers or trunks are usually appropriate for HS, but tight briefs should be avoided (Fig. 1). However, it is possible that in some situations, clothing that fits snugly may reduce the movement of fatty tissue and help to minimize friction. Thus, an individualized approach may be advisable, in which patients try different undergarments to determine which garment types are best at reducing friction. Additionally, for patients with a large pannus or multiple inflammatory, draining lesions, abdominal liners may be helpful for pressure reduction and absorbing sweat and discharge.

*Fabrics*

Clothing fabric choice may also play an important role in minimizing friction and skin irritation in HS patients. Traditionally, materials such as cotton, wool, polyester, and nylon have been used in the majority of garment manufacturing. In recent years, "new age fibers" have emerged in the textile industry, which may help to minimize inflammation and irritation from clothing in HS patients.

For example, garments made from cellulose-derived rayon fibers (Tencel, Lyocell) [16, 17] may be beneficial for HS patients. In general, these fabrics are soft, strong, absorbent, wrinkle-resistant, and allow for good temperature control [18]. Importantly, rayon fibers also have a high degree of inherent whiteness and thus require less bleaching for cleaning [19], which is practical for HS patients who frequently have drainage from actively infected or inflamed lesions. In addition to these fabric characteristics, cellulose is a major component of the cell wall in plants and represents the most abundant organic polymer on the planet [16]. Therefore, it likely represents a sustainable source for textile production.

Clothing made from bamboo fibers is also an alternative to consider in garment selection for HS patients. During the fabric production process, bamboo stalks are first processed into fibers, then spun into yarn and woven into fabric. In addition to being inexpensive, absorbent, and hypoallergenic, these fibers are also usually softer than traditional cotton fibers and may be helpful for minimizing friction [20, 21]. Furthermore, bamboo stalks grow at a rapid rate and may represent another sustainable source for fabric production. One drawback, however, is that the processing of bamboo stalks requires extensive use of solvents, which may potentially be harmful for the environment [21].

Moisture-wicking clothing or cloth rolls may be additional considerations in patients who are prone to excessive sweating. Although traditionally made with 100% polyester, these fabrics can also be synthesized from environmental fibers such as soybean protein [22]. Rather than absorbing and retaining sweat, these fabrics transport water away from the skin in order to optimize heat and moisture dissipation through evaporation [22]. This may help to decrease humidity and maintain a comfortable thermal environment beneath garments, which is important for controlling HS disease activity. In particular, bicycle shorts may be useful in HS because in addition to their moisture-wicking properties, they extend down to the thighs and have the added benefit of minimizing irritation in the groin area. Of note, these recommended mid-thigh shorts should be distinguished from tight-fitting compression cycling shorts, which could exacerbate HS.

Although controversial due to concerns regarding potentially sublethal toxic effects on cells and the release of nanosilver particles into the environment [23, 24], silver-containing antimicrobial fabrics may also be a consideration in garment selection for HS patients [25–27]. Silver ions are known to inhibit the growth of bacteria, yeast, and algae, and these fibers are created by either applying silver salt to the fabric surface or by incorporating them into the fibers [26, 27]. Given that HS patients frequently have microbial colonization and bacterial infection of their lesions, wearing clothing made from silver-containing fibers may help to decrease microbial burden, frequency of HS flares, and odor. Silver-containing antimicrobial fabrics are relatively long-lasting and can usually maintain efficacy through up to 50 washes [28, 29]. Thus, they may represent a possible adjunctive solution for patients with frequent HS flares and superimposed infection. However, factors that may deter patients from using silver-impregnated clothing include higher cost and less availability of these garments compared to other clothing types.

Given the relatively higher cost and limited availability of some of the suggested fabrics and clothing, discussion regarding insurance coverage of these items may be warranted in the future. In the meantime, clothing made from 100% cotton may be a viable option for patients, especially for those who are not able to obtain garments made from the newer style fabrics discussed above. In addition to being readily available and more affordable than other options, cotton is also relatively gentle on the skin and can be helpful for decreasing friction and irritation in HS.

## Conclusions

While the HS treatment arsenal encompasses procedural approaches such as intralesional steroid injections, laser therapy, and wide local excision and medical therapies including topical antimicrobials, systemic antibiotics, and biologics, providers and patients should not overlook the importance of undergarment and fabric selection in disease management. Poor choice of undergarments can prevent patients from participating in activities important to their life trajectory, such as sitting through college classes or boardroom meetings, and good clothing can significantly improve quality of life. Recommended un-

dergarments for women include sports bras and camisole tanks without underwires or tight elastic bands in the inframammary area, and seamless or laser-cut underwear styles without irritating seams or bands in the inguinal folds. Men should be encouraged to wear loose-fitting boxers rather than tight briefs. Temperature control, softness, absorbency, and durability are desirable characteristics in clothing fabrics, and can be found in rayon cellulose-based Tencel, Lyocell, 100% cotton, and bamboo-based fabrics.

Education regarding appropriate undergarment styles and clothing fabrics can empower patients to implement lifestyle changes that reduce friction and irritation at affected sites and help to decrease the frequency of HS flares. Providers should incorporate a discussion of garment selection in initial encounters with HS patients, as minimizing mechanical stress from undergarments and clothing will augment the effectiveness of anti-inflammatory and antimicrobial medical therapies. Taking time to counsel HS patients on these considerations and providing examples of appropriate fabrics and undergarments may help to decrease patient morbidity and improve clinical outcomes. Further research regarding this aspect of HS management is warranted in the future.

## Key Message

Undergarments for HS patients should be loose-fitting without wires or tight elastic bands, and clothing fabrics should be breathable and nonirritating to decrease microbial colonization, odor, and sweat retention.

## Disclosure Statement

Vivian Yan Shi is a stock shareholder of Learn Health, and has served as an advisor, investigator and/or speaker for Sanofi, Regeneron, AbbVie, Novartis, Pfizer, Leo, Dermira, Eli Lilly, SUN Pharma, Menlo Therapeutics, GpSkin, Burt's Bees, and Skin Actives Scientific. There were no financial incentives or transactions otherwise relevant to this paper. Tiffany Y. Loh, Aleksi J. Hendricks, and Jennifer L. Hsiao have no potential conflicts of interest to declare.


## Funding Sources

No funding was received for this study.


## Author Contributions

All authors contributed to drafting and revision of the manuscript and approved the final version for submission.

## References


1 Margesson LJ, Danby FW. Hidradenitis suppurativa. Best Pract Res Clin Obstet Gynaecol. 2014 Oct;28(7):1013–27.
2 Slade DE, Powell BW, Mortimer PS. Hidradenitis suppurativa: pathogenesis and management. Br J Plast Surg. 2003 Jul;56(5):451–61.
3 Hoffman LK, Ghias MH, Lowes MA. Pathophysiology of hidradenitis suppurativa. Semin Cutan Med Surg. 2017 Jun;36(2):47–54.
4 Hadi MS. Sports Brassiere: Is It a Solution for Mastalgia? Breast J. 2000 Nov;6(6):407–9.
5 Alikhan A, Sayed C, Alavi A, Alhusayen R, Brassard A, Burkhart C, et al. North American clinical management guidelines for hidradenitis suppurativa: A publication from the United States and Canadian Hidradenitis Suppurativa Foundations: Part I: Diagnosis, evaluation, and the use of complementary and procedural management. J Am Acad Dermatol. 2019 Jul;81(1):76–90.
6 Zouboulis CC, Bechara FG, Dickinson-Blok JL, Gulliver W, Horváth B, Hughes R, et al. Hidradenitis suppurativa/acne inversa: a practical framework for treatment optimization - systematic review and recommendations from the HS ALLIANCE working group. J Eur Acad Dermatol Venereol. 2019 Jan;33(1):19–31.
7 Kelly G, Prens EP. Inflammatory Mechanisms in Hidradenitis Suppurativa. Dermatol Clin. 2016 Jan;34(1):51–8.
8 Danby FW, Jemec GB, Marsch WC, von Laffert M. Preliminary findings suggest hidradenitis suppurativa may be due to defective follicular support. Br J Dermatol. 2013 May;168(5):1034–9.
9 Boer J, Nazary M, Riis PT. The Role of Mechanical Stress in Hidradenitis Suppurativa. Dermatol Clin. 2016 Jan;34(1):37–43.
10 Garg A, Birabaharan M, Strunk A. Prevalence of type 2 diabetes mellitus among patients with hidradenitis suppurativa in the United States. J Am Acad Dermatol. 2018 Jul;79(1):71–6.
11 Garg A, Neuren E, Strunk A. Hidradenitis Suppurativa Is Associated with Polycystic Ovary Syndrome: A Population-Based Analysis in the United States. J Invest Dermatol. 2018 Jun;138(6):1288–92.
12 Ring HC, Thorsen J, Saunte DM, Lilje B, Bay L, Riis PT, et al. The follicular skin microbiome in patients with hidradenitis suppurativa and healthy controls. JAMA Dermatol. 2017 Sep;153(9):897–905.
13 Ring HC, Bay L, Nilsson M, Kallenbach K, Miller IM, Saunte DM, et al. Bacterial biofilm in chronic lesions of hidradenitis suppurativa. Br J Dermatol. 2017 Apr;176(4):993–1000.
14 von der Werth JM, Williams HC. The natural history of hidradenitis suppurativa. J Eur Acad Dermatol Venereol. 2000 Sep;14(5):389–92.
15 Matusiak Ł, Szczęch J, Kaaz K, Lelonek E, Szepietowski JC. Clinical Characteristics of Pruritus and Pain in Patients with Hidradenitis Suppurativa. Acta Derm Venereol. 2018 Feb;98(2):191–4.
16 Frazer L. New spin on an old fiber. Environ Health Perspect. 2004 Sep;112(13):A754–7.
17 Woodings CR. The development of advanced cellulosic fibres. Int J Biol Macromol. 1995 Dec;17(6):305–9.
18 Love WE, Nedorost ST: Fabric preferences of atopic dermatitis patients. Dermatitis. 2009 Jan-Feb;20:29-33.
19 Lau L, Fan J. Laundry performance of fabrics and garments. In: Fan J, Hunter L. Engineering apparel fabrics and garments. Cambridge: Woodhead Publishing in Textiles; 2009. p. 339–60.
20 Waite M: Sustainable textiles: the role of bamboo and a comparison of bamboo textile properties. Part 1. JTATM. 2009;6(2):1–21.
21 Nayak L, Mishra SP. Prospect of bamboo as a renewable textile fiber, historical overview, labeling, controversies and regulation. Fashion and Textiles. 2016;3(1):2.
22 Dai XQ, Imamura R, Liu GL, Zhou FP. Effect of moisture transport on microclimate under T-shirts. Eur J Appl Physiol. 2008 Sep;104(2):337–40.

23 Benn T, Cavanagh B, Hristovski K, Posner JD, Westerhoff P. The release of nanosilver from consumer products used in the home. J Environ Qual. 2010 Nov-Dec;39(6):1875–82.
24 Mao BH, Chen ZY, Wang YJ, Yan SJ. Silver nanoparticles have lethal and sublethal adverse effects on development and longevity by inducing ROS-mediated stress responses. Sci Rep. 2018 Feb;8(1):2445.
25 Jung WK, Koo HC, Kim KW, Shin S, Kim SH, Park YH. Antibacterial activity and mechanism of action of the silver ion in Staphylococcus aureus and Escherichia coli. Appl Environ Microbiol. 2008 Apr;74(7):2171–8.
26 Seltenrich N. Nanosilver: weighing the risks and benefits. Environ Health Perspect. 2013 Jul;121(7):A220–5.
27 Zhang G, Liu Y, Gao X, Chen Y. Synthesis of silver nanoparticles and antibacterial property of silk fabrics treated by silver nanoparticles. Nanoscale Res Lett. 2014 May;9(1):216.
28 Liu H, Lv M, Deng B, Li J, Yu M, Huang Q, et al. Laundering durable antibacterial cotton fabrics grafted with pomegranate-shaped polymer wrapped in silver nanoparticle aggregations. Sci Rep. 2014 Aug;4(1):5920.
29 Zhang D, Chen L, Zang C, Chen Y, Lin H. Antibacterial cotton fabric grafted with silver nanoparticles and its excellent laundering durability. Carbohydr Polym. 2013 Feb;92(2):2088–94.