Occupational skin diseases in the hairdressing industry

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1 The European hairdressing industry

The current European Risk Observatory report entitled “Occupational skin diseases (OSD) and dermal exposure in the EU (EU-25)”, published in 2008 by the European Agency for Safety and Health at Work, lists skin diseases as the second most common occupational health problem in Europe. Occupational skin diseases are considered "one of the most important emerging risks related to the exposure to chemical, physical and biological risk factors". The percentage of skin diseases among all occupational diseases is calculated at 7%. Furthermore, the report points out the high economic costs of these diseases, now calculated to be 5 billion euros per year in the EU (De Craecker et al. 2008).

According to the European Agency for Safety and Health at Work, there are close to 355,000 hairdressing companies and 400,000 hairdresser salons in Europe employing an estimated 940,000 hairdressers. More than 50% of them work in Germany or Italy, with an additional 29% in France and the United Kingdom.

2 Epidemiology of occupational skin diseases in the hairdressing industry

Until the present, there have not been comparable data regarding the epidemiology of occupational skin diseases in the hairdressing industry in European countries, as definitions of "occupational skin diseases" (with frequent overlapping definitions of irritant and allergic contact hand dermatitis) and data collection systems vary. These systems often also do not assume random sampling or relate to a given population. Despite these reservations, Table 1 shows a summary of data and estimates regarding the incidence (new diagnosis rate per year of a disease) and prevalence (number of affected patients at the time of examination) of occupational skin diseases by country and by publication.

The data provide the reader with a general orientation regarding the relevance of occupational skin diseases in the hairdressing industry. According to Diepgen (2007), the prevalence in studies has been estimated too low, and is actually 30-50 times higher than reported.

<table>
<thead>
<tr>
<th>Country</th>
<th>Publication</th>
<th>Incidence</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>Diepgen 2003 (State of Bavaria)</td>
<td>24 cases / 1000 persons / year</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Uter et al. 1998 in Diepgen et al. 2007</td>
<td>-</td>
<td>3-year prevalence during training: 23.9 cases / 2352 persons</td>
</tr>
<tr>
<td></td>
<td>Dickel 2002 (North Bavaria)</td>
<td>97.4 cases / 10,000 persons / year</td>
<td>-</td>
</tr>
<tr>
<td>Denmark</td>
<td>Diepgen 2003</td>
<td>11 cases / 1000 persons / year</td>
<td>-</td>
</tr>
</tbody>
</table>
3 Structure and functions of the skin

The skin is the outermost layer of the body and has an area of approx. 2 m². After the lungs, it represents the largest organ of the human body. As the outermost layer, it fulfills various duties that can be differentiated into protective and contact functions. The contact function includes external appearance and properties as a touch organ. Additional functions of the skin provide protection:

- from physical conditions such as heat, cold (thermoregulation, cooling function) and radiation
- from mechanical influences such as pressure, friction and impact
- from chemical substances and water
- from invasion of infectious agents and for defense against them
- from uncontrolled loss of water (transepidermal water loss; TEWL).

In addition, the skin plays a role in absorption (transdermal application of medicines), storage (adipose tissue, depot injections) and metabolic functions (Vitamin D synthesis) (Jung/Moll 2003).

These functions correlate with the skin’s structure.

3.1 Layer structure

The skin is made of three layers. From outside in, these layers include the epidermis, dermis and subcutis (see Figure 1).
The subcutis is mostly made of fat. It is involved in the storage and warmth-retaining functions of the skin. The fat also provides protection from mechanical influences. For example, the fat deposits under the heel provide padding for footsteps. Fat layers also protect the internal organs.

The dermis is the layer that is retained when leather is produced. It gives the skin its unique mechanical toughness. It includes various structures such as sweat and sebaceous glands, nerve cells and blood vessels. By changing their diameters, blood vessels play a role in the body’s heat regulation processes and supply the avascular epidermis with nutrients and oxygen.

The epidermis plays the most important role in protecting the body from chemical and physical influences, although it is the thinnest of the three skin layers at only 0.2 to 0.4 mm thick. It is composed of four layers, which from bottom to top are the basal cell layer (stratum basale), the spinous layer (stratum spinosum), the granular layer (stratum granulosum) and the cornified layer (stratum corneum) (see Figure 2). The epidermis has a regenerative capacity that is otherwise only found in the liver and intestines (Kerschner et al. 2009).
3.2 Skin regeneration

The basal cell layer represents the innermost layer directly outside the dermis, allowing it to be optimally supplied by nutrients from the blood. The basal cells continually undergo cell division or “germinate”, which is why this layer is also called the germinative layer. In addition to basal cells, this layer also includes melanocyte cells. They create the pigment melanin, which is released to the skin cells as needed. In the skin cells, the pigments are arranged to protect the cell nuclei (Jablonski 2004, Brenner/Berking 2010). Melanin thereby serves as the natural sun protectant of the skin (tanning) and protects the living cell layers from the energy-rich sunlight, which could otherwise lead to cell mutations (skin cancer).

![Figure 2: Structure, regeneration and developmental stages of the epidermis](image)

The newly formed cells in the basal cell layer are then pushed upwards by the most recently formed cells, towards the surface of the skin (Heymann 2003). While they "migrate" towards the skin's surface, they pass through various stages of development (see Figure 2). First, they create cellular appendages and cell contacts, which gives them a spinous appearance. This cell layer, immediately above the basal cell layer, is called the spinous layer for this reason. Superficial to this lies the cornified layer, in which the cells form small keratin-filled granular structures and small adipose bodies (lamellar bodies or Odland bodies). This begins the process known as cornification. Cornification involves the cells losing their nuclei as they become stiff and immobile, until they are finally completely filled with keratin at their final position in the cornified layer. The cells are now called cornified cells (keratinocytes) and are arranged in a strictly ordered geometric pattern that has a brick wall-like appearance. The fat from the adipose bodies is released to the intercellular spaces and binds the cells like the mortar between bricks in a wall. In the cornified layer, the cornified cells (keratinocytes) are pushed further towards the skin surface. In this process, the cell connections are continually...
weakened over a period of about four weeks, after which the cells are released from the skin (desquamation). Every day, between 0.5 and 1 g of dead keratinocytes are released. This means that healthy skin requires approximately four weeks to completely regenerate (Fartasch 2002).

In most cases, the cornified layer is made up of only 10-12 cell layers (although up to 86 layers have been documented; Ya-Xian et al. 1999) and ranges from 0.02 to 4 mm thick depending on the body region and mechanical demands (Kerscher et al. 2009, Heymann 2003). This means that the cornified layer is thinner than a hair in most body regions!

As the outermost cell layer, the cornified layer is directly exposed to damaging environmental influences and serves as a functional barrier. Full functionality of this layer is, therefore, extremely important for maintaining healthy skin.

3.3 The barrier function

The structure of the cornified layer was first described in the 80s with the brick-and-mortar model (Elias 1983). In this case, the cornified cells form the “bricks” and fatty substances (primarily ceramides) form the “mortar”. The fat-containing substances released from keratinocytes in the uppermost granular layer create a watertight seal at the intercellular spaces. These fats are important for the contiguity of the cells and the seal that is created (barrier function). Just as air bubbles can form in the joints of a wall when building a house (see Figure 3), the fatty substances can be unevenly distributed among the cornified cells. In order to protect the “house” from environmental influences and stresses, a wall is coated or covered with clinker. This additional protection is also present in the skin, in the form of natural water-lipid film (hydrolipid film). This film is composed of a water and a lipid phase. Both phases are bound by natural emulgators in an emulsion, which is easily spread over the skin surface and keeps it soft. The oils are created by sebaceous glands and skin cells; water is created in the sweat glands (perspiration) and released from the body by the skin cells (transepidermal water loss, TEWL) to the skin (Fartasch 2002, Schaefer/Redelmeier 1996, Rawlings/Harding 2004).

Figure 3: Brick wall as a model for the cornified layer
In addition to protecting the body from water loss, the cornified layer and the hydrophilic layer are also capable of protecting the body from many external physical influences. Blocking external substances is another extremely important protective function. This may represent “chemicals” of various types (such as various hairdressing chemicals), or also bacteria, fungi, viruses and other microorganisms and their metabolic products. The intact cornified layer hinders these substances from entering the living skin layers and also protects against a substantial portion of water loss from the body. Because of this, it is also known as the cornified layer barrier. Substances that are capable of crossing the cornified layer barrier represent a danger for the body.

3.3.1 Protection from Water and Dehydration

The specific structure of the cornified layer protects the deeper, living skin layers, creating a moist environment that is important for the maintenance of cell and tissue functionality. The oils in the intercellular spaces and the natural moisturizing factors (NMF) in the skin reduce water evaporation from the body’s surface. Oil repels water, preventing the water from the body from passing through the oil layer of the cornified layer and forcing it to pass through the cells. However, the natural moisturizing factors are located here. These represent water-binding and water-attracting (hydrophilic) molecules in the cornified cells that are even able to bind water from the air if humidity is greater than 50%. One of these substances is urea (Schürer/Kresken 2000).

In summary, this means that water is first chemically bound and then released through water insoluble (lipid) segments of the cornified layer, conserving it in the body. However, the body is not completely watertight! In addition to the water released from the sweat glands, approximately 300 ml of water are released daily through the skin barrier. This is the previously mentioned “transpidermal water loss (=TEWL). The TEWL is an indicator for the functionality of the skin barrier. Elevated TEWL shows that the skin barrier is damaged or completely destroyed and water is being released from the body in an uncontrolled fashion (Forslind et al. 1997).

This protective barrier that protects us from dehydration also works in the opposite direction. Rainwater or tap water also forms pearls on the skin surface and the body does not swell like a sponge after taking a bath. However, the palms of the hand and soles of the feet do swell up. This is because the body does not have hair here and thereby does not have sebaceous glands (a sebaceous gland is always connected to a hair). The oil from the sebaceous glands, which makes up 90% of the superficial skin oils, is not present here at all. Instead, oils are only released from the cornified cells. The cornified skin layer is somewhat thicker on the palms and soles due to mechanical influences (standing, walking, gripping, holding, etc.). These cornified cells, as is the case everywhere in the body, contain natural moisturizing factors that bind water strongly. This combination of little oil and high levels of water-binding substances causes the skin of the palms and soles to swell more than the rest of the body and in a way that is visible to the eye. This “raisin skin” is also known as “washerwoman’s hands” (Fritsch 1990).
3.3.2 PROTECTION FROM CHEMICAL AND MICROBIAL INFLUENCES

The hydrolipid film lies at the surface of the skin. The lipid layer protects against unhindered infiltration of water and water-based chemicals (such as acids, bases, cleaning solutions), while the water-based portions in the skin provide a barrier against fats and oils.

Due to the water content within the skin and overlying the skin, the skin has a specific pH value. The superficial hydrolipid film has a pH value of 5.5, which is slightly acidic (Parra/Paye 2003). Because of this, the hydrolipid film also serves as a layer of protection against acid (Schade/Marchionini 1928).

The acidic pH value leads to a unique bacterial flora on the surface of the skin (microflora) (Parra/Paye 2003). This helps the skin to protect itself against disease-causing bacteria, viruses and fungi, which can cause skin infections. These good, “symbiotic” bacteria are only comfortable at an acidic pH level. Increases in pH value kill these bacteria. This leaves “empty space” on the skin, which microbes that prefer higher pH values (>7) can use. Unfortunately, this mostly consists of disease-causing bacteria, viruses and fungi.

3.3.3 PROTECTION FROM MECHANICAL STRESSES

The skin reacts to repetitive mechanical stresses by increasing its thickness. This causes it to form “calluses" (in medical terminology: hyperkeratosis). Classically, calluses occur in the form of raised bumps on the palms and soles; however, they can occur on any part of the body.

In addition to the adaptability of the epidermis to mechanical influences, the deeper skin layers (dermis and subcutis) also serve protective functions. The dermis consists of highly-resistant collagen and elastic fibers and gives the skin strength against tension and tearing (Jung/Moll 2003). The subcutis protects the internal organs and serves as a shock absorber at the soles of the feet.

3.3.4 PROTECTION FROM UV RADIATION

The epidermis also serves as a barrier against high-energy sunlight. This is partly by way of skin tanning, as described above, and partly due to increased thickness caused by UV radiation. When the skin is exposed to the sun, more skin cells are formed and a so-called "solar keratosis" (acanthosis = thickening of the dermis) is formed. This provides additional protection, along with skin pigmentation, which can block radiation and protect living cells from skin cancer to a certain extent (Jung/Moll 2003). Solar keratosis is often seen in people who work mostly outdoors (such as roofers) or who visit sun tanning salons frequently. These people have skin with a thick and leathery appearance. Skin peeling, seen frequently after summer vacation, does not just occur after sunburn. It is a natural process that occurs when additional skin layers that were built up due to sun exposure are exfoliated.
4 Occupational skin diseases

Up to 90% of occupational skin diseases are forms of dermatitis. Dermatitis is caused by inflammation of the epidermis and the outermost dermis and is not of infectious origin. Dermatitis can present with redness, papules, blisters, weeping or scaly skin, or increased skin wrinkling. Acute dermatitis is primarily characterized by weeping changes, while chronic dermatitis shows dry scale formation.

Dermatitis is most commonly found on the hands and forearms in the hairdressing industry, as these parts of the body are most frequently subjected to damaging influences. However, the face can also be affected by airborne contact dermatitis (such as in case of an allergy against para-phenylenediamine, PPD).

The term “dermatitis” does not describe the cause and clinical course of a skin disease, but is used as a general term for many times of skin diseases. There are many different causes of dermatitis. They can be generally divided into those with “internal” causes and those with “external” causes. The various types of dermatitis can be categorized by causes as follows:

- **Dermatitis / internal cause** = endogenic such as atopic dermatitis
- **Dermatitis / external cause** = exogenic = contact dermatitis

![Diagram of dermatitis types](image)

**Figure 4: Causes of dermatitis**

Exogenic dermatitis can be occupational. Endogenic dermatitis may be aggravated by activities that damage the skin.

Occupational skin diseases are explained in more detail below.

4.1 Acute-toxic contact dermatitis

This type of dermatitis is caused by short-term exposure to highly irritating substances, such as concentrated hydrogen peroxide. It is typically caused by accidental skin exposure.
Immediately after contact, the skin reacts with acute inflammation, the extent of which is dependent on the sensitivity of the skin and the concentration and exposure time of the substance in question. Typical features of this include highly limited areas of skin changes to the area of exposure and quick recovery after removal of the irritating substance (Elsner 2008). Acute-toxic contact dermatitis is generally easy to diagnose by the treating physician, as the affected patients can generally name the irritating substance. Substances that can irritate the skin must be marked with a pictogram.

4.2 Cumulative-subtoxic contact dermatitis

Cumulative-subtoxic contact dermatitis is the most common occupational type of dermatitis. This represents the chronic form of contact dermatitis and is the result of cumulative skin irritation with a skin irritant (Frosch/John 2006, Skudlik/Schwanitz 2003). Skin irritants, aside from water, must be marked with the following pictograms:

4.2.1 Etiology

Cumulative-subtoxic dermatitis develops in three phases due to the long-term effects of one or more irritants. Due to chronic skin irritation, various repair mechanisms of the epidermis and dermis are overwhelmed. In the first phase, the hydrolipid film (acid protection layer) is removed (such as with too frequent handwashing), which causes the cornified layer to be exposed. The skin stretches and feels “dull”. Regeneration of the natural acid protection layer takes approx. 1.5 to 3 hours.
If the skin is repeatedly irritation the damage accumulates and, in the second phase, the natural fats of the cornified layer are removed from the deeper cell layers. The cornified layer can then be infiltrated by various substances used for work. In the third phase, external irritating substances (Table 2) cause an inflammatory reaction of the skin.

4.2.2 Types of presentation

The skin changes that occur have a wide variety of presentations. Depending on the concentration and duration of contact of the skin irritants (Table 2), they often are limited to low-grade redness and scaling with small tears of the skin. They usually have unclear borders. It is typical to begin in the web spaces between the fingers, as the skin here is particularly sensitive. Moisture and other substances can also collect between the fingers and underneath hand jewelry (finger rings, bracelets, watches).

4.2.3 Consequences

Even early signs of cumulative-subtoxic dermatitis should be taken seriously! In early stages, it can often be treated easily and is healed by limiting skin irritants and performing persistent skin care (skin lotion) in combination with adequate skin protection (skin protection lotion and gloves). However, if no changes are made, cumulative-subtoxic dermatitis can take on a chronic course and become difficult to treat, last for extended periods or have massive recurrences with only minimal skin exposure.

With cumulative-subtoxic dermatitis, the damaged cornified layer barrier is subjected to risk of infection or sensitization (development of an allergy) to occupational and/or non-occupational substances. With the latter, cumulative-subtoxic dermatitis can develop into allergic contact dermatitis (see next chapter). Cumulative-subtoxic dermatitis must be fastidiously allowed to heal. Recurrences often occur due to repeat exposure of the skin prior to full recovery of the epidermis, as the skin may appear externally intact.

4.3 Allergic contact dermatitis

In many cases, the skin reacts to external substances that are normally well tolerated with dermatitis. This reaction is known as an allergy because the body and immune system react in a hypersensitive way. The purpose of the immune system is to clear away foreign substances that have entered the body. In the case of allergies, these immune mechanisms overshoot their target. Almost all substances, including occupational substances or hair and skin cosmetic products can cause an allergic reaction. Allergies should not be confused with acute-toxic skin irritation. Every person’s skin will react sooner or later to concentrated acids (such as hydrogen peroxide) with skin inflammation or irritation.
The actual purpose of the immune system is to protect the body. With allergies, the immune system fights fiercely against harmless substances, so-called “allergens”, without a clear reason as to why. The accompanying and subsequent reactions such as inflammation and tissue damage including skin dermatitis are types of hypersensitivity reactions.

4.3.1 ETIOLOGY

For an allergic reaction to occur, there must first be sensitization to a specific substance, the allergen. With allergic contact dermatitis, two phases of development are described. In the first phase (sensitization phase), the body is introduced to the allergen. Contact allergens represent haptenes (semi-allergens), which are too small to have an immunogenic effect. They can only processed by the immune cells in the dermis or mucous membranes (Langerhans cells) after being bound to carrier proteins. After a Langerhans cell presents the immune system with the allergen that has entered the body (antigen presentation), the immune system creates matching defensive cells based on the lock-and-key principle. This sensitization phase is not noticeable and is not predictable. It requires at least 5-7 days, but may also last for years (Jung/Moll 2003). After the sensitization phase, the immune system is protected against the allergen until the end of life.

The second phase is known as the reactive phase. The immune system is now sensitized to a certain substance (allergen = antigen). In case of repeated contact with the allergen, it is recognized as an antigen and an inflammatory reaction (defense reaction) is induced (Jung/Moll 2003).

Practically any substance, even if tolerated well for years, can suddenly cause an allergy.

Whether or not and when a person develops an allergy cannot be predicted and depends on several factors, such as the duration and intensity of contact, the sensitization potential of the allergen, genetic disposition and skin condition. (Jung/Moll 2003). It is clear, however, that cumulative-subtoxic dermatitis often precedes allergic contact dermatitis. Damage to the cornified layer barrier makes it easier for allergens to invade into the skin.

4.3.2 TYPES OF PRESENTATION

Presentation of these diseases is similar to cumulative-subtoxic contact dermatitis. To determine the cause and extent of disease, dermatologists can perform allergy testing (prick tests).

Allergic contact dermatitis represents a so-called “delayed type” allergic reaction. Signs of inflammation are first visible after approx. 24 hours from contact. Skin reactions that first occur after 48, 72 or 96 hours following allergen contact can also be observed. This is a reason why the irritating substance is often difficult to pinpoint. The affected persons often cannot remember what substances were in contact with their skin 1-3 days ago. Another
reason is that the number of substances that can cause allergies is now so high that the physician and patient will need detective-like skills to track down the allergen.

4.3.3 Consequences

Once acquired, contact sensitization against occupational substances cannot be cured and often forces affected patients to give up their occupation. It remains for the rest of the patient’s life. Hyposensitization cannot be performed for type 4 sensitization. The only way to keep the skin healthy is to consistently avoid an allergen by changing products or using appropriate protective gloves.

5 Activity-related risk factors and hazardous substances in the hairdressing industry

5.1 Irritants and allergens

Hairdressers have skin contact with a wide range of irritating or allergenic substances in the course of their occupation. Table 2 provides an overview. This lists activity-specific potential allergens and irritants.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Products</th>
<th>Special contact substances</th>
<th>Irrita-</th>
<th>Sensitiza-</th>
<th>Protect. measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hairwashing, hair care, hair styling</td>
<td>Shampoo, cream rinse, conditioner, hair spray, hair gel, hair wax</td>
<td>Tensides (such as cocamidopropylbetaine), preservatives (such as methylidibromoglutaronitrile MDBGH, methylchloroisothiazolone MCI / methylisothiazolone MI, perfumes (such as cinnamaldehyde, Eugenol, HMPCC) water phenols selenium disulfide formaldehyde(^1) Paraben Dichloromethane (in hair lacquer)</td>
<td>+</td>
<td>+</td>
<td>extended single use gloves</td>
</tr>
</tbody>
</table>

| Coloring agents | Oxidation colors | e.g para-phenylenediamine (PPD), | +       | +          | Single use gloves |

\(^1\) since 2004, officially considered carcinogenic by the International Agency for Research on Cancer (IARC) of the World Health Organization (WHO) (Bruneteau et al. 2004).

\(^2\) Bruneteau et al. 2004
### SafeHair 2.0

<table>
<thead>
<tr>
<th>Group</th>
<th>Agents</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixing agents</td>
<td>Wassermstoffperoxid</td>
<td>+ (+)</td>
</tr>
<tr>
<td>Fixing agents</td>
<td>Wasserstoffperoxid</td>
<td>+ (+)</td>
</tr>
<tr>
<td>Oxygen agents, bleaches</td>
<td>Hydrogen peroxide, hydrochinone, p-dihydroxybenzol</td>
<td>+ (+)</td>
</tr>
<tr>
<td>Blending agents</td>
<td>Ammonium persulfate</td>
<td>+ (+)</td>
</tr>
<tr>
<td>Perms</td>
<td>E.g. ammonium thioglycolate, glycerol monothioglycolate (GMTG)³, cysteaminehydrochloride</td>
<td>+ (+)</td>
</tr>
<tr>
<td>Hair straightening</td>
<td>Formaldehyde² and/or methylene glycol (= reversible product of formaldehyde in water)</td>
<td>+ (+)</td>
</tr>
<tr>
<td>Hair straightening</td>
<td>Sodium hydroxide</td>
<td>irritant²</td>
</tr>
<tr>
<td>Hair straightening</td>
<td>Potassium hydroxide</td>
<td>irritant²</td>
</tr>
<tr>
<td>Hair straightening</td>
<td>Lithium hydroxide</td>
<td>irritant²</td>
</tr>
<tr>
<td>Cleaning</td>
<td>E.g. formaldehyde¹, glutaraldehyde, perfumes, tensides, preservatives</td>
<td>+ (+)</td>
</tr>
<tr>
<td>Contact with occupational tools</td>
<td>Nickel</td>
<td>+</td>
</tr>
<tr>
<td>Skin protection</td>
<td>Latex, mercaptobenzothiazoles, thiuram, carbamates, phthalates</td>
<td>Latex, phthalates and accelerator free gloves</td>
</tr>
<tr>
<td>Skin protection</td>
<td>Preservatives, lotion bases, perfumes</td>
<td>+ (+)</td>
</tr>
<tr>
<td>Hair cutting (Füeßl 2011)</td>
<td>Hair</td>
<td>+⁴</td>
</tr>
</tbody>
</table>

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³ "1995 beschlossen die Hersteller von Haarkosmetika und die (deutschen) Friseurinnungen, GMT nicht mehr bei der sauren Dauerwelle einzusetzen." (Berger et al. 2005: 13)

⁴ Danger of pilonidal sinus (Füeßl 2011)
According to Brans/Merk (2009), hairdressers should undergo not just DKG epicutaneous testing for hairdresser-typical tests, but also the “standard”, “Externa contents” and “Preservatives and disinfectants” tests.

5.2 Primary risk factor: water-related activity

Table 2 lists water as an irritant, cumulative subtoxic substance. The extent of occupational skin diseases in the hairdresser industry caused by frequent contact with water is often underestimated.

In Germany, “water-related activity” is a clearly defined topic. According to TRGS 401, this includes activities with the following characteristics:

- more than two hours of work daily in a moist environment or
- more than two hours of work for which watertight gloves must be worn or
- activities that require frequent and/or intense handwashing.

Long contact to water or moisture leads to swelling of the keratinocytes. Keratinocytes can bind a great deal of water with natural moisture retaining factors. After the contact with moisture is complete, the swelling leads to dehydration of the skin. The water that has been taken up evaporates and the cells shrink. With this, the intercellular spaces (see Figure 5) enlarge and allow more water to escape. In addition, potential irritants and allergens (see Table 2) can now more easily pass through the cornified layer into deeper layers and cause inflammation or sensitization.

Water can pass through the skin particularly well after watertight protective gloves are removed (if sweating occurs in the gloves) or after handwashing (such as after washing hair without protection and/or performing cleaning or disinfection).

![Figure 1: Influence of water-related work or extended glove wear (sweating in watertight gloves; source: Bundesverband Hautschutz e.V. 2007, modified)](image-url)

Left: Healthy group of cells. Right: Loosened group of cells with enlarged intercellular spaces after extended contact with moisture or glove wear.
Constant contact with water is one of the most important risk factors with regard to formation of hand dermatitis. It has been proven that workers in “water-related occupations” (above all hairdressers) suffer much more frequently from contact dermatitis than persons with occupations that do not involve water contact.

5.3 Risk factor “washing-active substances”

Washing-active substances such as soaps and shampoos cause natural oils to be washed away and cause damage to cell membranes (Effendy/Maibach 1995, Tupker 1996). Due to these influences, the barrier function is damaged, which often represents the beginning of a severe skin disease. The affected persons may not even notice the disease or may not take it seriously. Dry, raw skin is often an early sign of reduced functionality of the skin’s intrinsic defense mechanisms.

6 Skin protection in the hairdressing industry

6.1 Work organization

The time spent with moisture-related activities should be reduced if possible or spread among multiple employees to reduce individual exposure. Workflows should allow for switching between moist and dry activities (TRGS 401, Declaration from Dresden).

6.2 Three column model

Skin protection has a three column model, consisting of the following:

1. Skin protection during work
2. Skin cleaning and
3. Skin care after work

These methods have been shown to be particularly effective (Winkler et al. 2009, Kütting et al. 2009).

The following paragraphs explore the three columns in more detail.

6.2.1 Skin protection

Methods for skin protection include both protective gloves and skin protection lotions.

Skin protection lotions should be tailored to the activities performed by the hairdresser. They may protect primarily against moisture and water or can reduce the tendency to sweat under watertight gloves. The protective effect is discussed in the literature with controversy.
Bock et al. (2001) were able to show an antitransparent effect of aluminum chlorohydrate skin protection lotion, which was worn under impermeable protective gloves. Fartasch et al. 2010 showed no such effect in a short-term study.

However, it should be remarked again that frequent use of skin protection creams in the context of the three column model can work preventively against the development of occupational skin diseases (as previously explained). However, when using skin protection agents, they must be applied at least 20 minutes prior to glove wear or exposure to occupational substances to avoid potential negative interactions between the glove material or occupational materials and the contents of the product.

Protective gloves in the hairdressing agency must fulfill the European Norm 374 (EN), “Protective gloves for chemicals and microorganisms”. For all typical hairdresser activities (coloring hair, etc.), single use gloves made from nitrile rubber or vinyl are appropriate with adequate normation. They are to be disposed after single use. In general, nitrile rubber has a higher level of protection compared to polyvinyl chloride, so that single use gloves made from this material are preferable (Bundesverband Hautschutz e.V. 2009). If used repeatedly, the gloves may no longer be able to carry out their protective function due to the thinness of the material. For cleaning and disinfection work, reusal chemical gloves with high thickness (0.4 mm) are to be used. For known sensitizations to vulcanization accelerators (such as mercaptobenzothiazole, dithiocarbamate, thiurame), which may be contained in protective gloves made from natural or synthetic rubber, special accelerator-free protective gloves are available (Diepgen et al. 2009, Zuther et al. 2007). The same is true for the softeners contained in vinyl single use gloves (phthalates).

Wearing protective watertight gloves often leads to a blockade of moisture and heat. To reduce this, gloves can be changed frequently, cotton undergloves can be worn that are changed after becoming moist (Ramsing/Agner 1996) or a sweat-reducing skin protection cream can be applied (Bock et al. 2001). In the hairdressing industry, wearing gloves when cutting hair is not well accepted, as this can often reduce fine motor skills. Single use gloves in combination with cotton undergloves to prevent occlusion effects are even less accepted and less widely used. Fingerless cotton undergloves represent an alternative.

As previously mentioned in Chapter 5.2, occlusion of moisture with watertight protective gloves causes the cornified layer barrier to become more easily permeable. This increases the irritability of the skin. Exposure to occupational substances or other skin hazards after wearing gloves should be avoided (Wulfhorst et al. 2011, Fartasch et al 2011).
6.2.2 SKIN CLEANING

When cleaning the skin, the following rule should be followed: “As little as possible, as often as needed”.

When using skin cleansers, the following points should be observed:

- the pH value should be skin pH-neutral (approx. 5.5; important for maintaining the acid protection layer) (Schmid/ Korting 1995)
- the product is free of dyes, perfumes and preservatives (potential allergens)
- the product contains mild tensides
- the product is free of solvents (Klotz et al. 2002, Stolz 2005)
- the product is free of abrasives (Löffler et al. 2000)
- products containing reducing agents are only used when needed (such as with severe skin coloration).

For cleaning the skin, lukewarm water should be used. After washing, the hands should be carefully patted dry with single use paper towels. Forceful rubbing can cause abrasion of the superficial skin layers and can damage or destroy the skin barrier even more.

6.2.3 SKIN CARE

After work, appropriate skin lotions should be used for regeneration of the skin. When needed, lotion can be generously applied to the hands and covered in cotton gloves overnight to promote healing.

6.3 Recommended actions

All recommended courses of action for skin protection in the hairdressing industry described here are found in the “European Framework Agreement for Prevention of Health Risks in the Hairdressing Industry” (2010) and the “Declaration of Dresden” (2010).
**Literature**


45. Technische Regeln für Gefahrstoffe (TRGS) 401: Gefährdung durch Hautkontakt Ermittlung – Beurteilung – Maßnahmen (2008), unter: http://www.gaa baden-wuerttemberg.de/servlet/is/16495/5_401.pdf [Stand Oktober 2011]


