

Dermatoses in Competitive Athletes

Auftreten von Dermatosen bei (Hochleistungs-)Sportlern

Summary

- › **Problem:** The skin is exposed to numerous stresses during sport. In addition to infection-related or allergic triggers, the development of sport-associated skin diseases depends on the discipline practiced and can be caused by mechanical stressors, thermal damage, and UV radiation. Methods: This review intends to give an overview of study results on the incidence and prevalence of skin diseases in competitive athletes. Publications describing case reports of the outbreak of a specific skin disease within a small cohort of athletes of a defined discipline were included as well as publications comparing the incidence of dermatoses between different disciplines based on large study cohorts.
- › **Results:** Most studies focus on the analysis of the occurrence of certain skin diseases in athletes of only one defined discipline, in most cases athletes performing sports with close body contact. Hardly any studies deal with dermatoses in competitive athletes among multiple disciplines. This review displays the occurrence of infectious, allergic, traumatic, UV-induced, and sebaceous dermatoses in competitive athletes by taking different disciplines into account.
- › **Discussion:** Depending on the training environment, flow of movement, climatic influences and other factors, certain skin diseases occur frequently in athletes of specific disciplines.

Zusammenfassung

- › **Problem:** Die Haut ist beim Sport zahlreichen Belastungen ausgesetzt. Neben infektionsbedingten oder allergischen Auslösern werden sportbedingte Dermatosen je nach Sportart durch die Beanspruchung der Haut im Zuge von mechanischer Belastung, thermischer Schädigung und UV-Strahlung ausgelöst.
- › **Methoden:** Dieser Überblick soll Studienergebnisse zum Auftreten von Hauterkrankungen bei Leistungssportlern aufzeigen. Fallberichte zum Ausbruch spezifischer Krankheiten innerhalb einer kleinen Kohorte an Sportlern einer Disziplin wurden dabei ebenso berücksichtigt wie disziplinenübergreifende Vergleichsstudien.
- › **Ergebnisse:** Viele Studien fokussieren sich auf die Analyse und Beschreibung des Vorkommens von Dermatosen oder gar einer einzigen, spezifischen Hauterkrankung bei Sportlern einer bestimmten Sportart. Es gibt nur wenige Studien, die sich disziplinenübergreifend mit der Verbreitung von Dermatosen unter Leistungssportlern beschäftigen und vergleichend ein repräsentatives Bild von Anfälligkeit, bestehenden Prädispositionsfaktoren und der tatsächlicher Erkrankungshäufigkeit zwischen Athleten verschiedener Disziplinen aufzeichnen. In diesem Review wird das Vorkommen infektiöser, allergischer, traumatischer, UV-induzierter und Talgdrüsenassoziierter Dermatosen bei Leistungssportlern dargestellt. Dabei soll das Erkrankungsgeschehen unter Einbezug unterschiedlichster Sportarten präsentiert werden.
- › **Diskussion:** In Abhängigkeit von Trainingsumfeld, Bewegungsablauf, Witterungseinflüssen und anderen Faktoren treten bestimmte Hauterkrankungen gehäuft in einzelnen Sportdisziplinen auf.

KEY WORDS:

High-Performance Athlete, Skin Disease, Training, Specific Disciplines

SCHLÜSSELWÖRTER:

Leistungssportler, Hauterkrankungen, Training, Sportdisziplin

Introduction

Practicing sport has many benefits on our general wellbeing, including physical and psychological aspects. People who practice sports regularly are at lower risk for the development of conditions such as obesity or type 2 diabetes. Although the benefits are plentiful, participation in athletic activity, especially in high-performance sports, can also have negative effects on the body. Hereafter, the impact of sport on skin health is explained and

an overview of various sport-related skin diseases in competitive athletes of different disciplines is provided.

A top athlete's skin is exposed to a wide range of environmental, physical, and infectious agents threatening the integrity of the skin barrier (Figure 1). Furthermore, increased sweating, increased heat, friction caused by sports clothing, and close body contact support the onset and wide

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Table 1

Bacterial infections.

PATHOGEN SPECIES	DISEASE	MAJOR FINDINGS AS CITED IN THE MANUSCRIPT	COHORT AND TYPE OF SPORTS	PUBLICATION CITED
Staphylo coccus spp. (MRSA)	(non-) purulent infections	35% of all athletes were positive for MRSA with significant correlation in wrestlers (76% positive) and baseball (44% positive).	223 university student athletes in nine different sports (e.g. wrestling, baseball, basketball, tennis)	Champion et al. Ann Clin Microbiol Antimicrob. 2014
		The most common pathogens responsible for the outbreaks were MRSA (33%) and tinea (29%). Most outbreaks occurred in non-weapon-based combat sports (wrestling or judo: 33%) or American football (24%).	high school or collegiate competitors in a variety of sports	Collins CJ, O'Connell B. J Athl Train. 2012
Strepto coccus spp.	e.g. Furunculosis Impetigo Folliculitis Abscess"	Seven of 32 team members were MRSA positive (6 infected, 1 colonized).	32 high school wrestlers and their surrounding community	Lindemayer JM et al. Arch Intern Med. 1998
		S. aureus was carried by 42% of enrolled athletes (23.8% for the judo players to 54.8% for the wushu/kung fu). Of all athletes, 1.3% carried MRSA.	238 athletes from gyms in 9 different contact sports (e.g. taekwondo, judo, karate)	Mascaro V et al. Infect Drug Resist. 2019
		The overall attack rate was 25%. The attack rates for varsity football (36%) and varsity basketball (33%) were four times higher than for nonvarsity teams.	Male athletes of a high school in a variety of sports	Sosin DM et al. Am J Sports Med. 1989

Table 2

Mycotic infections.

PATHOGEN SPECIES	DISEASE	MAJOR FINDINGS AS CITED IN THE MANUSCRIPT	COHORT AND TYPE OF SPORTS	PUBLICATION CITED
Trichophyton spp. (T. tonsurans T. rubrum)	Tinea pedis T. capitis T. corporis	The prevalence of Tinea corporis caused by T. tonsurans ranged from 4-77%.	variety of sports	Adams BB. Sports Dermatology. 2006
		8.2% of the wrestlers had fungal skin infections. Malassezia furfur (50%) and trichophyton tonsurans (30%) were most common.	454 wrestlers from wrestling clubs	Ahmadinejad Z et al. Asian J Sports Med. 2013
		15% of swimmers had positive cultures. They had infections with Trichophyton mentagrophytes (87.5%) and T. rubrum (12.5%). One case with a dual infection was observed.	150 regular swimmers	Attye A, Joly J. Eur J Epidemiol. 1990
Malassezia spp. (M. furfur)	Pityriasis versicoloris	The most common pathogens responsible for infectious disease outbreaks were MRSA (33%) and tinea (trichophytosis; 29%). Most outbreaks occurred in non-weapon-based combat sports (wrestling or judo: 33%) or American football (24%).	high school or collegiate competitors from a variety of sports	Collins CJ, O'Connell B. J Athl Train. 2012
		Athletes were 2.5 times more likely to develop onychomycosis with infections of the toenails being seven times more prevalent than those of the fingernails.	variety of sports	Daggett C et al. Am J Clin Derma. 2019
		20.1% of wrestlers had tinea gladiatorum. T. tonsurans was grown from all the scrapings of tinea gladiatorum samples as the only dermatophyte species. T. tonsurans was the only dermatophyte species grown from wrestling mat samples and 55.5% of samples were positive for the growth.	324 wrestlers from seven active clubs	Hedayati MT et al. Br J Sports Med. 2007
		23.4% of non-athletes and 43.3% of athletes were positive for dermatophytes. In a cohort of a non-athletic swimming class 72.1% were positive for dermatophytes whereas only 23.4% of non-swimming class participants were positive.	559 high school students of various sports and athletic teams (e.g. swimming, water polo, soccer)	Kamihama T et al. Public Health. 1997

distribution of dermatoses in top athletes (20). Traumatic injuries, like blisters or grazes, are commonly found and surely the most obvious dermatological abnormalities. Infectious lesions caused by bacterial, viral, or mycotic agents, are often diagnosed in athletes, too (2, 21, 57). Other potentially harmful factors that can cause aberrations of the physiological appearance of the skin are allergies and increased exposure to UV radiation. Intense sun exposure must not be underestimated as it remains one of the major risk factors for the development of skin cancer (1, 2, 15). Allergic reactions can be triggered by multiple allergens found in the air, in water, or sportswear, depending on the environment associated with the sports discipline. Considering the huge variety of stressors as well as the multitude of disciplines, it is not surprising that some lesions are more prevalent in athletes of specific disciplines compared to others.

Material and Methods

Using the PubMed database, a literature search was conducted to identify clinical studies, articles from medical specialist books, and review articles that assessed the prevalence of various sport-related skin diseases in competitive athletes of different disciplines. The research was limited to English or German language articles published between 1971 and 2019. The following keywords were used to perform the literature search: [athletes OR competitive athletes OR top athletes] AND [Skin disease (names of the various skin diseases, e.g. furunculosis OR impetigo OR folliculitis)] AND [sports discipline (names of the various sports, e.g. American football OR rugby OR judo, wrestling OR basketball)]. Search terms were entered in several combinations. Articles were selected when they covered at least one of the topics of interest in the above mentioned diseases.

Infectious Dermatoses

Infectious diseases in athletes are, in contrast to non-infectious diseases, comparatively well described (Table 1-3). It should be emphasized, however, that the majority of studies addressing this topic include athletes practicing sports with close physical contact. Sosin et al. report, that the incidence of boils found in American football and basketball players was four times higher than in athletes who did not participate in team sports (55). Turbeville et al. conducted a literature search related to infectious diseases in athletes including publications from 1966 to 2005. They report that more than half of all infectious diseases in athletes (56%) were of cutaneous origin (57). A more recent literature review by Collins et al. from 2005-2010 revealed, that the percentage of skin as well as soft tissue infectious diseases in athletes was 71% (12). Direct skin to skin contact, which is inevitable in some sports (e.g., American football, rugby, judo, or wrestling), contributes to the spread of infectious diseases.

Bacteria Induced Dermatoses

Among the most frequently diagnosed infectious diseases of bacterial origin in athletes are furunculosis, impetigo and folliculitis (Figure 2), or abscesses (29, 36, 55). Staphylococcus and streptococcus species are widespread and often the causative agent for non-purulent or purulent skin infections (Table 1). While many infections are easily treated with antibiotics, infections with methicillin-resistant Staphylococcus aureus (MRSA) pose a growing problem for modern medicine. In a literature research from 2005 to 2010, Collins et al. report that, out of all infectious diseases diagnosed in athletes, 33% were caused by MRSA (12). A more recent study of Champion et al. concluded that 76% of college wrestlers are carriers of CA-MRSA (11). While these athletes are prone to develop infections themselves, they also put competitors at risk of infection. Mascaro et al. investigated the prevalence of S. aureus infections among contact sport athletes in Italy and confirmed S. aureus in 42% of 238 enrolled athletes. Of all athletes, 1.3% carried MRSA (39).

Mycotic Infectious Diseases

Mycotic infections on finger-/ toenails are a common disorder that is difficult to cure. The likelihood of developing onychomycosis is 2.5 times higher in athletes (Figure 2). A common location are the toenails which are affected seven times more often than the fingernails (14). Mycotic skin infections are caused by dermatophytes, yeasts, or molds (Table 2). The most common dermatophytosis in athletes is Tinea. Tinea is mostly caused by Trichophyton spp., primarily by T. tonsurans and T. rubrum. Another frequently diagnosed mycosis is Pityriasis versicolor. It is evoked by different species of Malassezia, especially Malassezia furfur (Table 2) (4, 16). Athletes who engage in close physical contact are at particular risk of infections with dermatophytes (2). In a literature analysis of the outbreak of infectious diseases in competitive sports between 2005 and 2010, Collins et al. summarize that 29% of relevant articles report an outbreak of Tinea – all of them

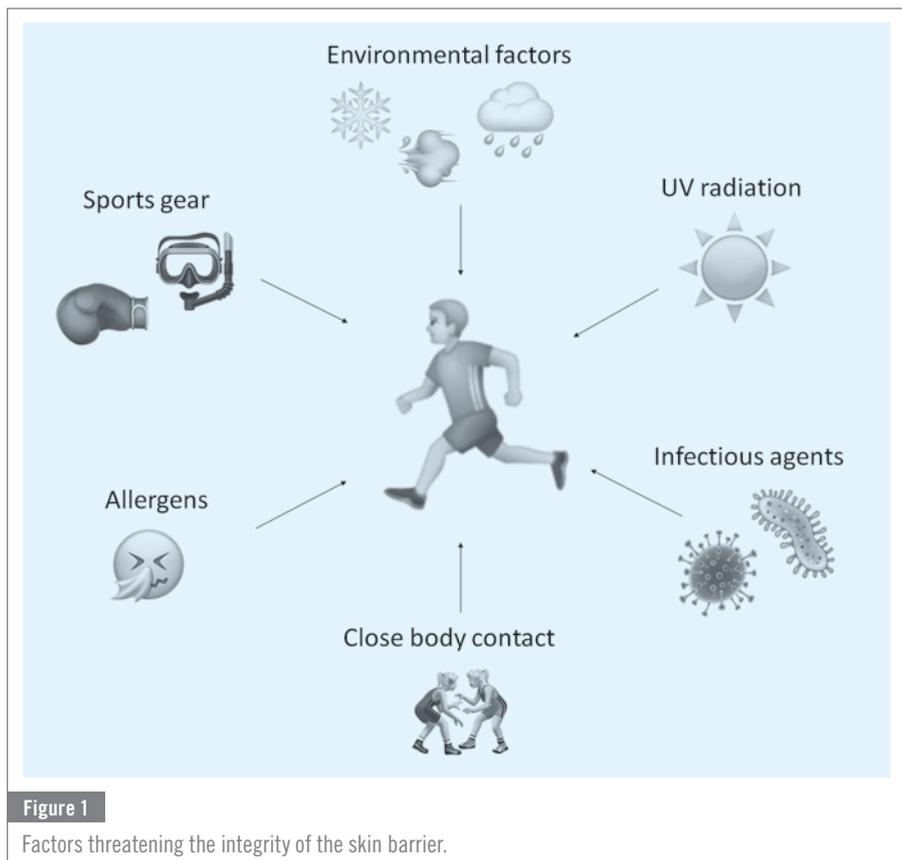


Figure 1

Factors threatening the integrity of the skin barrier.

among wrestlers and judo fighters (12). In a survey including 454 wrestlers Ahmadinejad et al. detected mycotic agents in 8.2% of these athletes. Malassezia furfur (50%) and Trichophyton tonsurans (30%) were the most prevalent germs (3). Hedayati et al. diagnosed a clinically manifest Tinea corporis gladiatorum in 62 out of 324 wrestlers (20.1%) (26).

One of the reasons for Tinea pedis and unguium being widespread among athletes may be the shared use of showers and changing rooms (2). Swimmers in particular seem to be exposed to fungal spores and mycotic infections. Several studies investigated the incidence of mycotic spores in swimmers. Attye et al. found that 15% of swimmers tested positive for mycotic spores (7). Kamihama et al. showed, that 63.6% of athletes included in their study tested positive for dermatophytes – almost four times as many as in the reference group (28).

Viral Infections

Viral infections are not uncommon among athletes, whereby the most frequently encountered viral infections are Herpes simplex, Verrucae, or Mollusca contagiosa (Table 3) (2). In the case of herpes, the majority of affected patients develop lesions in the orofacial area (Figure 2). The virus survives in the ganglia and establishes a latent residency. Therefore, the chance of recurrent infections after reactivation of the dormant virus is high. Winter sports athletes, especially high-altitude skiers, tend to suffer from recurring outbreaks of Herpes simplex labialis. Mills et al. reported, that 6 out of 51 (12%) skiers with a history of skiing-triggered recurring Herpes labialis developed a manifest infection within one week (41). Presumably, the reason is exposure to intense UV-radiation.

Since herpes simplex infections are very common among wrestlers and rugby players, the disease received its own name for these sports: herpes gladiatorum or herpes rugbeiorum (Table 3). 94-97% of infections are caused by the Herpes simplex virus type 1 (HSV-1) (6, 10, 23). Clearly, direct skin



Figure 2

Sample images for infectious dermatoses. Left=Folliculitis (bacterial); middle=Onychomycosis (mycotic); right=Herpes simplex (viral).

to skin contact is responsible for the transmission (9). Anderson examined participants of a high school wrestling camp for herpes gladiatorum and found that 96% of manifest infections occurred on the front of the body. Of these, 71.9% were located on the head, face (especially periorbital), and neck (6). In contrast, non-wrestlers rather showed manifest herpes simplex infections in the orofacial area.

Traumatic Skin Defects

Almost every type of physical activity is connected to traumatic skin lesions. Above all, traumatic skin defects can be found on the feet in form of bullae, callosities, corns, and onychodystrophies. Mailler and Adams reviewed studies investigating skin defects in marathon runners. On the day of the race, bullae were detected in 0.2-39% of runners. 2-16.3% of all participants suffered from jogger’s nipple – skin lesions of the mamillae caused by increased friction with sportswear (38).

Another widespread traumatic skin defect found in athletes of diverse disciplines are subungual hematoma on the toes (so-called jogger’s toe, tennis toe, skier’s toe) caused by repetitive collision of the toenail with the shoe tip. Furthermore, intracorneal hemorrhage may occur in the heel area (talon noir or black heel) or the palms (tache noir, black palm) (18, 22, 27, 60). Talon noir is associated with quick starts and abrupt stops as performed in tennis, squash, basketball etc. Black palm or tache noir describe similar hemorrhages on the palms occurring in sports exerting a lot of pressure on the hands such as weight lifting or gymnastics. Both conditions are harmless and resolve spontaneously (21).

Striae cutis distensae are streaky atrophies of the skin, running in parallel, due to stretch-related (tears) changes in the

connective tissue. Such changes are observed not only during pregnancy (stretch marks), in obesity, or in rapid growth in adolescence. The same applies to those who build muscles very quickly in weight training / bodybuilding (34, 35, 52). Especially the prolonged use of systemic or local glucocorticoids (steroid striae) leads to the formation of stretch marks (27, 30, 59).

Allergic Diseases

The sources of irritative contact eczema as well as contact allergies are manifold in athletes of different sport disciplines. In the case of water sports (e.g., swimming, scuba diving, surfing, sailing), allergic contact eczema caused by ingredients of sports wear, especially rubber, neoprene suits, fins, goggles, and snorkels, are frequent (Figure 3).

Substances like benzoylperoxid, various thiourea, and many others, can act as contact allergens (37, 48, 56). Furthermore, chemicals like chlorine or bromide, which are used as disinfectants in pool water, can lead to irritative contact eczema (49, 56). In the case of athletes who exercise outdoors (e.g. marathon runners or sailors), type IV allergies to sunscreen components, especially different UVA and/or UVB filters, need to be considered. In general, contact and photocontact sensitivity to sunscreen was reported and reviewed previously, independent of sporting activity (47, 50). The frequent use of sunscreen in outdoor athletes increases the risk of developing an allergic reaction to these chemical components.

In runners and in athletes of other disciplines not related to water, delayed allergic reactions can often be found on the feet. Causative agents are components of shoes, such as rubber, leather, glue, or dyes (33). Sportswear and diverse externa (e.g., anti-inflammatory or anesthetic cremes, gels, or sprays) can cause allergic reactions, too.

Table 3

Viral infections.

PATHOGEN SPECIES	DISEASE	MAJOR FINDINGS AS CITED IN THE MANUSCRIPT	COHORT AND TYPE OF SPORTS	PUBLICATION CITED
Herpes spp. (HSV-1)	H. labialis H. gladiatorum	Over a 42d period, 61 wrestlers and three coaches, who participated in a wrestling tournament, contracted Herpes gladiatorum via direct contact with infected individuals. For 13 individuals, cultures were obtained, which were positive for HSV-1 in all cases.	high-school wrestlers	Anderson BJ. Med Sci Sports Exerc. 2003
		35% of participants of a wrestling training camp developed an illness; HSV-1 was cultured from 78% of wrestlers who had cultures of suspicious skin lesions. 39 wrestlers were identified by clinical symptoms without verification using culture.	high-school wrestlers	Belongia EA et al. NEngl J Med. 1991
		12% developed reactivations of orofacial herpes.	51 leisure time skiers	Mills J et al. Am J Sports Med. 1987

Sun-Related Skin Diseases

UV induced skin cancer may indirectly be caused by physical activity dependent on the time spent outdoors. Intense and prolonged sun exposure is one of the most important factors leading to the development of melanomas and other types of skin cancer (Figure 4). A series of dosimetric studies revealed that triathletes, cyclists, mountain climbers, skiers, and snowboarders are often exposed to enormous doses of UV radiation due to prolonged sun exposure, reflection of UV radiation by snow and water, and reduction of the minimal erythema dose (MED = smallest dose of UV radiation to produce erythema within 1-6 hours) (43, 46). Moehrle revealed that the UV exposure rate of participants of the Ironman in Hawaii was increased to 8.3 MED (44). Similar results were found when the UV exposure of cyclists racing the Tour de Suisse was measured (45). Ambros-Rudolph et al. conducted a case-control study with 210 marathon runners comparing the athletes to non-athletes of the same age and gender. The runners showed more dysplastic nevi, lentiginos, and suspicious skin lesions related to white skin cancer. The results correlated positively with exercise intensity (5). The most common, immune-mediated photodermatosis induced by UV rays is the so called "Polymorphic light eruption". Clinical symptoms, such as papules, vesicles, plaques, cocardial lesions, etc., occur after a latency period of hours or a few days on sun-exposed body parts (24, 25). It is a phenomenon that has already been observed in athletes who engage in outdoor sports activities (13, 17).

Sebaceous Gland Related Diseases

Acne mechanica, cutaneous lesions caused by mechanical stress, manifests itself in the form of papulopustular eruptions and nodules. It is caused by a combination of sweating, occlusion, friction, and pressure, especially beneath protective sports gear like helmets or shoulder pads (8, 19, 42). Predictive sites of clinical manifestation are the chin, forehead, jawline, neck, and the shoulders (1) (Figure 5). Sports commonly associated with heavy forms of acne mechanica are for example American football and ice hockey, where protective head and body gear is part of the equipment. In addition, boxers, equestrians (beneath the helmet straps and on the forehead), and athletes of other disciplines are frequently affected by acne mechanica.

Another severe form of acne, located in the neck and occipital scalp area, is acne keloidalis nuchae. It constitutes a chronic fibrotic folliculitis and perifolliculitis leading to the development of hypertrophic scars or celoids. Knabe et al. investigated the manifestation of acne mechanica and acne keloidalis in 453 high school, college, and professional football players and found that acne keloidalis nuchae occurred primarily in college athletes and professional players. Interestingly, acne keloidalis nuchae affected almost exclusively Afro-American players (32).

Various cases in professional sports have brought the matter of doping - the use of performance-enhancing drugs - to the attention of dermatologists. Acne induced by abuse of anabolic-androgenic steroids (AAS) and whey proteins, so-called "steroid acne", is developed by up to 50% of all AAS users (40, 53). These products are used in the bodybuilding and fitness scene. With continuous abuse of AAS, in addition to strongly pronounced seborrhea as a clinical appearance, the development of acne vulgaris, acne papulopustulosa, acne conglobata, or acne fulminans is possible (31, 51, 54, 58).



Figure 3
Sample image for allergic skin diseases: Eczema.



Figure 4
Sample image for sun-related diseases: Melanoma.



Figure 5
Sample image for sebaceous gland related diseases: Acne.

Conclusion

When practicing sports, an athlete's skin is exposed to various stress factors and certain sports predispose the athlete to specific skin diseases. Numerous studies examine the occurrence of specific dermatoses in defined sport disciplines. The onset / outbreak of skin diseases is highly correlated with the discipline practiced. Infectious skin diseases are most commonly diagnosed in athletes participating in contact sports. Traumatic lesions are found in athletes of various disciplines with feet and hands being predisposed locations. Allergic reactions arise >

from a multitude of allergens, for example substances used for the production of sports gear or ingredients of sunscreen. UV rays per se can trigger photo dermatoses. Furthermore, intense UV radiation can be the trigger for the development of skin cancer. Athletes often suffer from severe forms of acne. This is connected to skin irritation due to contact with protective sports wear or caused by the abuse of anabolic drugs.

Up to now, there are only a few studies, that compare the prevalence of dermatoses in athletes of various sports disciplines within one demographic-epidemiological setup. Hardly any studies examine the variants of dermatoses across disciplines and the overarching effect of high-performance sports on skin diseases. Further studies should be carried out to examine the general effects of sport on skin health. To this end, a stronger interdisciplinary cooperation between sports physicians and dermatologists is required. ■

Conflict of Interest

The authors have no conflict of interest.

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