

Review Article

Cement burns: a review 1960–2000

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We review the literature on cement burns of the skin published during the last 4 decades. 51 case reports were analyzed with special regard to common modes of injury, localization of cement exposure, preventive measures taken and treatment. Cement burns are injuries concerning professionals at the workplace as well as amateurs during do-it-yourself work. In 49% of the cases, no attempt to protect the skin had been made. The majority of injuries were located on the lower legs and knees. Full-thickness burns were reported in 66% of cases. Surgery had to be performed in 34%. Cement burns can be avoided by adequate skin protection. Although acute cement injuries may seem rare, prospective studies should be carried out for correct estimation of prevalence. The need for information on the harmful properties of cement in the occupational as well as the domestic environment is emphasized.

Key words: cement burns; full-thickness burns; partial-thickness burns; occupational; skin protection; skin graft; prevention. © Munksgaard, 2001.

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More than 30 million tons of cement are processed in Germany each year, and cement is the leading cause of occupational skin disease in the construction industry. Most cement-related skin effects are due to allergy. By irritation of the horny layer in building occupations, for example due to micro-trauma, penetration of hexavalent chromate and cobalt compounds is facilitated and may lead to Type-IV sensitizations.

Cement burns are rarely reported, particularly considering the heavy skin exposure and high frequency of use. They may, however, lead to severe illness needing intensive therapy, as well as significant loss of working time. We review the literature on cement burns in order to identify risk profiles and reflect on preventive measures that should be taken for avoiding these injuries. Pathophysiology and biochemistry of cement burns have been reviewed elsewhere (1–5) and are not covered in this paper. We included in our analysis only articles describing purely non-thermal cement effects and giving at least some information on individual cases. These were set against analyses presenting larger patient populations (2, 6–8).

The skin, eye and respiratory tract are the organ systems most prone to damage by ready-mixed ce-

ment or cement dust. Damage to the respiratory epithelium may become life-threatening (6). So-called cement burns do not relate to skin damage caused by thermal effects, but are due instead to irritation or alkaline burns of the upper skin layers. The skin lesions induced are classified in degree according to the depth of the damage. Explosions in cement plants may, principally, also cause emission of hot cement powder (6).

Apart from the alkalinity of cement (pH 12), relevant factors for developing cement burns are occlusion and abrasion: the skin surface is damaged by the abrasive properties of added particulates, such as sand, and penetration of alkaline cement, mostly used ready-mixed, is thus facilitated. This effect is increased by occlusion due to wet clothes. A few hours after exposure, burning sensations, pain, erythema and vesicles occur as the initial symptoms. 12–48 h later, partial- to full-thickness burns characterize the clinical picture.

Materials and Methods

A total of 51 cases published in 1960–1997 were included into the analysis. In 45 cases (1, 3, 4, 9–25), patients were exposed to ready-mixed cement

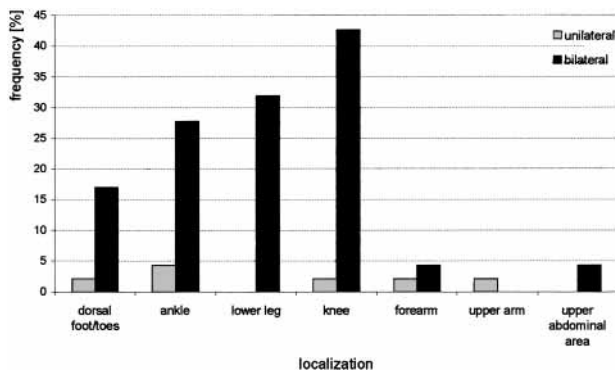


Fig. 1. Frequency of cement burns in different body regions ($n=47$). Multiple statements were allowed.

or concrete mixtures, or with mixtures prepared from cement powder by the patients themselves. In these cases, burns were not induced while mixing, but during later work with the mixture. All these reports relate to accidents during construction work with cement. 2 patients were burnt while they were unloading concrete blocks, which had already dried, during rainy weather (26). 4 patients describe exposure to cement powder that had been used for marking soccer fields (27, 28). These cases are discussed separately, since they cannot be considered a typical form of exposure. To standardize terminology in the publications evaluated, the terms ulceration and necrosis were classified as full-thickness burns.

Results

45 of the 47 patients exposed in construction were male, with a mean age of 40 years. No information about occupations was given in 15 patients (32%), 25 (53%) had occupations within the construction industry or related areas (construction workers, mine workers, workers in cement plants, electricians, bricklayers etc.), and 7 (14.9%) belonged to other occupational groups.

19 (40%) of the burns reported occurred during do-it-yourself work, and 18 (38%) were work accidents. No information was available in 10 (21%) cases. The majority of cement burns affected the lower limbs: a common way of laying concrete or pouring foundations is to take-up a kneeling position, usually without additional protection for the knees, when levelling the concrete or cement (20 (43%) of the cases described).

Another frequent mode of injury was the spilling of wet cement over the top of Wellington boots or the penetration of cement through defective protective shoes (11 cases, 23%). In these cases it is notable that most patients did not take off their boots to clean them, but continued to wear them

until finishing work, even if symptoms had already begun. 2 patients (4%) were injured on the lower extremities while cleaning their cement-soiled boots. 6 patients (13%) carried out their work in a standing position, 5 of them wearing no special protective clothes, no information on this point being provided in 1 case. 3 persons were injured on the upper limbs laying stones, plastering a ceiling or while working with a concrete sprayer. 2 obese patients (4%) complained of skin damage in the abdominal area after unloading concrete blocks, which had already dried, during rainy weather. No information about the mode of injury was provided in 3 cases.

The localization of injuries peaked on the lower extremity, which is consistent with the modes of the accidents. The distribution of localizations of injuries is shown in Fig. 1. For analysis, multiple statements were taken into account. In some cases the injuries were unilateral, which may, in the case of the lower extremity, be attributed to defective protective clothes or shoes, or in the case of the upper extremity to increased exposure of the dominant hand.

The use of preventive measures is presented in Fig. 2. Special work or Wellington boots, work trousers or gloves are considered protective equipment in the following paragraphs. More than 1 statement was again possible. It is notable that 10 (40%) out of 25 of the patients working in the building industry had not taken any preventive measures, 7 (39%) of those injured during working hours ($n=18$) not having taken any preventive measure. The mean duration of exposure was 4 h ($n=28$). Initial signs were noticed after 6 h ($n=27$), with the development of clinical symptoms 0.25–48 h after the beginning of exposure being highly variable. The mean duration from exposure to consulting a doctor was 38 h ($n=23$).

Clinical symptoms and signs were described uni-

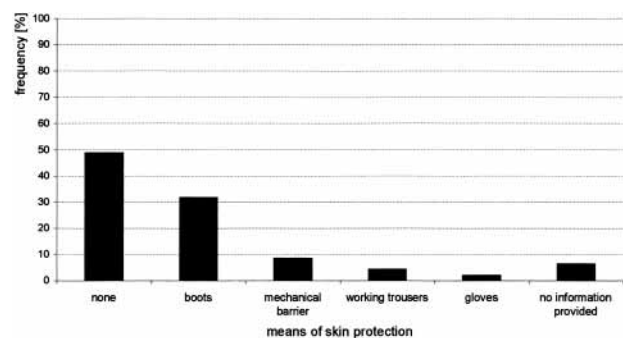


Fig. 2. Frequency of skin protective measures taken in the case reports evaluated ($n=47$). Multiple statements were allowed. Mechanical barrier=underlying objects (e.g., planks, mats) for prevention of direct skin contact.

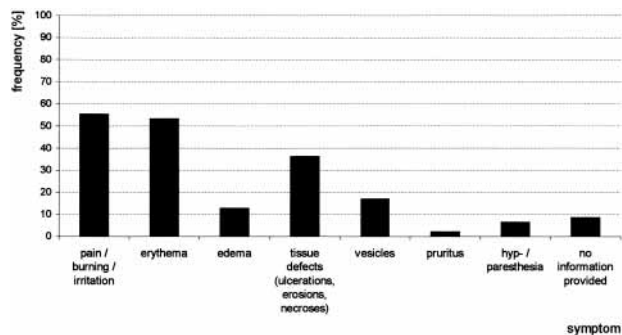


Fig. 3. Frequency of symptoms of cement burns ($n=47$). Multiple statements were allowed.

formly: pain, burning sensations, erythema and tissue defects (erosions, ulcerations, necroses) were mentioned in almost all cases. In several reports edema and vesicles were described, whereas pruritus or hypesthesias were rare. Multiple statements were again allowed, an overview being given in Fig. 3.

The clinical diagnoses show, as displayed in Fig. 4, that severe injuries such as full-thickness burns were present in more than $2/3$ of the cases analyzed. This apparent frequency of severe injuries may be due to publication bias.

29 (62%) of the injured had to be treated as inpatients. No information on this point was available in 8 cases (17%). The mean duration of hospital stay was 21 days (data on 25 (86%) of the patients hospitalized). Surgical treatment was required in 16 cases (34%), in 20 (43%) conservative treatment was sufficient, and no information was available on 11 (23%) patients.

A survey of local and systemic treatment and of surgical debridement or skin grafting is given in Fig. 5. It is clear that skin grafting was necessary in $1/4$ of the cases reported. Information on the mean duration of the healing process was available for 29 persons (62%), and amounted to 6 weeks. Sequelae were assessed in individual cases only and usually consisted of hypertrophic scar formation, sometimes associated with hypersensitivity and contractures.

As mentioned above, 4 cases of exposure to cement powder used for marking playing fields have been described (27, 28). All those affected were of school age. Skin lesions on the thighs were induced by falling on the touchline and moistening of the dry powder by sweat or rain. The scrotal skin was also involved in 1 case. Clinical symptoms developed approximately 1 h after the end of the soccer matches. Comprising burning, stinging and erythema, they were similar to the symptoms described above, though clinical findings were less distinct and skin lesions more superficial. In all

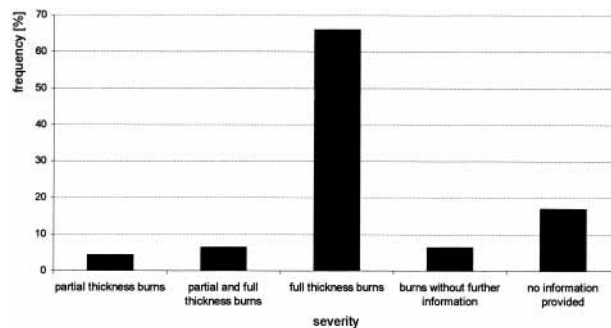


Fig. 4. Distribution of severity of cement burns ($n=47$).

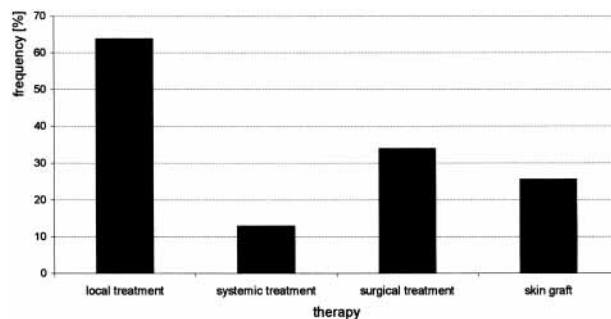


Fig. 5. Treatment modalities in cement burns ($n=47$).

cases, conservative therapy, including local or systemic antibiotics and dressings, was sufficient.

Discussion

Cement burns are rarely reported, which may prompt speculation of a low prevalence rate for these conditions. In a study conducted during the construction of the Channel Tunnel, however, Irvine et al. (29) reported 323 cement burns diagnosed in 1138 workers presenting with dermatological problems during the observation period (2 years), a figure which suggests that the prevalence of cement burns may be hugely underestimated. Properly conducted prospective studies are necessary for better assessment of the true epidemiologic situation.

Analyzing case reports and comparing these with the data published on larger study populations (2, 7, 8), differences were found in therapeutic management between the Anglo-American and German literatures. Full-thickness burns were treated by surgery and skin-grafting without delay in the former countries, resulting in short duration of complaints and hospitalization (2, 7), with, however, not always satisfactory cosmetic results. Partial-thickness burns were treated conservatively on an outpatient basis. A German publication reports cement burns in 23 patients who were treated

exclusively conservatively (8), in part resulting in long-lasting courses of disease. It should be mentioned, however, that the trend has also been towards surgical treatment of these injuries in Germany in recent years.

The analysis of the case reports is concordant with the data found in the literature. Typical features of cement burns are damage to the horny layer by abrasion, occlusion and wetness, and possible progressive damage to deep skin layers by the alkalinity of cement. The delay between the initial development of symptoms and the clinically obvious burn and consultation with a physician can be explained in this way. Cement burns are avoidable by means of adequate protective measures, such as suitable gloves, work clothes and appropriate protective boots, as well as immediate first aid. For prevention of these injuries, information and training in risk management is recommended for employees and apprentices in the construction industry. Adequate hazard notification and information is especially important in avoiding accidents during do-it-yourself work, which seems to be over-represented in the case reports evaluated.

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