

## A study on Chromium induced occupational dermatoses among the construction workers attending tertiary care hospital in Coimbatore

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### Abstract

**Introduction:** Occupational contact dermatitis is the most frequent dermatoses. It is evident that Chromium causes contact dermatitis in construction workers. This study is conducted to assess the prevalence and pattern of contact dermatitis among construction workers.

**Materials and Methods:** This was a prospective hospital based clinical study, conducted among construction workers who presented with skin manifestations from Oct 2016 to Jan 2017. Data including demographic details, clinical findings were collected. Patch test done and readings were taken according to ICDRG criteria.

**Results:** Fifty patients were enrolled in our study. The prevalence of contact dermatitis in construction workers is 2.6% and prevalence of Chromium induced contact dermatitis is 50%. Age group predominantly affected was 41-55 years. The male to female ratio is 3.5:1. The mean duration of exposure to cement was 13.02 years. The minimum and the maximum time taken for the contact dermatitis to occur after exposure were 2 weeks and 40 years respectively. The median period for the onset was 10 years. Thirteen patients had acute eczema, 29 had chronic eczema and 9 had subacute eczema. Ninety two (92%) had allergic contact dermatitis and 8% had irritant contact dermatitis. The most common allergen positive by patch testing was Chromium [50%] followed by ppd [10%], parthenium [6%] and pb [4%].

**Conclusion:** Our study concludes that Chromium (hexavalent) in cement causes allergic reactions in 50% of construction workers. Control measures include health education, safety measures, health surveillance and reduction of Chromium VI concentration by adding 0.35% ferrous sulfate.

**Keyword:** Contact dermatitis, Chromium, Patch test.

### Introduction

Coimbatore being one of the most industrialized city and largest growing economies in Tamil Nadu, encompass numerous industries like textile mills, wet grinders, foundries, automobile components, motor pump sets, granite etc., there is a sharp increase in construction projects. People working in the building projects are invariably exposed to chemicals which induce various skin diseases and systemic effects. Most common substance causing dermatitis in construction workers is cement followed by rubber. Contact dermatitis (also called contact eczema) is the commonest occupational dermatosis. The term refers to the skin changes, usually accompanied by inflammation, from direct skin exposure to exogenous physical or chemical agents.<sup>1</sup> Hexa-valent Chromium Cr(VI) in cement is a well known contact allergen, and is able to elicit contact dermatitis at very low concentrations. Trivalent Chromium Cr(III) is also capable of eliciting contact dermatitis but it is less potent.<sup>2</sup> The wet cement contains an abrasive and alkali agent with a pH >10 and leads to irritant contact dermatitis (ICD). Cement burns may occur as severe necrosis and ulcer within a few hours of contact with wet cement. The effects of Chromium on skin manifest as Irritant contact dermatitis, Allergic contact dermatitis and Chrome ulcer.<sup>1</sup>

### Materials and Methods

This was a prospective observational hospital-based clinical study, conducted among construction workers who presented with skin manifestations to the Outpatient department of Dermatology in Coimbatore Medical College Hospital, Coimbatore district of Tamil Nadu state from Oct 2016 to Jan 2017. After obtaining institute ethical committee clearance, fifty consecutive patients with skin manifestations related to construction work were enrolled in our study based on the inclusion and exclusion criteria. The written informed consent was obtained from all patients. The inclusion and exclusion criteria of our study were as follows.

**Inclusion Criteria:** Participants of both genders above the age of 18 years working for at least 1 year in construction field with no past history of skin disease prior to joining the work were recruited.

#### Exclusion Criteria:

1. Workers less than 18 years of age
2. Pregnant and lactating females
3. Workers having non- occupational dermatoses

### Methodology

The data were collected using a proforma giving due consideration to the workers' detailed information regarding demographic details, occupational details including their duration of employment, usage of protective devices, disease duration and symptoms. A

thorough clinical history including the onset, progress, nature, extension, recurrences of skin manifestation, co morbidities were collected. A detailed dermatological examination including morphological pattern, site of involvement and level of extension was done. Detailed systemic examination pertaining to respiratory system, liver, kidneys and CNS were carried out. After giving proper instructions to the patients, Patch test –Indian Standard Series (Chemo technique Diagnostics Ltd.) was carried out to all patients. These allergens were applied on Finn chambers and strapped on the back with hypoallergenic tapes. Patients were instructed to avoid showering, strenuous hard work and sunlight

exposure. Patients with acute eczema were treated and patch test was carried out after 2 weeks. After 2 days, the Finn chamber was removed and the squares representing the allergen on each chamber was marked by marker pen. The first reading was taken after half an hour. A second reading was taken on day 4 to confirm the presence of allergic reaction. Patch test result was interpreted according to International Contact Dermatitis Research Group [ICDRG] criteria [Table 1]. The data collected were entered in and analyzed using Statistical Packages for Social Sciences (SPSS) version 22.

**Table 1: Reading criteria of the ICDRG**

| Symbol | Morphology  | Assessment                |
|--------|---|---------------------------|
| ---    | no reaction                                       | Negative reaction         |
| ? +    | faint erythema only                               | Doubtful reaction         |
| +      | Erythema, infiltration, possible papules          | Weak positive reaction    |
| ++     | Erythema, infiltration, papules, vesicles         | Strong positive reaction  |
| +++    | Erythema, infiltration, coalescing vesicles       | extreme positive reaction |
| IR     | Various morphology- soap effect, bullae, necrosis | Irritant reaction         |

### Observation and Results

The result of the study done in 50 patients of constructional workers with contact dermatitis attending the OPD during the 4 months period [from October 2016 to January 2017] is discussed below.

The total OPD census during the study period [from October 2016 to January 2017] was 36,114. Among them 1,853 patients were engaged in construction field and its related works. The prevalence of contact dermatitis in construction workers attending our OPD is 2.6%. Out of 50 patients, 78 percent were male, 22 percent were female. The male to female ratio is 3.5:1. It is observed that the majority of the patients are belonging to male category. From the collected data, the majority of the patients belong to 41 to 55 age category. The maximum and minimum age in our study was 26 and 70 respectively. The mean age was 48.

Based on their total duration of employment in the construction field, the maximum duration of exposure to cement was assessed. Out of 50 patients, 17 [34%] patients were exposed to cement for <5years, 12[24%] were exposed for 6 to 10 years and 21 patients were exposed to cement for > 10years. One patient was exposed to cement for the maximum of 35 years by working as a mason in the construction field.

The time taken for the manifestation of skin diseases once they exposed to cement was recorded as the duration taken for the onset of dermatitis after the exposure to cement. Maximum of 19 patients [38%] developed dermatitis after exposure to cement for 0-5 years. 13 patients [26%] developed dermatitis after 6-10yrs of exposure and 18patients [36%] developed it after exposure for > 6yrs. The minimum and the maximum time taken for the contact dermatitis to occur after exposure observed in our study was 2 weeks and

40 years respectively [Fig. 1]. The median period for the onset was 13.02 years. In our study, most of the patient suffered from recurrent episodes of dermatitis on and off which always coincide with the working periodicity. Remission was noticed on off days from work. Out of 50 patients, 36[72%] had 1 to 2 episodes, 8[16%] had 3 to 4 episode and the remaining of them had > 5 episodes.

Based on the morphological pattern of dermatitis, patients were categorized according to the type of eczema. Thirteen [26%] patients had acute type of eczema, 29[58%] had chronic type of eczema and 9[18%] had subacute eczema. Acquired Ichthyosis in form of dryness, xerosis and cracquale particularly in limbs was noticed in 17 [34%] patients. Only one patient presented with chrome ulcer. Callosities and fissure foot were noticed in 4 patients and one patient respectively [Table 2]. Nail involvement was noticed less frequently in our study (6 patients). Out of 6 patients, 3 patients had nail dystrophy, 2 had onycholysis and one presented with clubbing. All nail changes were associated with hand and foot eczema. Extremities being the exposed area, they were the commonest site of involvement. Almost all patients [100%] showed involvement in any one of the extremities. Out of 50patients, 34 [68%] showed both upper and lower limb involvement, 10 [20%] showed lower limb involvement alone and 6 [12%] showed upper limb alone. Head and neck particularly the face was involved in 10 patients [20%] and trunk being the unexposed area was involved only in 8 patients [16%].

Based on the history and clinical assessment like onset after the exposure of cement, duration, severity and type of eczema, cement contact dermatitis was classified as allergic and irritant. Out of 50 patient, 46

[92%] were diagnosed as allergic contact dermatitis and 4[8%] were irritant contact dermatitis.

Protective devices like gloves, boots, cap etc were less frequently used by the workers in our study. Based on the data, only 13 patients [26%] were using gloves during their work. Among the 50 patch tested patients, total of 30 positives and 20 negatives were observed. Out of 30 positive patients Chromium positivity was noticed in 25 patients. Isolated Chromate allergy was noticed in 17 patients [34%] [Table 3]. Multiple positive tests were frequently noticed. Eight patients [16%] showed positive for Chromate and also for one or more allergens [Fig. 2]

Along with Chromium allergy, other allergens like Nickel, PPD (Paraphenylene diamine), Ptn (Parthenium) and Pb (Lead) showed positivity in the range of 2%, 10%, 6% and 4% respectively [Table 4]. Six percent positive of fragrance mix and 2% of Vn was just noted incidentally which is no longer related to cement. Number of contact dermatitis patients with relevance positive allergy for Chromium – 25 [Fig. 3]. The Prevalence of Chromium induced contact dermatitis [confirmed by patch test] is 50%. In Chromium positivity, only mild<sup>1</sup> and moderate<sup>2</sup> grades were observed. Out of 25 Chromium positive patients, 20 [40%] had grade 1 and 5 [10%] had grade 2.

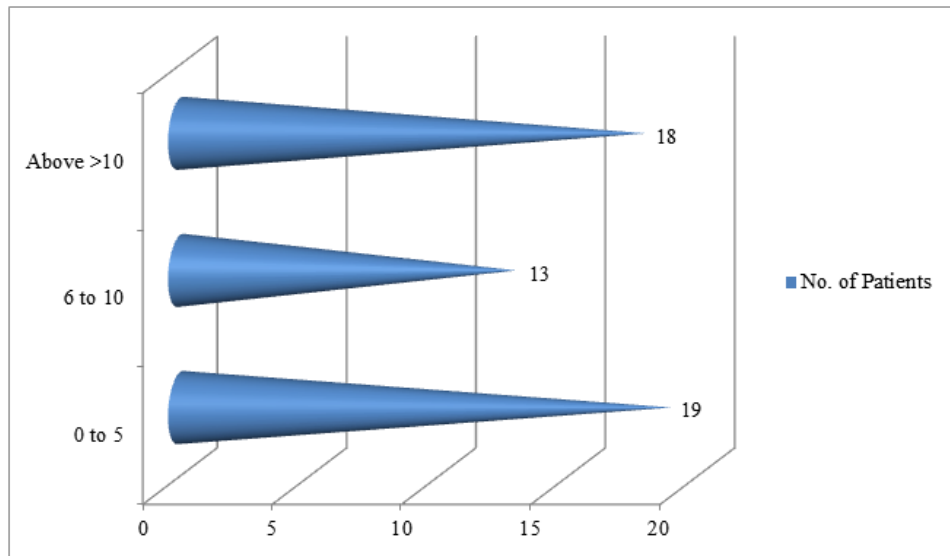


Fig. 1: Distribution of the patients according to the time taken for onset after exposure

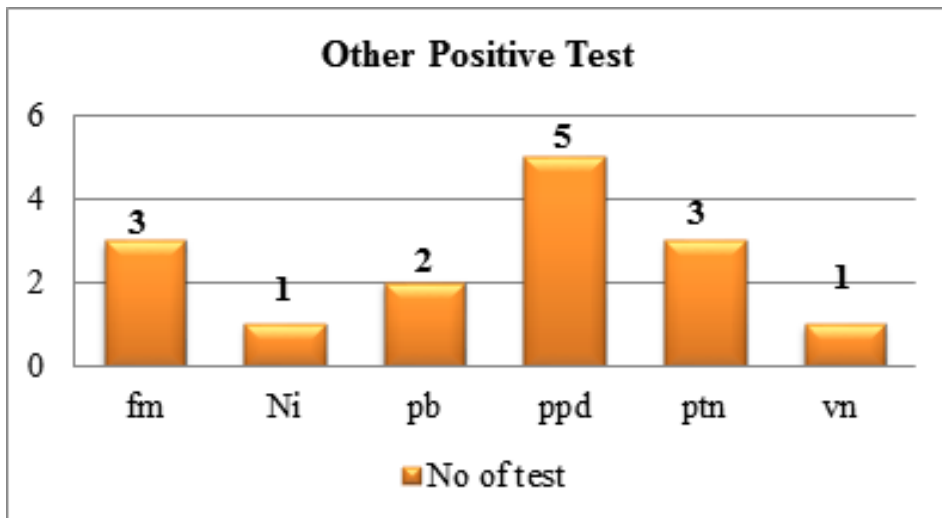


Fig. 2: Distribution of patch test positivity for other allergens



Fig. 3: A case of allergic contact dermatitis with chronic eczema showing grade two positivity for Chromium

Table 2: Distribution of patients with other skin lesions

| Other Skin Lesions     | No of Patients | Percent | Cumulative Percent |
|------------------------|----------------|---------|--------------------|
| Chrome Ulcer           | 1              | 2.0     | 2.0                |
| Ichthyosis             | 17             | 34.0    | 36.0               |
| Callosities            | 4              | 8.0     | 44.0               |
| Bilateral fissure foot | 1              | 2.0     | 46.0               |

Table 3: Distribution of patients according to patch test result

| Patch Test                        | No of Patients | Percent | Cumulative Percent |
|-----------------------------------|----------------|---------|--------------------|
| Positive for Chromium [Cr]        | 17             | 34.0    | 34.0               |
| Positive for others               | 5              | 10.0    | 60.0               |
| Positive for Cr and others (both) | 8              | 16.0    | 50.0               |
| Negative                          | 20             | 40.0    | 100.0              |

Table 4: Distribution of patch test positivity for other allergens

| Other positive Patch Test   | No of test | Percent | Cumulative Percent |
|-----------------------------|------------|---------|--------------------|
| fm (fragrance mix)          | 3          | 6.0     | 6.0                |
| Ni (nickel)                 | 1          | 2.0     | 8.0                |
| Pb (lead)                   | 2          | 4.0     | 12.0               |
| ppd (paraphenylene diamine) | 5          | 10.0    | 22.0               |
| ptn (parthenium)            | 3          | 6.0     | 28.0               |
| Vn (Vaseline)               | 1          | 2.0     | 30.0               |

## Discussion

**Prevalence:** In our study prevalence of contact dermatitis in construction workers attending as outpatient in our OPD is 2.6% and Prevalence of Chromium induced contact dermatitis [confirmed by patch test] is 50%. There is no study available which estimates the prevalence of contact dermatitis among patients (as construction worker) attending OPD in tertiary centers. Most of the studies from literature and journals, showed the prevalence of cement contact dermatitis based on the population of cement workers engaged in industries and in field work. Liden et al

reported the prevalence of allergic contact dermatitis (ACD) to Chromate among the working population as more than 10%.<sup>3</sup> Bock et al reported the prevalence among symptomatic construction workers who were patch tested is more than 45%.<sup>3</sup> So we could not compare the prevalence with any of the studies conducted so far.

**Occupation:** In our study of 50 patients, 32 [64%] persons were cement mixers, 9 persons [18%] were masons and 5[10%] persons were dealing with centering work and remaining of them were working in tile paving,<sup>2</sup> white washing<sup>1</sup> and as electrician.<sup>1</sup> According to the epidemiology study conducted by

SajiK.G et al.,<sup>4</sup> they observed 43% were masons, 15% helpers, 9% concrete mixers, 27% loading unloading workers, and 6% tile workers.

**Age:** Age group predominantly affected in our study was 41-55 years which constitutes 54 %. Sharma V et al, in their study, observed 82% of the patient belonged to the age group of 25-50years.<sup>3</sup> Results of our study are comparable with the above mentioned study. The mean age of our study group was 48 years which is higher than that noticed in Shah KR et al<sup>5</sup> study [25.83 years] and in Sarma N et al<sup>6</sup> study [24.8 years].

**Sex:** In our study of 50 patients, 78% were male, 22% were female. The majority of the patients were belonging to male category. This is well comparable with the study of Shah KR et al in which 60% were male subjects and 39% were female subjects.<sup>5</sup>

**Duration of Exposure:** In our study 34% of patients have been employed in construction work for less than 5 years and 42% of patients for more than 10 years. Sharma V et al noticed 90% of patients were in the occupation for more than 5 years.<sup>3</sup> In comparison with the above study, we noticed majority of our patients had exposure for > 10years. The mean duration of exposure to cement in our study was 13.02 years which is higher when compare to Shah KR et al.<sup>5</sup> study where the mean duration of exposure was 6.58 years.

**Duration taken for the Onset after Exposure:** The minimum and the maximum time taken for the contact dermatitis to occur after exposure observed in our study was 2 weeks and 40 years respectively. The median period for the onset was 10 years. The median period according to Sharma V et al. study was also mentioned as 12 years.<sup>3</sup>

**Usage of Protective Devices:** In the present study protective devices in the form of gloves were used only by 26% of patients. Less usage of protective devices [gloves] were observed in our study when compare to the study of Shah KR et al. in which majority [83.3%] of subjects were using gloves.<sup>5</sup>

**Clinical Patterns:** In our study, 13 [26%] patients had acute type of eczema, 29 [58%] had chronic type of eczema and 9[18%] had subacute eczema. Chronic eczema is the commonest type observed in our study. The incidence of acute eczema in our study [26%] was higher in comparison with that [1.66%] of Iraj F et al study conducted in Isfahan.<sup>7</sup> Acquired Ichthyosis particularly in limbs was noticed in 17 [34%] patients. Eight [8%] of patients showed callosities either in palms or soles and 2% showed fissure foot. Chrome ulcer was noticed in only one patient. In Shah KR et al study, they found that 19.6% had friction callosities and 10.9% had ichthyosis in form of dry fissured scaly skin.<sup>5</sup> Our study showed less incidence of callosity and high incidence of ichthyosis as compared to the above study. Chrome ulcer were observed in 32% patients in a study conducted by Sharma V et al<sup>3</sup> whereas only 2% was seen in our study which shows very low occurrence. Various nail changes like nail

dystrophy, onycholysis and clubbing were observed. All nail changes are associated with hand and foot eczema. We have not come across any report mentioning the nail involvement.

**Sites of Involvement:** Almost all patient [100%] showed involvement in any one of the extremities which was exposed to cement. Both upper and lower limb involvement was seen in 68%, lower limb alone was involved in 20%, upper limb alone was involved in 12%, trunk was involved in 16% and face was involved in 20%. Sarma N et al observed in their study that, dermatitis affecting the exposed parts was seen in 93.75% and unexposed parts [covered areas] was 62.5% and they also observed hand dermatitis predominated among the site of involvement in 73.3%.<sup>6</sup> In comparison with the above mentioned study, our study showed higher involvement of exposed areas and lower involvement of covered areas. The predominant involvement of hands [80%] in our study is almost concurrence with the Sarma N et al study.<sup>6</sup>

**Type of Contact Dermatitis:** In Bock M et al study,<sup>8</sup> allergic contact dermatitis [61.5%] occurred more often than irritant contact dermatitis [44.5%]. Another study by Sarma N et al also observed 60% of allergic contact dermatitis and 20% of irritant contact dermatitis.<sup>6</sup> In our study, out of 50 patient, 92% had allergic contact dermatitis and 8% had irritant contact dermatitis which is well comparable with those of Bock M et al and Sarma N et al.

**Patch Test:** The most common allergen positive in our study was Chromium. The total positive test for the relevant allergen Chromate was 25 [50%] This is well comparable with Sarma N et al study who reported total Chromium positive was 70% and relevant Chromium allergy was positive in 60%.<sup>6</sup> The next common allergen positive in our study was PPD [10%], Ptn [6%] and Pb [4%] whereas in Sarma N et al study, the next common allergen noticed was epoxy resins [30%], followed by Cobalt and Nickel each constituting 20%.<sup>6</sup> Positivity to PPD, Ptn, Fm and Vn is perhaps from non-occupational causes. Grading of Chromium positivity showed mild and moderate grades in our study.

## Conclusion

Our study concludes that Chromium which is available as hexavalent in our cement induces sensitization and causes serious allergic reactions in almost 50% of construction workers. This study was done only on the symptomatic patients with cement induced dermatitis attending the OPD. The overall prevalence of cement induced contact dermatitis among the construction workers was not studied. This is the limitation of our study.

The available information from the literatures clearly explained that reduction of Chromium VI in cement to less than 2 ppm and to the less bioavailable Chromium III compounds will reduce the prevalence of allergic cement eczema in workers. Reduction of

Chromium VI to the Chromium III is achieved by adding 0.35% Ferrous sulfate to the cement which reduces the concentration of Chromium VI to less than 2ppm.

Without protective measures, reduction of Chromium VI in cement alone will reduce but not eliminate the prevalence of Chromium allergy. Only by means of protective measures like washing the skin with warm water and soap, encouraging clothes with long sleeves and long trousers and by wearing gloves, boots and cap, we can eliminate the prevalence of irritant cement eczema. Thus it is recommended that Health surveillance and social security schemes with good occupational health services should be implemented to protect the workers from health hazards.

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