

BURNS (CEMENT)



“The Course of Empire: The Savage State”, oil on canvass, Thomas Cole, 1836



“The Course of Empire: The Arcadian or Pastoral State” oil on canvass, Thomas Cole, 1836



“The Course of Empire: Consummation”, oil on canvass, Thomas Cole, 1836



“The Course of Empire: Destruction,” oil on canvass, Thomas Cole, 1836



“The Course of Empire: Desolation”, oil on canvass, Thomas Cole, 1836

The barbarian conquerors of Rome usurped in a moment the toil and treasure of successive ages, but except the luxuries of immediate consumption, they must view without desire all that could not be removed from the city on the Gothic wagons or the fleet of the Vandals. Gold and silver were the first objects of their avarice, as in every country, and in the smallest compass, they represent the most ample command of the industry and possessions of mankind. A vase or a statue of those precious metals might tempt the vanity of some barbarian chief; but the grosser multitude, regardless of the form, was tenacious only of the substance; and the melted ingots might be readily divided and stamped into the current coin of the empire. The less active or less fortunate robbers were reduced to the baser plunder of brass, lead, iron and copper; whatever had escaped the Goths and Vandals was pillaged by the Greek tyrants; and the emperor Constans, in his rapacious visit, stripped the bronze tiles from the Pantheon. The edifices of Rome might be considered as a vast and various mine; the first labour of exacting the materials was already performed; the metals were purified and cast; the marbles were hewn and polished; and after foreign and domestic rapine had been satiated, the remains of the city, could a purchaser be found, were still venal. The monuments of antiquity had been left naked of their precious ornaments; but the Romans would demolish with their own hands the arches and walls, if the hope of profit could surpass the cost of the labour and exportation. If Charlemagne had fixed in Italy the seat of the Western Empire, his genius would have aspired to restore, rather than to violate, the works of the Caesars, but policy confined the French Monarch to the forests of Germany; his taste could be gratified only by destruction, and the new palace of Aix - la - Chapelle was decorated with the marbles of Ravenna and Rome...

....But if the forms of ancient architecture were disregarded by a people insensible of their use and beauty, the plentiful materials were applied to every call of necessity or superstition; till

the fairest columns of the Ionic and Corinthian orders, the richest marbles of Paros and Numidia, were degraded perhaps to the support of a convent or a stable. The daily havoc which is perpetrated by the Turks in the cities of Greece and Asia may afford a melancholy example; and in the gradual destruction of the monuments of Rome, Sixtus V may alone be excused for employing the stones of the Septizonium in the glorious edifice of St Peters. A fragment, a ruin, however mangled or profaned, may be viewed with pleasure and regret, but the greater part of the marble was deprived of substance, as well as of place and proportion, it was burnt to lime for the purpose of cement. Since the arrival of Poggius the temple of Concorde and many capital structures had vanished from his eyes; and an epigram of the same age expresses a just and pious fear that the continuance of this practice would finally annihilate all the monuments of antiquity. The smallness of their numbers became the sole check of the demands and depredations of the Romans. The imagination of Petrarch might create the presence of a mighty people; and I hesitate to believe that, even in the Fourteenth century, they could be reduced to a contemptible list of thirty - three thousand inhabitants.

*Edward Gibbon,
"The History of the Decline and Fall of the Roman Empire"
volume 6 1787.*

On the 15th of October 1764 Edward Gibbon was sitting among the ruins of the Temple of Jupiter musing over the fate of the greatest empire the ancient world had ever known. He tried to understand how such a seemingly all powerful civilization could have come to such a sad and desolate end. It was at this very moment he decided to write his monumental "Decline and Fall of the Roman Empire". His final pages describe in summary his thoughts on how this great catastrophe of civilization had come about. His musings on the fall of the empire with respect to its people, its army and its civilization are well documented - but less well so are his fascinating insights into the decline and fall of the city itself - that is the physical buildings that once made up the greatest city on the planet. Modern sensibilities may suppose that in the year 476 AD there was a great calamity of barbarian invasion that completely destroyed the city in a single stroke - but this was not the case at all. The Western Empire ceased to exist in an administrative instant, when the German barbarian general Odoacer decided to drop all pretence of a Roman puppet emperor and take control for himself. But the physical city of Rome would endure for many centuries thereafter - there was no great physical destruction of the city that accompanied its fall. While it is true - as Gibbon describes - that the precious ornaments of the city in the form of gold, silver and bronzes were rapidly plundered - the city being stripped bare of these in short order, this largely occurred over two generations prior to its ultimate fall, in the famous sack by the Goths in 410 AD. The Romans were the greatest engineers of the ancient world - without peer - the ruins that we see today reached their current desolate state not overnight but over many, many centuries - the ruin of Rome did not occur in a single stroke of barbarian invasion, rather the startling fact of the matter is that it was the Romans themselves who destroyed the physical evidence of the grandeur of their own glorious heritage! Rome most certainly was not built in a day - it was at its height an immense city - and its once magnificent buildings were plundered for its abundant materials as if it were no more than an inexhaustible common quarry - a quarry that was plundered for 900 years! Gibbon is scathing in his descriptions of what he considered no more than wanton vandalism, though he does grudgingly concede that at least in the form of St Peter's ancient Rome's material bones were put to some good use!

The only reason we have any memorial whatsoever of the Roman civilization, Gibbon attributes to the fact that Rome - a city that once boasted possibly a million inhabitants - a staggering number, and unprecedented in the ancient world - by the Fourteenth century had fallen to just 33,000 souls!! What saved anything of Rome for us today was the mere fact that the city had so declined in population (and in prestige - despite the claims of the great poet Petrarch) that it became physically incapable of scavenging any more of the raw materials of the ancient city. It would be the newfound reverence of Romans for their heritage in the time of the Renaissance that would finally save what was left of the old city for posterity. The Romans were history's greatest builders and engineers, until the modern age and in large part they owed this distinction to two striking innovations that forever changed human civilization - the invention of the arch, and the invention of...concrete! As humble as these entities appear, it was the arch that enabled an explosive new radiation of design and it was humble concrete that enabled the lasting legacy of millennia.

The invention of cement would also usher in a new medical malady not previously seen - the delayed and severe effects of an alkali chemical burn. Just as the decline of Rome's buildings was a slow gradual affair, so too are the effects of its buildings major chemical constituent on human flesh....cement!

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Introduction

Cement can result in significant *chemical burns*.

Initially the injury may appear fairly innocuous and so patients will often underestimate the severity of a burn caused by cement which can result in delayed presentation.

There also remains widespread inexperience among medical staff in general in dealing with cement burns patients with resulting delays in surgical referral.

The lack of information and education regarding risks related to cement handling has been identified as a major risk factor for this type of injury.²

Cement burns can be avoided with good preventative education and early therapeutic management.

In cases of deep burns, *early* surgical evaluation and treatment constitutes the best means of improving outcomes.

Chemistry

Cement is made by heating limestone (calcium carbonate) with small quantities of other materials (such as clay) to 1450⁰ C in a kiln, in a process known as calcination, to form **calcium oxide**, (or **quicklime**), which is then blended with the other materials.

The resulting hard substance, called “clinker”, is then ground with a small amount of gypsum into a powder to make “Ordinary Portland Cement”, the most commonly used type of cement.

Concrete is a composite material consisting of aggregate (gravel and sand), cement, and water. As a construction material, concrete can be cast in almost any shape desired, and once hardened, can become a structural (load bearing) element.

History

The word “cement” has its origins in ancient Rome. The Romans used the term *opus caementicium* to describe masonry resembling modern concrete that was made from crushed rocks with burnt lime as a binder.

Clear records of the effects of cement on the skin date back to the 1700s when they were presumed to be due to a form of contact dermatitis. Rowe and Williams were probably the first to recognize the true nature of cement burns in 1963.³

Pathophysiology

Cement contains **lime (i.e. calcium oxide)** and when wet can have a pH of 11 to 13, which means it is a highly alkaline substance and so can cause significant chemical burns.

Hydrated calcium oxide becomes **calcium hydroxide** that causes skin damage primarily due to the action of hydroxyl ions.⁴ Tissue is destroyed by dissolving protein and collagen, saponifying fat and dehydrating cells.

Even when not exposed to moisture, the dry powder is very hygroscopic and may also result in a desiccation type injury of the skin.

Dry cement can potentially penetrate clothing and react with sweat causing an exothermic reaction.

Clinically burns can vary in their severity, with contact leading to dry skin, itchiness and scaling to serious full thickness wounds requiring skin grafting.

Clinical features



*Left: Severe full thickness burns from cement, (clinical photo, Alfred Hospital Burns Unit).
Right: Typical appearance of cement burns.²*

Cement does not cause pain on initial contact; hence people may unwittingly be in contact with it for extended periods of time.

Additionally cement burns typically have an insidious onset and most patients report that they notice only mild irritation initially.²

The initial appearance of cement burns can also look fairly innocuous, (the clinical photographs above are of *late* presentations).

If cement is not immediately removed from the skin, it continues to corrode and can often deepen necrosis relatively painlessly under clothing.

The majority of cement burns occur to the limbs, with workers typically kneeling or standing in the wet product for an extended period of time.

As such typical regions of concern will include **the hands, feet** and areas over **joints**.

Pain, erythema and blistering can develop within hours, but most patients present at around 24 hours or even later.

Post burn sequelae include:

- Hypertrophic scarring and contractures
- Skin fragility
- Pruritus.

These occur more frequently when healing is delayed for more than 3 weeks, as full-thickness burns, which are common in cement burns, heal by secondary intention, if treated conservatively.

These sequelae can best be avoided by early recognition and accurate identification of burn depth, with referral for surgery if healing is not evident within a few days of injury.

Risk factors

These include:

- Rapid expansion of major construction industries.
- Poor recognition/education (on the part of both medical staff *and* patients) regarding the potentially severe effects of cement burns.

Investigations

None is specifically routinely required, other than those needed to investigate or rule out potential secondary complications.

Management

1. First aid measures:

- Remove and discard any cement contaminated clothing
- **Copious** water irrigation of all cement from the skin
- Analgesia is given as clinically indicated.
- Removal of any remaining particulate matter:
 - ♥ After analgesia use a pre-operative scrubbing brush as tolerated.

Note that this should be considered as a strictly first-aid procedure and not conducted when the wound has progressed to necrotic tissue.

- ♥ Irrigate with abraded regions with chlorhexidine.

2. Tetanus immunoprophylaxis is given as clinically indicated.
3. Some authors have recommended the application of a buffered phosphate solution to limit the spread of the cement, but this practice is controversial, as the heat produced by the subsequent exothermic chemical reaction of neutralization could in fact worsen the burns.
4. Conservative management:
 - Minor burns may be treated conservatively, but will require close follow up.
5. Surgical management:

This primarily involves debridement and split-thickness skin grafting.

Initial debridement can be very painful and problematic when cement granules are strongly embedded in the wound, and therefore a **general anaesthetic** may be required.

The treatment of cement burns, though not unequivocal in the literature, is currently oriented toward **early excision** of necrotic tissue and **grafting**, once the diagnosis of **full-thickness burns** has been clearly established.

Longer hospitalization of patients with cement burns was required for complete skin healing than in the overall burns group in one study. In this group of patients, slow healing, graft failure and re-grafting are more common as compared to full-thickness lower extremity burns of different aetiologies of the same area.²

After the healing period, postoperative follow-up should correspond to that of any burn graft, that is, prevention of the hypertrophic and contractile tendency of scars by the wearing of compression garments and massaging of the scars, possibly in association with physical therapy.

Disposition

Plastics referral is the most appropriate disposition for lesser burns.

For more severe injuries referral to a specialist Burns Unit will be required.

- In Melbourne this will be the Alfred Burns Unit or for Paediatric cases, the Burns Unit of the Royal Children's Hospital.

References

1. Burns Management Guidelines, Victorian State-wide Burns Service:
 - www.vicburns.org.au/
2. Alam M et al. Cement Burns: The Dublin National Burns Unit Experience. *Journal of Burns and Wounds*, vol 7, October 5, 2007, p. 33-38.
3. Feldberg L, Regan PJ, Roberts AHNR. Cement burns and their treatment. *Burns*. 1992; 18:51-53.
4. Ricketts S, Kimble FW. Chemical injuries: the Tasmanian burns unit experience. *ANZ J Surg*. 2003; 73:45 - 48.

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