

#### Version 1

#### Flame Burns

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#### **FOREWORD**

The greatest pleasure I experience as a teacher, is to see my students excel in their chosen careers and perform even better than myself. The series of e-booklets prepared to better equip medical officers to handle common conditions likely to be encountered in their day to day forensic practice by Professor Dinesh Fernando, is a good example of one of my students doing better than me!

Dinesh is the son of Emeritus Professor of Community Medicine, Former Head, Department of Community Medicine, Former Dean, Faculty of Medicine and Vice Chancellor of the University of Peradeniya, Malcolm Fernando, who was an illustrious medical academic. Following his father's footsteps, he joined the University of Peradeniya in 2003.

Dinesh was one of my post graduate trainees at the Department of Forensic Medicine and Toxicology, Faculty of Medicine, Colombo, and obtained the doctorate in Forensic Medicine in 2003. He underwent post-doctoral training at the Victorian Institute of Forensic Medicine, Melbourne, Australia, with my colleague and contemporary at Guy's Hospital Medical School, University of London, Professor Stephen Cordner. During this period, he served as the honorary forensic pathologist of the Disaster Victim Identification team in Phuket, Thailand following the tsunami, and was awarded an operations medal by the Australian Federal Police.

He has edited, and contributed chapters to, 'Lecture Notes in Forensic Medicine' authored by the former Chief Judicial Medical Officer, Colombo, Dr. L.B.L. de Alwis and contributed to 'Notes on Forensic Medicine and Medical Law' by Dr. Hemamal Jayawardena. He is the editor of the Sri Lanka Journal of Forensic Medicine, Science and Law. Continuing his writing capabilities, he has compiled an important and unique set of e-booklets which will be a great asset to undergraduate and post-graduate students of Forensic Medicine, and also to our colleagues. Its succinct descriptions of complicated medico-legal issues and clear and educational photographs are excellent. It makes it easy for the students to assimilate the theoretical knowledge of each topic as they have been augmented with histories, examination findings, macroscopic and microscopic photographs of actual cases. In some areas, photographs from multiple cases have been included, so that the students can better appreciate the subtle differences that would be encountered in their practice.

I sincerely thank my ever so grateful student Dinesh, for giving me this great honour and privilege to write the foreword.

#### Professor Ravindra Fernando

MBBS, MD, FCCP, FCGP, DMJ (London), FRCP (London) FRCP (Glasgow), FRCP (Edinburgh), FRCPath. (UK)

Senior Professor of Forensic Medicine, General Sir John Kotelawala Defence University, Ratmalana. Emeritus Professor of Forensic Medicine and Toxicology, Faculty of Medicine, University of Colombo

## About the authors.....

Dr. Dinesh Fernando is a merit Professor in Forensic Medicine at the Faculty of Medicine, University of Peradeniya and honorary Judicial Medical Officer, Teaching Hospital Peradeniya. He obtained his MBBS in 1994 with Second class honours from the North Colombo Medical College, Sri Lanka, and was board certified as a specialist in Forensic Medicine in 2004. He obtained the postgraduate Diploma in Medical Jurisprudence in Pathology from London in 2005, and possesses a certificate of eligibility for specialist registration by the General Medical Council, UK. He underwent post-doctoral training at the Victorian Institute of Forensic Medicine, Melbourne, Australia. He has also worked at the Wellington hospital, New Zealand, as a locum Forensic Pathologist and as an Honorary Clinical Senior Lecturer at the Wellington School of Medicine and Health Sciences, University of Otago, New Zealand. He was invited to visit and share experiences by the Netherlands Forensic Institute in 2019.He was conferred a Fellowship by the College of Forensic Pathologists of Sri Lanka in 2021.

Dr. Sarangi Amarakoon, a temporary research assistant at the Department of Forensic Medicine, obtained her MBBS in 2023 with second class honours and Dr. Diniki Agalawatte, temporary lecturer at the Department of Forensic Medicine, obtained her MBBS in 2025 with second class honours from the Faculty of Medicine, University of Peradeniya.

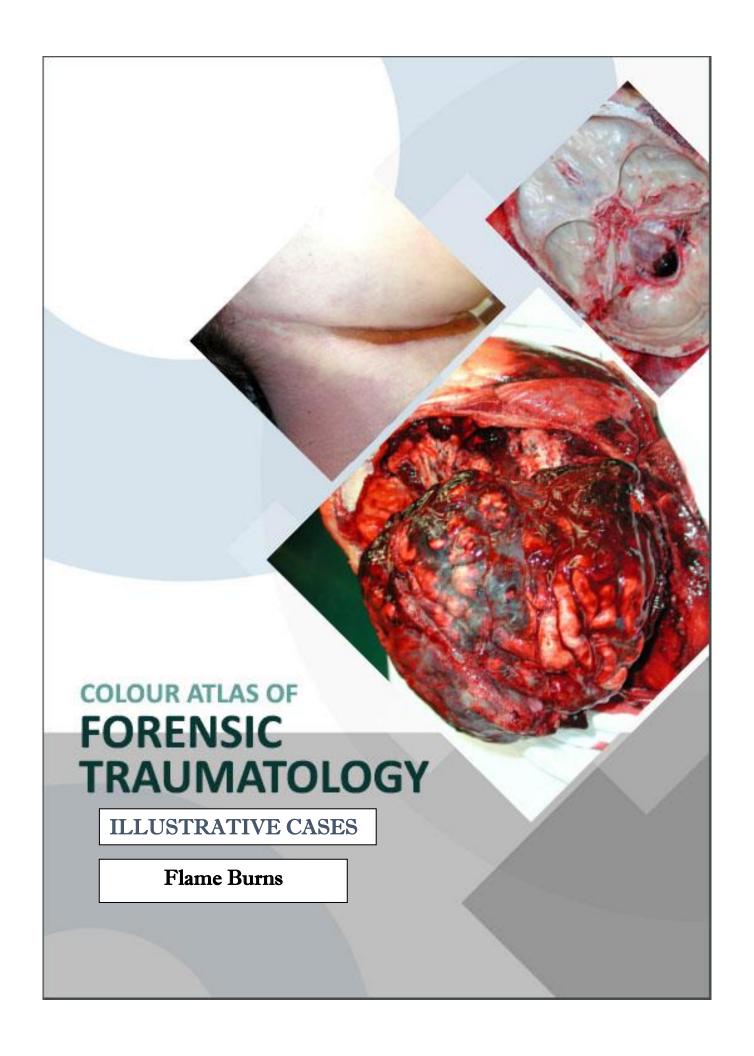
#### **PREFACE**

Forensic Medicine in Sri Lanka encompasses, both, examination of patients for medico-legal purposes and conducting autopsies in all unnatural deaths, in addition to those that the cause of death is not known. In the eyes of the justice system in Sri Lanka, all MBBS qualified medical officers are deemed to be competent to conduct, report and give evidence on medico-legal examinations of patients and autopsies conducted by them, as an expert witness. However, during their undergraduate training, they may not get the opportunity to assist, nor observe, a sufficient variety of representative of cases that may be encountered in the future.

Therefore, a series of e-booklets has been prepared to better equip medical officers to handle common conditions that are likely to be encountered in day to day forensic practice. The case histories, macro and micro images are from cases conducted by Prof. Dinesh Fernando. Ms. Chaya Wickramarathne did a yeomen service in the initial designing of lay out and formatting the booklet. The compilation of the case and photographs for publication was initiated by Dr. Sarangi Amarakoon and completed by Dr. Diniki Agalawatte.

The content herein may be used for academic purposes with due credit given.

Any clarifications, suggestions, comments or corrections are welcome.





# Flame Burns

Burns occur when energy from a physical or chemical source enters living tissues, disrupting their metabolic functions and frequently resulting in irreversible alterations that ultimately cause tissue death. Depending on the extent and size of the damaged area, burns can be divided into three categories: first, second, and third-degree.

Blisters and erythema are seen in first-degree burns. Burns of the second degree expose the dermis and burn the entire thickness of the epidermis. Third-degree burns destroy subcutaneous tissues, occasionally exposing muscle and bone and causing carbonization. The harm caused by a dry heat source is referred to as a "burn," while a moist heat source, such as hot water, steam, or other liquids, is referred to as a "scald."

Burns can be divided into several categories, based on the degree of tissue destruction. Burns that are extremely superficial, like sunburn, might only result in minor blistering and reddening. The injured cell layers peel off without leaving any scars after five to ten days. Superficial partial thickness burns produce fluid, which raises the dead epidermis to create blisters. The burn is painful is sensory nerves are affected. The burn heals in 10–14 days with minimal to no scarring. Deep partial thickness burns are less painful since nerve endings are destroyed, and scarring occurs. Full thickness burns destroy all skin elements and may necessitate extensive reconstruction surgery.

Burns can be categorized as ante-mortem and post-mortem burns. In ante-mortem burns, affected skin and underlying tissues show vitality and evidence of tissue inflammation, but post-mortem burns do not show a vital reaction and will appear charred or leathery. The presence of soot in the mouth, throat and airways indicate that the person was alive, while soot is not present in post-mortem burns. The location of the body when it is found may suggest that the victim was alive and able to move after the fire began; the victim may move into a cupboard, a corner, or the area farthest from the fire.

Differentiating heat haematoma from extra dural haematoma is crucial in forensic pathology. Heat haematoma forms between the dura mater and the inner table of the skull, and is caused by heat induced vessel rupture. It is usually soft, jelly like in consistency due to coagulation breakdown from heat. Colour varies from dark red to brown. On sectioning, this haematoma may display a characteristic honeycomb appearance due to the presence of air bubbles produced by the expansion of heated blood and soft tissue. Extra dural haematoma forms between the dura mater and the skull, and is almost always associated with a skull fracture. It is firm, well organized and adherent to the dura, typically bright red or dark red in colour. The HbCO concentration in a heat haematoma will be similar to that in blood. However, in a extra dural haemorrhage, if the person has been breathing during the fire, the blood HbCO will be higher, since the EDH was formed prior to inhalation of CO.

When a body is recovered from a fire, the pathological investigation should ascertain the deceased's identity, whether they were alive or dead during the fire and the cause of death.

#### History

A severely charred body was discovered in a house following a fire which destroyed the entire house. The occupant of the house had suffered a stroke one year previously, underwent a craniotomy and was confined to a wheelchair. She had a past medical history of bipolar affective disorder and paranoia and was on lithium. She was also a medium to heavy smoker and had a history of alcoholism.

#### **External Examination**

The body was in a pugilistic posture with flexion at elbow, hip, knee and toes. The skull was charred and on the left parietal area a healing craniotomy was present. The bone flap was held in place by three metal clips situated anteriorly, posteriorly and superiorly. The bone flap was oval in shape and measured 8 x 5 cm with its long axis in an anterior/posterior direction.

Severe charring was evident on the eyelids, eyes, nose, and most of the ears were missing. The lips were also charred, though their inner aspect was unharmed. Unburnt pinkish skin was seen on the right side of the chest, back, posterior right arm, upper right thigh, and top of the right foot.

#### **Internal Examination**

A dissection of the neck and face did not reveal any injuries to the neck structures or to the face. The larynx contained soot and mucus. The vocal cords were oedematous. The lumen of the trachea and bronchi contained soot mixed with mucus, up to the tertiary divisions. The pulmonary parenchyma manifested congestion and soot like material was seen in the cut sections of the smaller airways.

Anterior one-third of the tongue was blackened. Loops of small intestine which had protruded from the defect in the anterior abdominal wall were charred while the rest of the intestines were unremarkable. The lumen of the oesophagus contained soot like material mixed with mucus. The stomach was empty and contained soot like material mixed with mucus.

A heat haematoma which had a brown honeycomb appearance was present in the frontal region. It extended into the bilateral anterior cranial fossae. Heat lacerations and heat fractures were present. The skin and subcutaneous tissue overlying the skull was completely absent.

#### **Toxicology**

Blood taken at the time of autopsy was 60% saturated by carbon monoxide and the extradural heat haematoma was 75% saturated with carbon monoxide.





Figure 1: The scalp is absent from the forehead, sides and top of the head. Completely burned ears, eyelids, eyes and nose is seen. Teeth are present in lower jaw. Note the heat lacerations (yellow arrows).



Figure 2: Pugilistic posture of the body with flexion at elbow, hip, knee and toes. Note the wheel of the wheelchair adherent to the body.





Figure 3: A flap of scalp remains in the posterior aspect of the skull. No hair is evident on the remaining scalp which is free of injuries.



Figure 4: Note the charred skull. The craniotomy on the left parietal area showed fusion on the inner aspect.



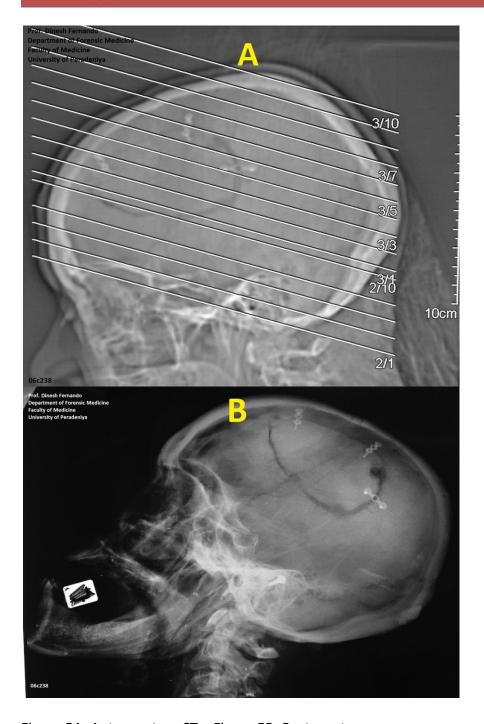


Figure 5A: Ante mortem CT ; Figure 5B: Post mortem x ray Radiographic evidence of craniotomy. Note the bone flap and fixation hardware in both images.



Figure 6: Remnants of breast tissue on the chest with more on the right. Note a 9 cm long and 3 cm wide irregular heat laceration on the anterior aspect of the right upper arm and a 4 cm long transversely placed heat laceration on the mid anterior right arm (red arrows). Note exposed, fractured, calcined bone (green arrow).





Figure 7: An unburnt area of skin on the right posterolateral aspect of the chest, back and posterior right arm. Note the pinkish colour of skin due to HbCO in blood.



Figure 8: A heat haematoma with a honeycomb appearance in the frontal region.





Figure 9: Soot and mucus inside the larynx and trachea.

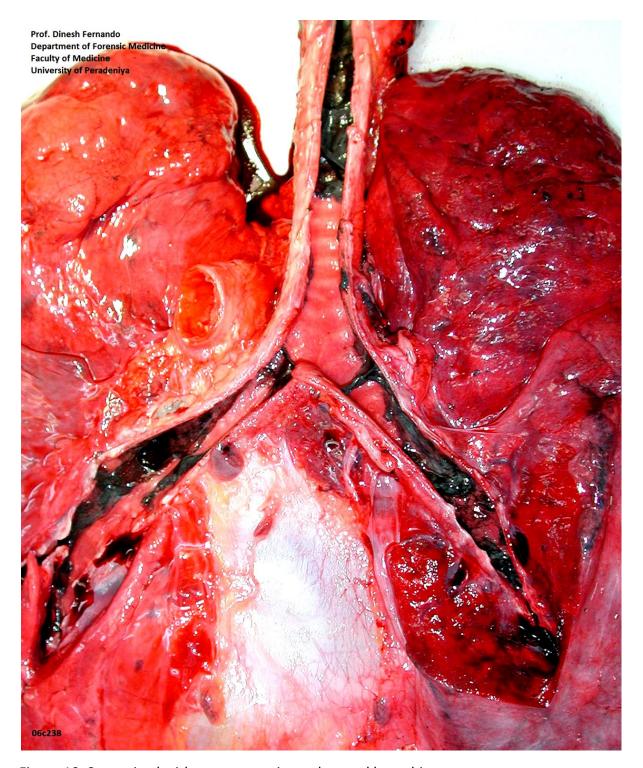


Figure 10: Soot mixed with mucus seen in trachea and bronchi.





Figure 11: Teeth often remain intact, serving as a vital tool in identification, even in a severely charred body when other tissues are destroyed.



Figure 12: Charred loops of small intestine.

# Cause of death

Effects of smoke inhalation, combined with carbon monoxide toxicity at 60% saturation.

# NO ST

# COLOUR ATLAS OF FORENSIC TRAUMATOLOGY

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