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Flame time of a cigarette lighter to achieve temperature capable of inflicting a burn

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ABSTRACT

Objective: Cigarette lighters are frequent vectors in intentional contact burns. Time and temperature needed to cause thermal injury are considered to differentiate accidental from inflicted burns. This study examines the minimum time needed to heat a cigarette lighter's top to temperatures capable of inflicting any clinically visible skin burn. This information could be useful in child abuse and other forensic cases.

Methods: A literature search was performed to establish the time and temperature at which partial/full thickness skin burns are acquired, regardless of vector. Using a thermocouple, the temperature of the top of two common lighters was measured at ten second intervals while sustaining maximal flame held both upright and sideways and during cooling once the flame was extinguished.

Results: In the literature, the lowest temperatures documented to cause burns in one second were 69 °C–70 °C for transepidermal or partial thickness burns. From an ambient temperature prior to flame ignition, it took over 50 s for the lighter tops to reach 60 °C when held upright. After 180 s, the lighters were shut off. It then took less than 60 s for the lighters to cool to less than 60 °C. The BIC lighter held to the side heated to 60 °C in about 15 s and needed over 100 s to cool to under 60 °C.

Conclusions: Cigarette lighter burns are often blamed on non-intentional occurrences. At least 50 s of sustained flame is needed to heat typical cigarette lighter tops to temperatures capable of inflicting clinically visible skin burns. This time is longer than the time required to light a cigarette. Therefore, for a cigarette lighter to inflict a contact burn injury, there needs to be intent and preparation, making accidental cigarette lighter burns unlikely.

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1. Introduction

Burn/fire injuries account for almost 2% of the nonfatal injuries among children 0–19 years of age (190 per 100,000 children) [1]. Burns account for up to 20% of all abuse cases [2]. Intentional burns and scalds are found in 10% of physically abused children and 5% of sexually abused children [3]. Fifty percent of children with abusive burns may experience recurrent abuse and 30% of children with recurrent abusive burns are eventually mortally injured. Intentionally inflicted burns tend to be more extensive and severe, and undergo longer hospitalizations and increased intensive care unit admissions. Furthermore, there is a 30% mortality rate from intentional burns compared to 2% from accidental burns [2]. Diagnosing intentional burns and differentiating them from accidental burn injuries may help identify children at risk of recurrent abuse and possible death from abuse.

Cigarette lighters are frequently used in non-accidental contact burns, leaving a characteristic burn pattern on the skin (Fig. 1). A history of an accidental mechanism is often given to explain abusive burns. To aid in differentiating accidental from inflicted burns, the time and temperature needed to cause thermal injury have been studied with water and irons. The current study examines the minimum amount of time necessary to heat the metal on a cigarette lighter to a temperature capable of inflicting any clinically visible skin burn within a contact time that could be consistent with an accidental mechanism.

2. Methods

A literature search was conducted to establish the time and temperature at which partial or full thickness skin burns are acquired, regardless of the vector used. The literature search was conducted using PubMed, and then by reviewing the reference sections on the initial papers from the PubMed search. Search terms included, but were not limited to, skin burns, temperature, non-accidental, child abuse, cigarette lighter burns, partial thickness burns, and full thickness burns. The studies reviewed included both scald burns and contact burns inflicted on both human and animal skin, as well as time and temperature parameters for burns from various computational models.

After a review of the existing literature was performed, a field test was conducted to evaluate the length of time to heat

Fig. 1 – Patterned burns consistent with head of a cigarette lighter.

Fig. 2 – a and b Green vintage lighter and blue BIC lighter.

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