

Falling Clothes Irons Rarely Cause Burns

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Children's Hospital of Michigan's Burn Center treats approximately three pediatric contact burns annually related to clothes irons, which involve the face, torso, and extremities. These burns leave well-demarcated burn patterns, including the steam holes from the heat plate of the iron. The average age of these children is 15 months. The history given by the parent is that the child pulled the cord of an iron that was on an ironing board or high shelf. It seemed unlikely to the investigators that a falling iron would produce such demarcated burns. A free-standing shelf unit was built with shelf heights of 36, 60, and 72 inches (the height of an ironing board and shelves at home). Three irons of different weights were put in three different positions on each shelf, with the cord dangling. A doll the approximate size of a 15-month old was positioned in front of the shelf. The dangling cord was pulled, and the falling iron was videotaped. The video was edited in freeze frame at the point at which the iron hit the doll. Two hundred seventy falls were recorded. The flat heat plate of the iron never hit the doll. The linear edge of the heat plate hit the doll on only seven falls. This study demonstrates that it is very unlikely for the flat heat plate of a falling iron to contact a toddler-sized doll. Children who allegedly sustain demarcated burns in this manner need to be investigated for nonaccidental injury. (*J Burn Care Res* 2014;35:525–527)

Our burn center treats 425 inpatients each year. Approximately 15 of these patients are treated for contact burns related to clothes irons. Most of these burns are palmar, clearly caused by the child attempting to hold or pick up the iron. However, about three of these patients each year have burns to their face, arms, chest, and/or abdomen that are clearly demarcated with obvious spared, circular areas from the steam holes of the iron.

The history is always that the iron was either on the ironing board, put away on a high piece of furniture, or on a high shelf; the child pulled on the cord that was inadvertently left dangling, and the falling iron created the burns. It seemed inconsistent to the study authors that a falling iron would leave clearly demarcated burns with intact areas from the steam holes—a smeared or irregular burn pattern would seem more logical. Some preliminary testing was done with a doll, which demonstrated that the heat plate of a falling iron did not

even touch the doll. These two factors together raised the thought that such histories are likely to be false.

This study was undertaken to examine whether the heat plate of a falling iron ever touches a child; if not, then certainly the falling iron could not produce any burns to a child. An inconsistent parental history for a child's injury is very suspicious for the injury's being nonaccidental.

METHODS

The average age of a child who sustained these suspiciously demarcated burns was 15 months. Per the standard growth chart, an average 15-month old is 31 ½ inches in height and 23 lb in weight. The weight of a 24-month old (the closest age we found) is typically distributed in the following percentages: 20% of total weight is in the head and neck, with 60% in the arms and trunk, and 20% in the legs.¹ Per the standard growth chart, the head circumference of an average 15-month old is 18 ¼ inches.

For this study a doll was selected with dimensions that were very close to actual. The height was 30 inches, and the doll was placed on a 1½-inch tall book or stack of paper, resulting in a height of 31½ inches. The weight was 19 lb 9 oz (produced by putting cement in the doll), with 5 lb in the head and

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neck, and approximately 2 lb in the arms, 10 lb in the trunk, and 2 lb 9 oz in the legs (the trunk of the doll was not large enough to hold enough cement to make it the proper weight). The head circumference was 16 7/8 inches.

A free-standing shelving unit, with shelf heights of 36, 60, and 72 inches, was built. A standard ironing board is 36 inches, and 60 and 72 inches are common approximate heights of shelves in a linen closet (where parents often report placing their hot iron).

Three irons were purchased: an inexpensive lightweight iron weighing 1 lb 7 oz (0.64 kg) including duct tape to hold it together as it cracked during use, a moderate weight and priced iron weighing 2 lb 2 oz (0.96 kg) including duct tape, and a heavy and more expensive iron weighing 3 lb 2 oz (1.41 kg) including duct tape. Each iron was placed on each shelf in three positions: with the heat plate facing the back of the shelf, to the right side of the shelf, and to the left side of the shelf.

The doll was placed in a standing position in front of the shelving unit, with standard baby crib mattresses butted up against the doll's feet/ankles in front and back. The mattresses reduced damage to the irons as they fell.

The principal investigator sat behind the shelving unit, pulling the dangling cord of the iron out toward the doll, either with his arm or with the aid of a stick taped to the cord. The iron was allowed to free-fall and hit the doll.

The distance the doll was placed from the shelving unit had to be carefully calculated. When the doll was right in front of the shelving unit, with the iron on the 36-inch-high shelf, all three irons hit the top to back of the doll's head. When the doll was right in front of the shelving unit and the iron was on the 60- and 72-inch-high shelves, the iron went flying well past the doll. After many attempts it was discovered that for the iron to hit the face/chest/abdomen of the doll it had to be at the following approximate distances from the shelving units:

36-inch shelf lightest iron	14 inches	medium iron	18 1/2 inches	heavy iron	20 1/2 inches
60-inch shelf lightest iron	34 inches	medium iron	33 inches	heavy iron	30 inches
72-inch shelf lightest iron	32 inches	medium iron	31 inches	heavy iron	30 inches

These distances again provided doubt about the parental histories of the child pulling the cord and being burned by a falling iron. When an iron is placed on a shelf, the dangling cord falls down right in front of the shelf. The child would need to walk up to the dangling cord, hold onto it, and then step back the appropriate distance so that when the cord was pulled, the child would get hit in the face, chest, or abdomen by the iron. This seems unlikely.

Two video cameras were arranged, by an experienced video technician, on either side of the shelving unit to capture the fall of the iron from the shelf, the iron hitting the doll, and then the iron falling onto the mattresses. Ten falls per iron (times 3 irons) per position (times 3 positions) per shelf (times 3 shelves) were videotaped, with a total of 270 videotaped falls.

This videotape was edited to show the falling iron in slow motion, with the video freeze framed at the point the iron first touched the doll, continuing in slow motion as the iron fell away from the doll.

RESULTS

Of the 270 videotaped falls, the flat heat plate of the iron never touched the doll. On seven falls (2.5%), the outer edge of the heat plate touched the doll's forehead (twice), face (twice), chest, right shoulder, and right arm. Six of these falls were from the 36-inch height (five with the lightweight iron and one with the heavyweight iron), whereas the last one was at the 72-inch height with the lightweight iron.

An additional significant finding was the amount of damage done to the irons.

All three irons had some plastic parts crack and fly off. The heaviest iron had a significant indentation to the metal base from hitting the doll's head. Neither our emergency department physicians nor neurosurgeons could recall ever caring for a child with blunt force trauma from a falling clothes iron.

It is also significant to note the distance the doll had to be away from the iron in order to even get hit by it. It is unlikely that a toddler would grasp the dangling cord and walk back the proper distance to then be able to get hit by the falling iron.

DISCUSSION

In his chapter on the evaluation of physical abuse, Feldman wrote that unintentional injuries leave blurred, not sharp, outlines.² This study provides support that toddlers are not even burned in any manner by a falling clothes iron.

One limitation of this study is that the principal investigator was pulling the iron cord, not the toddler. Also, the iron might have hit and traveled against the skin of a toddler differently than the plastic coating over cement of the doll used in this study.

This study has demonstrated that it is very unlikely that the flat heat plate of a falling clothes iron would strike a toddler-sized doll. When parents provide such an inconsistent history to explain their child's burn, there must be a strong suspicion that the child's burn injury was nonaccidental. A referral to Protective Services should be made, along with a thorough examination of the child's entire body. Professional medical photographs of the child's burn and any other skin lesions should be obtained. For children under the age of 36 months a skeletal survey should be performed to seek any occult fractures.

Protective Services staff need to be educated about the findings of this study to help them understand

why the history of a falling iron is extremely unlikely to have caused such burns. It is also important for any other children in the home to have a thorough physical examination to rule out abuse.

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