

Electric Fire Burn

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Electric fires are of three types: silica-sheathed, fireclay-mounted, and exposed rod. Children who grasp the heating element of electric fires of the exposed-rod type sustain severe burns of the hand. Wynn Williams (1955) reviewed 100 cases of children with burnt hands and noted that 36% were due to electric fires. Muir (1958) described and illustrated the electric bar fire burn of the hand, separating it from electric current burns and defining it as a thermal injury. Clarkson and Pelly (1962) also described it as a severe and specific injury of the hand in children. Evans (1962) recorded the impression that the injury was happening more often. This paper reviews the incidence and results of this burn and discusses prevention.

Incidence

From 8 February 1953 until 31 December 1966 the Children's Burns Unit at Guy's Hospital admitted 735 children for burns of all kinds. Of these, 19 were admitted with an electric bar fire burn of the hand. Since 1962 four additional children have been treated for flexion contracture due to the same cause after the burn had healed elsewhere.

The annual incidence of fresh burns is given in Table I; there appear to have been slightly more cases in recent years. The burns occur chiefly in winter, as do other burns (Clarkson, 1965); but children have been admitted in every month of the year.

TABLE I.—Electric Fire Burn of Hand. Admissions to Children's Burns Unit: Annual Incidence

	1953	54	55	56	57	58	59	60	61	62	63	64	65	66
No.	0	3	0	0	1	2	2	0	1	1	2	3	2	2

According to Clarkson (1965) 60% of the children were admitted for burns of all types from addresses in S.E. London and 20% from S.W. London postal districts. Twelve out of 19 children with an electric bar fire burn were admitted from S.E. or S.W. London.

The age and sex incidence of this injury is shown in Table II. A few more boys than girls are seen to be involved, but the predominance of male toddlers is noted. All these 19 children who were admitted up to 31 December 1966 were white; no immigrants have been admitted with this burn.

TABLE II.—Electric Fire Burn of Hand. Age and Sex Incidence

Sex	Age in Years											Total	
	0-1	1	2	3	4	5	6	7	8	9	10		11
M	0	2	8	0	0	0	0	0	1	0	0	0	11
F	0	1	1	1	1	1	1	0	0	1	0	1	8

Mode of Accident

The hospital notes are not always complete and the description of injury is not always full. However, it has been possible

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to trace some more recent patients, and their mothers have answered a questionnaire. From their answers and the case notes the following facts emerge.

(1) The accident may happen very quickly, even if adults are present in the room. Usually children are in the room alone or with other children.

(2) A small child can easily slip his hand through the guard or over or under it. The British Standard Specification (British Standard 1945) is not designed to prevent this happening, and a note of this is made in the text. The guard is designed to prevent severe clothing burns, and indeed the incidence of clothing burns in Birmingham has fallen since its adoption (Bull, Jackson, and Walton, 1964).

(3) A severe burn may be sustained even if the fire is grasped after being switched off or while the fire is warming up. When the fire first glows dull red the surface temperature of the nickel-chrome wire element is 550° C. At normal working temperatures the element glows a bright orange-yellow, and then the surface temperature is 800-850° C. (Belling, 1966).

(4) After grasping the element a small child may easily sustain a burn of the whole of the volar surface of one or both hands (Fig. 1). Only one infant had all the finger-tips of one hand burnt. If there are two or more elements in one fire then a child may burn the dorsum of the finger or hand on the second element (Fig. 2).

(5) It may be difficult to release a child who has grasped the fire. The burnt flesh of the hand may stick to the element. The closed hand may be trapped between the bars of the guard. An electrical effect causing muscle spasm may make it more difficult to release the child.

Treatment

None of the children admitted to the Guy's Children's Burns Unit after an electric fire burn have died, and burns have been confined to the part of the hand in contact with the heating element. The results are given in Table III and compared with the results of other burns. Though it is not the purpose of this paper to deal with treatment the results cannot be assessed without reference to it.

TABLE III.—Results in 116 Children with Burns of the Hand

Type	No. of Cases	No. whose Hand Grafted	Amputation	Late Surgery
Electric-fire burn ..	19	17	2	7
Electric-current burn:				
Low-voltage:				
Flash	5	0	0	0
Contact	10	8	0	0
High-voltage:				
T.V. set	2	2	1 finger	0
Conductor rail ..	2	2	2 major upper limb	0
Non-electric causes ..	78	9	1 finger	0

The following local measures are employed in electric fire burns after sedation (Gunn, 1967).

Toilet.—The whole upper limb is thoroughly cleaned with Savlon.

Extension Splintage.—In previous papers Wynn Williams (1955) and Clarkson and Pelly (1962) have stressed the importance of

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extension splintage. There are many advantages in treating superficial burns of the hand by exposure. Potentially deep burns of the palm or the volar surface of the fingers in children should be treated by extension splintage in order to prevent flexion contracture of the fingers. Flexion contracture can be prevented by splintage, but may develop within days without splintage. An established contracture may require prolonged treatment. In these children joint stiffness has not been seen even after prolonged extension splintage of the wrist and fingers.

Skin-grafting.—Deep burns require skin-grafting. In practice, burns which are unhealed after 14 days are regarded as deep. It is an advantage to delay grafting until the third week after burning for the following reasons. The diagnosis of depth is easier and unnecessary excision is avoided. The slough is more readily separated and haemorrhage is less, so that excision and grafting can be completed in one operation. Where the graft bed persistently bleeds grafting may be delayed for two to five days while the hand is dressed with polyurethane foam sponge. Discharges are readily absorbed and a clean granulating surface is left, which is ideal for grafting. As a rule thick split-skin grafts cut from the thigh give a reliable take and satisfactory permanent cover. If tendons, bones, or joints are exposed then flap cover is indicated.

In only two patients were the burns superficial, and these did not undergo skin-grafting. The remaining 17 required skin-grafting to heal. Of these 17, six developed flexion contractures of the fingers (Fig. 3) or adduction contracture of the thumb (Fig. 4) and required further surgical treatment. One patient underwent primary amputation of the ring finger (Fig. 5); another not only required primary amputation of the little finger but also developed a flexion contracture later.

On average these children were in hospital for 34.7 days. This figure does not take into account the fact that not all children were admitted on the day of burning. Nor does it allow for the fact that a few children had their hospital stay interrupted for some reason or other. The five-week average stay suggested that the time required for primary healing is likely to be five or six weeks. This agrees with the 6.5 weeks' hospitalization given by Wynn Williams (1955) for deep burns treated surgically.

Treatment of established contractures is apt to be protracted. Several operations may be required to correct all deformities

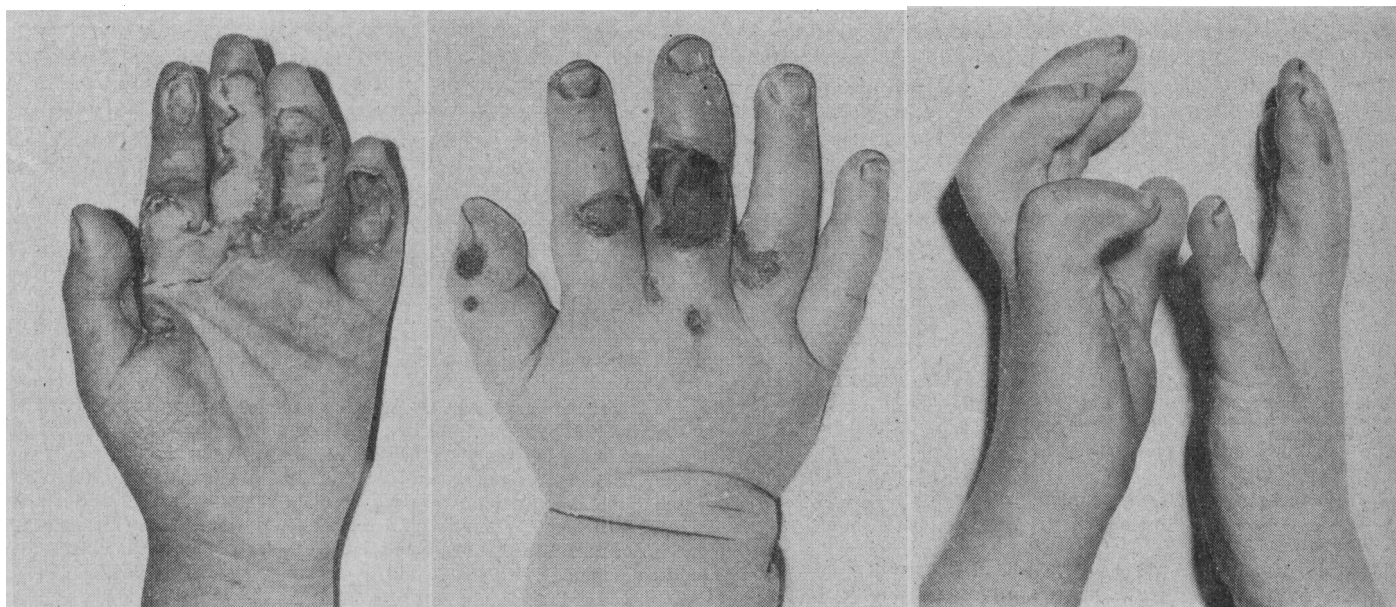


FIG. 1

FIG. 2

FIG. 3

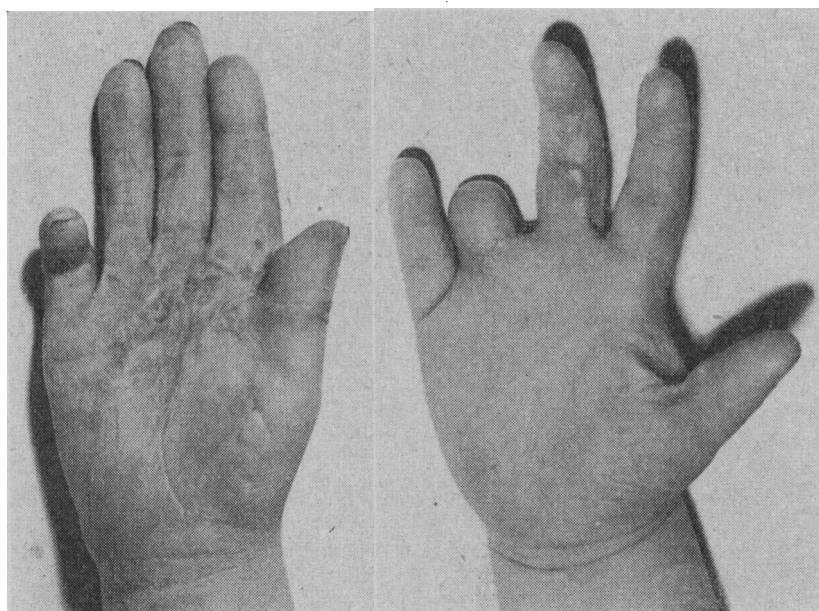


FIG. 4

FIG. 5

FIG. 1.—Recent burn of the fingers. Lesions may be more extensive than this.

FIG. 2.—Dorsum of the middle finger shows a full-thickness burn requiring flap cover.

FIG. 3.—Severe flexion contractures of right little and ring fingers after healing; left ring finger and right middle finger are affected to a lesser degree.

FIG. 4.—This burn healed with adduction contracture of the thumb and severe flexion contracture of the little finger.

FIG. 5.—The right ring finger was so badly damaged that amputation was unavoidable.

when many fingers are scarred. Recurrence after correction is also a serious problem.

Results

The results show that the electric fire burn is potentially very serious because the element is very hot and a large area is burnt in a small hand. Comparison with other types of burn will also show that this is the most important burn of the hand in children. Most electric current contact burns of children occur at the normal domestic voltages and produce small burns which usually heal without complications after grafting. Low-voltage flash burns have all been superficial. High-voltage burns may be disastrous, but they seldom occur. Patients with a wide variety of non-electric burns have been admitted; the majority of them had extensive or potentially deep burns elsewhere and only a small number required skin-grafting to the hand.

It is therefore made clear that if a child grasps the heating element of an electric fire of the exposed rod type he will sustain a severe and potentially crippling injury. The incidence throughout the country remains uncertain. It may be that more or fewer cases than average are admitted to the Children's Burns Unit at Guy's Hospital. But it has been estimated that the Guy's Children's Burns Unit serves a population of 2,500,000 (Clarkson, 1965), and in recent years two to three new cases of electric fire burns have been admitted annually. The Guy's figures may not be representative; but if they are then 40 to 60 new cases may occur each year.

There are good reasons for believing that the risk is increasing. Figures supplied by the Electricity Council show that

TABLE IV.—Electricity Statistics—England and Wales

	1954-5	1965-6
Domestic consumption (million kWh) ..	17,017	50,829
Ownership of domestic consumers of electric space heater:		
% consumer owning	60.5	79.7
No. of consumers	7,275,000	12,156,000
Loading (MW)	17,000	41,875
Use of electricity space heating (million kWh)	4,000	12,500

domestic consumption has increased. Estimates show that more people own electric space heaters and that more electricity is used by these heaters (Table IV).

Prevention

For the above reasons it is desirable to review measures which might prevent these accidents. (1) Doctors should know about these accidents and how serious they may be. In turn, they could warn the public and ensure that the victims got prompt and adequate treatment. (2) If these accidents were

all notified the necessity for further prophylactic measures could be assessed. (3) The safety of electric space heaters and the design of their guards might be reviewed. It would be relatively easy to set a new British Standard for fireguards. It does not seem likely that cost would be prohibitive, but a new guard might greatly reduce the effectiveness of the space heater. (4) It is desirable for all electric space heaters to be in a clear space and protected by a guard, just as open fires and paraffin stoves should be. (5) If a suitable guard cannot be designed for electric space heaters of the exposed rod type, then it might be better to abandon them in favour of fireclay-mounted or silica-sheathed electric space heaters. Silica-sheathed electric space heaters are regarded as safest by the Consumers' Association (*Which?*, 1965).

Summary

The elements of electric fires of the exposed rod type are sometimes grasped by young children. The child sustains a thermal injury of the palm of the hand which is almost always deep and is potentially crippling: 89% require grafting, 10% lose a finger, and 37% need surgery for late complications. Late complications may require protracted treatment.

The electric fire burn is the most important burn of the hand in children. It is estimated that 40 to 60 may occur in Great Britain annually. As the use of electric fires increases so may the risk of this accident.

To reduce the incidence the following measures are suggested: the risk must be publicized; cases should be made notifiable; the design of the guards on these fires should be reviewed; electric fires must be enclosed by a guard; and electric fires of the exposed rod type may have to be discarded in favour of safer models.

I wish to thank Mr. P. W. Clarkson for kindly allowing me to study his patients, and for his constant encouragement in the preparation of this paper. The Electricity Council kindly supplied me with figures relating to the domestic consumption of electricity and the domestic use of electric space heaters, and allowed me to publish them. I am grateful to Mr. J. Rytina, of the Department of Medical Illustration, Guy's Hospital, for photographs illustrating this paper.

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