

## Oral electrical burns in children—early treatment and appliance fabrication

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### Abstract

*A case report of an electrical burn of the lips in a 22-month-old child is presented. The principles of early medical and dental treatment and the sequence of appliance fabrication are detailed. The appliance fabrication utilized in this case is unique because it is an intraoral treatment approach to a commissural burn in a child that had not yet erupted primary second molars.*

Electrical burns of the commissures of the mouth often result in severe facial scarring and deformation. This scarring and deformation is caused by adhesion of the lips, constriction of the commissure of the mouth and a generalized contracture of the wound during healing. The vast majority of these burns are due to the child sucking on the female end of a live extension cord or at the junction of an extension cord and a partially plugged in appliance.<sup>1-3</sup> Saliva acts as the contact medium through which the electric current flows, resulting in the oral electrical burn. Most electrical burns will occur in children under three years of age and they rarely are seen after the age of four years.<sup>3-5</sup>

The incidence rate of oral electrical burns has seldom been documented in the literature. Based on a report by the U.S. Consumer Product Safety Commission, Crikelair and Dhaliwal have reported a yearly incident rate of more than 4,000 extension and appliance cord injuries serious enough for emergency treatment.<sup>2</sup> In comparison with flame and scald burns, electrical burns are infrequent.<sup>5</sup> Muir<sup>6</sup> reported that Mount Vernon Center, which receives all of the severe burns from a population of five million, receives only two or three electrical burns per year. Thomson et al.<sup>7</sup> reported oral electrical burns to 43 children admitted to the Hospital for Sick Children in Toronto between the years 1945 and 1963. A total of 2,491 patients were admitted to the hospital for thermal burns during the same period. Oral electrical burns represented less than 2% of the total burn admissions.

The purpose of this paper is to present a detailed intraoral approach for treatment of a lip commissure burn to a 22-month-old child whose primary second molars had not yet erupted. Previous reports<sup>8-10</sup> have described the use of intraoral appliances utilizing stainless steel bands, Adam's clasps, ball clasps, or a Hawley retainer® for retention of the intraoral appliance. Most reports have been documented on patients with a full complement of primary teeth. Larson<sup>10</sup> reported the successful use of an intraoral acrylic splint appliance in a one-year-old patient. The appliance utilized was similar to that described in this paper, but few details on appliance fabrication are given in Larson's report. Richardson and Kittle<sup>11</sup> recently have reported on the problems associated with retaining intraoral appliances in the young burn patient with incomplete primary dentition. They reported the use of an extraoral facemask type of appliance in managing a lip commissure burn in a 28-month-old patient who did not have primary second molars. The technic they describe requires a general anesthetic with nasoendotracheal intubation to obtain a full facial alginate mouldage prior to construction of the extraoral appliance.

The technic described in this paper does not require that a general anesthetic be administered, only that maxillary and mandibular alginate impressions be obtained in the dental office prior to appliance construction.

Facial photographs made over a one-year period to demonstrate the progression of the burned commissure are provided. This paper reviews briefly the medical treatment and wound healing sequence associated with oral electrical burns.

### Immediate Treatment

Most commissural electrical burns involve mucosa, submucosa, muscle, nerve, and vascular tissue. The child should be examined for other points of electrical current entrance or exit. If the offending wire or appliance was in the oral cavity, burns of the tongue, palate, and alveolar ridges may be found.<sup>12</sup> A thorough and complete examination is absolutely necessary to determine the extent of the damage.

Bleeding is not a common finding because of cauterization of the blood vessels. Occasionally damage to the labial or lingual artery will cause massive bleeding.<sup>3, 7, 12</sup> This usually occurs three to four days after the burn when spontaneous loosening and sloughing of nonvital tissue begins. Pressure should be applied to the hemorrhage site to stop the bleeding and the patient should be taken to the nearest hospital emergency room for definitive care. This complication has prompted Gifford et al. to recommend hospitalization until the eschar sloughs.<sup>4</sup>

Antibiotic ointments have been recommended by some authors for application to the burn area.<sup>1</sup> Bacitracin is an acceptable topical agent because it is effective against many strains of streptococci and staphylococci and it has a low sensitizing tendency. Unlike bacitracin, topical application of penicillin in the mouth has produced a variety of unfavorable local reactions and its use for the local treatment of electric burns is contraindicated.<sup>13</sup> Systemic antibiotics are recommended by most clinicians to prevent wound infection.<sup>1, 5, 7, 14</sup>

The duration of antibiotic coverage depends on the severity of the wound. Pitts et al.<sup>5</sup> recommend antibiotic coverage until necrotic tissues slough and edema subsides. This is typically between 14 and 28 days.<sup>5</sup> Because postburn infections often are caused by penicillin-resistant organisms such as staphylococci and nonhemolytic streptococci, a penicillinase resistant semisynthetic penicillin is the antibiotic of choice. Methicillin, oxacillin, nafcillin, cloxacillin, dicloxacillin are examples. If subsequent wound infection occurs, culture and sensitivity tests should be performed and the appropriate antibiotic administered.<sup>13, 15</sup>

Tetanus immunization should be performed for children not previously immunized, or who have not had a booster within the last five years.<sup>12, 14</sup>

Pain is not a serious complication. Most individuals experience little or no pain after the initial burn.<sup>3, 7, 12, 14</sup> Acetaminophen may be used to ease discomfort if necessary.

Parents are usually upset and tend to blame themselves for the accident. Before and after treatment photographs of other similar cases and reassurance by the doctor help to ease tension and promote cooperation.

## Wound Healing Sequence

The healing process of most oral electrical burns involves three phases.

1. The wound will appear charred and coagulated for the initial 10 days with prominent swelling for seven to 10 days.<sup>3, 8</sup> Drooling often is present due to a lack of muscle and nerve function.

2. Sloughing usually begins with initial loosening of nonvital tissue at three to four days and becomes noticeable in 10–14 days. It generally is complete by two to three weeks.<sup>3, 8</sup>

3. The process of wound healing usually is completed

four to six weeks after the electrical burn. In the absence of an oral splint appliance, lip adhesions, scarring, and severe contraction of the commissure usually can be expected. Healing without a splint often will result in facial disfigurement. The resulting microstomia will limit the extent of oral opening, hinder oral hygiene efforts, and compromise the ability to eat and speak normally. Many of these children have required multiple plastic surgical revisions to correct microstomia.

## Appliance Treatment

Both removable and fixed appliances have been described,<sup>3, 8–10, 16</sup> and have the advantages and disadvantages of any fixed or removable appliance. Both types are similar in that they have posts which pass through and maintain the commissure of the lips during and after the healing process. Post position is critical to the success of these appliances.<sup>8</sup> The removable appliance has an additional advantage in that a wax-up and fitting of the posts is accomplished easily prior to final insertion of the appliance. The objective of appliance therapy is to prevent or minimize lip adhesions and contracture during healing and to minimize contracture following healing.

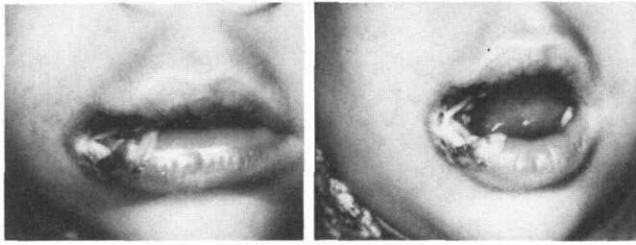
Lip contracture may occur for many months after the wound healing process is complete and often is evidenced soon after the appliance is left out of the mouth. For this reason, when possible, the appliance should be worn 24 hours a day for the first six months and then eight to 12 hours per day, usually at night, for the next six months.<sup>3, 8, 10, 11</sup> Child and parent cooperation are critical factors in the success.<sup>3</sup>

## Case Report

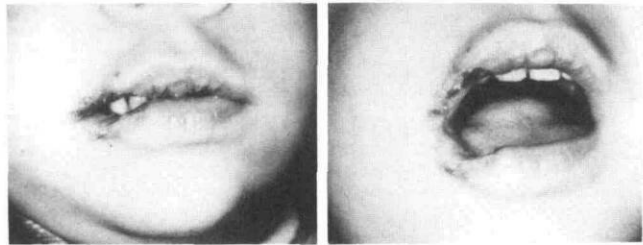
A 22-month-old white male was referred to the Department of Pedodontics, Medical College of Georgia one day after an electrical burn to the oral cavity. The child had been seen initially in the emergency room at University Hospital. The child was well nourished, well developed and in no acute distress when he came to the dental clinic. Both parents were present at the initial visit and a history of the accident revealed the child had been sucking on an electrical junction at the time of the injury. The child's past medical and dental history was noncontributory.

The clinical examination revealed edema and swelling of the right commissure area of the face (Figure 1). Other areas of electrical current entrance or exit were not found. The teeth were not damaged and were in normal occlusion. The primary second molars had not yet erupted.

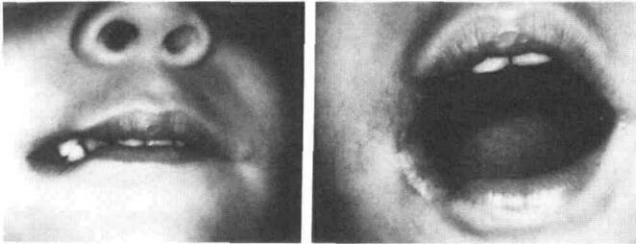
Pain and bleeding at the injury site were not elicited or observed, probably due to cauterization of the blood vessels and nerves. The child had been given an IM injection of a semisynthetic penicillinase-resistant penicillin (nafcillin 25 mg/kg) at the emergency room, and



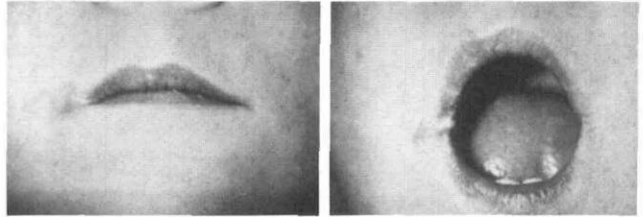
**Figure 1.** Facial photographs one day after an oral electrical burn to a 22-month-old child.



**Figure 2.** Facial photographs two weeks after electrical burn.



**Figure 3.** Facial photographs one month after electrical burn.



**Figure 4.** Facial photographs one year after electrical burn.

was placed on nafcillin elixir, 5 ml (one teaspoon) every six hours for 14 days (250 mg/5 ml). Tetanus immunizations were up-to-date.

The parents were reassured that a satisfactory result could be achieved with their help and cooperation. The wound-healing process was explained to both parents and the importance of closely monitoring their child for the next few days for bleeding complications of the lingual or labial artery was stressed. Before and after photographs of similar cases were shown to the parents to help promote reassurance and cooperation.

Alginate impressions were made at the initial visit. Vertical and lateral measurements of the unaffected commissure relative to the teeth and midline were made.<sup>8</sup> The patient returned to the clinic the next day to try the appliance. The acrylic resin base was adjusted for uniform occlusal contacts and the wax posts were adjusted for the desired position and tension at the commissures. The appliance was delivered the next day after conversion of the wax posts to acrylic. The importance of wearing the appliance 24 hours a day was stressed to the parents. Maintenance of the child's teeth and soft tissues and care of the appliance were reviewed. Fluoride drops<sup>9</sup> were prescribed with daily use of two to three drops to decrease caries susceptibility. The appliance had positive retention and at the one-week recall visit the parents reported that the child wore the appliance constantly and had no discomfort. However, drooling from the right commissure area was reported to have occurred with regularity. They reported no other complications.

The child was then seen two weeks postburn (Figure 2) and subsequently at one month postburn (Figure 3) at which time the parents reported no problem with the child's acceptance of the appliance. He had been wearing the appliance constantly except during meals and tooth-

brushing. From this point on, the child was seen and evaluated monthly. The only problem reported by the parents was occasional chapping of the right commissure area, which was treated with petroleum jelly. At the six-month recall the parents reported that the child was tired of the appliance and that occasionally during the sixth month, a day or two would pass when the child refused to keep the appliance in his mouth. At this time it was decided to have the child wear the appliance only at night. The eruption of the second primary molars required relief of the acrylic which was performed at this time and at each subsequent monthly recall. At the 12-month recall (Figure 4), appliance therapy was discontinued and no further treatment was deemed necessary. The child was referred for plastic surgery consultation and yearly follow-up. No corrective surgery is planned.

### Appliance Fabrication and Maintenance

The following is a step-by-step description of the appliance fabrication and maintenance used and recommended for similar cases.

1. Maxillary and mandibular alginate impressions should be made as soon as possible after the burn (two to four days). Anesthesia is usually unnecessary due to the relative absence of pain during this period. An accurate impression with full vestibular extension should be obtained for the maxillary arch.

2. After pouring the maxillary and mandibular models an acrylic base is made on the maxillary model using an autopolymerizing acrylic resin. No blockout or relief of tooth or tissue undercuts is done unless they are severe. Acrylic resin should extend into the vestibular areas to aid in appliance retention and stability. The palate and maxillary tubercle areas also are covered. Clear orthodontic acrylic resin is desirable in order to see erupted and newly erupting teeth.

<sup>9</sup> Thera-Flur, .5% F, Hoyt Laboratories, Norwood, MA.

3. A small amount of sticky wax is applied to the labial flange of the base adjacent to the labial surface of the primary canines. Red utility or pink baseplate wax then is added to the acrylic base to form the posts or wings. Prior clinical measurements of the unaffected commissure relative to the midline will aid in proper location of the posts.

4. The appliance is tried in the mouth. Relief of the internal surface of the acrylic base is performed only where necessary in order to obtain a snap-type retention. The occlusal portion of the splint should be adjusted to assure uniform bilateral occlusal contacts. The wax posts now are adjusted to obtain the desired position, curvature, and tension at the lip commissures. Since electrical burns usually involve only one commissure, the nonburn side can be used to establish the ideal position of the posts. Once this position is established, the wax post on the burned side is adjusted posteriorly 1-2 mm to compensate for the expected contracture during the later healing phase.

5. The maxillary model is placed on a flat surface. The wax-up and the exposed gypsum surfaces of the casts are lubricated with separating medium. A labial stone<sup>b</sup> matrix is formed after carefully brushing some stone around the wax posts. When the stone of the matrix is fully set, all the wax is removed and the mold is flushed with boiling or very hot water. The acrylic resin surface is roughened in the area of the posts to increase the bond strength. A tinfoil substitute is applied to all exposed gypsum surfaces of the mold and cast. A heavy elastic band is applied around the cast and the matrix. A clear acrylic resin is sprinkled and flowed to assure a well rounded post contour. The assemblage is placed into a pressure pot with warm water under 30 psi for 20 minutes to complete the cure.

6. Ideally, the completed appliance should be inserted into the mouth as soon as possible or within one week after the initial burn (Figure 5). Recheck for uniform occlusal contact of all teeth. The appliance should be highly polished and retentive. If retention appears inadequate, the use of a small amount of denture adhesive in the palate can aid retention, but will compromise oral hygiene. The commissure posts should be shaped with a gentle, rounded curvature passing around the commissures. The posts also should be smooth and highly polished. Observe the shape of the lip commissure as healing progresses (Figure 3). If the corner of the mouth is too large after some epithelization has occurred, thin the post superiorly-inferiorly to allow a more normal shape to occur during healing.

Since the appliance will be used over a period of about one year, proper cleaning of the teeth and appliance should be demonstrated to the child and parents. Fluoride gel placed in the appliance daily should decrease caries susceptibility. Plan for the future eruption of

<sup>b</sup> Mounting Stone, Whip-Mix Corporation, Louisville, KY.

primary teeth by making the acrylic resin coverage thicker over the areas of expected eruption. As eruption occurs, reduce the internal surface of the appliance over the teeth to extend the useful life of the prosthesis.

## Discussion

The 12-month photographs (Figure 4), reveal that the right commissure appears somewhat constricted when compared to the left. However, when comparing Figure 4 to Figure 1, treatment looks successful. Indeed, this case was successful and a great deal of credit for the success must be given to patient and parent for their cooperation. If patient cooperation had been minimal, a fixed appliance, removable appliance ligated to several of the erupted teeth, or an extraoral appliance as described by Richardson and Kittle<sup>11</sup> might be used. If parental cooperation had been minimal, one could likely predict an unfavorable result. Although the esthetic result of the case was not perfect, it was successful since the child may avoid extensive reconstructive surgery. With no appliance therapy this child would be disfigured and be subject to multiple extensive surgical procedures to improve the disfigurement.

The appliance therapy used in this case was acceptable to the child in spite of his young age and the fact that he had no primary second molars. The dentist also should anticipate a decline in patient and parental interest over time. Motivation was aided by placing the patient on a regular monthly recall schedule. Photographs or slides made at the time of the burn and at follow-up visits were helpful in motivating and reinforcing continued parental cooperation. The parents were unaware of the extent of the initial burn and the marked gains made in maintaining the commissure until they viewed photographs a few months later. The emphasis on prevention of caries with hygiene and fluoride therapy aids followup. This emphasis serves to educate the parent and to prepare the very young patient for future dental treatment.

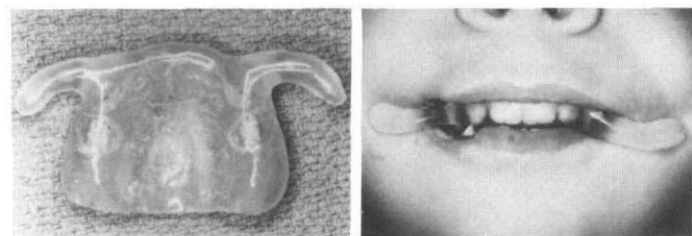


Figure 5. Completed appliance and delivery.

There are several advantages of the removal appliance described in this report.

1. The ease of fabrication and conventional laboratory technic enables the dentist to insert the splint within a minimal time period following the burn (one to three days). The technic does not require adaptation of bands or the cementation of the appliance.
2. The use of the wax posts at the try-in appointment permits accurate location and adjustment of the ten-

sion necessary to optimally splint the lip commissures.

3. The removable prosthesis allows adjustments and evaluations to be made easily, without having to remove and recement bands.
4. The removable prosthesis can serve as a carrier for fluoride gel, thus minimizing the risks of developing carious lesions.

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Florence, Italy, 1974

Dr. Theodore P. Croll