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Improperly Seated Active Electrodes – An Alternate Site Injury Risk

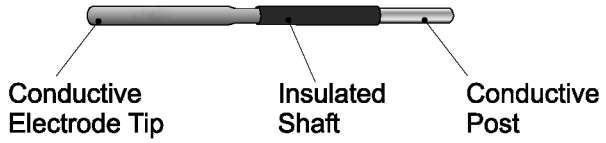
Electrosurgical tissue effect can occur at an alternate site, which is any place other than the surgical site or under the patient return electrode (PRE). An alternate site burn may occur if the electrosurgical current concentrates at an **unintended** point along the circuit pathway.[1] Alternate site injuries have been virtually eliminated with the advent of isolated generator technology, which references the therapeutic current back to the electrosurgical unit via the patient return electrode instead of back to ground.[2] However, skin injuries continue to be reported and documented in the literature. Many of the causes of alternate site injuries were reviewed in the HOTLINE Newsletter, "Alternate Site Lesions", Vol. 5, Issue 4, December 2000.

Recently, the Emergency Care Research Institute (ECRI) has had reports from several hospitals concerning patient injuries sustained by electrosurgical current arcing from the point of active electrode insertion to the electrosurgical pencil. Arcing injuries of this type tend to be more prevalent when the shaft of the electrode is in close proximity to unintended tissues. Injury sites could include the oral cavity, breast pockets, vaginal canal, or other confined surgical openings.

Most monopolar electrosurgical pencils come packaged with a removable flat blade electrode tip. This configuration is acceptable for most standard surgical procedures, while other procedures require a particular type of active electrode tip to achieve the appropriate electrosurgical effect. Replacement active electrode tips come in a wide assortment of configurations. A few examples are:

- *Needle Electrodes* are used for cutting or fine desiccation because the current is concentrated at the tip and requires lower power settings. The needle electrode configuration is selected for many plastic and ENT procedures.
- *Ball Electrodes* come in several sizes and are suitable for the desiccation or fulguration of broad surfaces.
- *Wire Loops* come in various sizes and configurations to achieve removal of tissue such as polyps, or to excise tissue samples for biopsy.

No matter which active electrode tip is selected, most consist of three distinct sections:



- *Conductive Electrode Tip*: the uninsulated, conductive portion of the electrode placed in close proximity to the target tissue to deliver the electrosurgical current.
- *Insulated Shaft*: mid-portion of the electrode insulated with nonconductive material to prevent the accidental conduction of electrosurgical current from this point to

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the patient. The high-temperature, nonconductive material that insulates the shaft typically extends at least 1/8 to 3/8 in. (3.2 to 9.5 mm) into the pencil receptacle when the electrode is **fully** inserted.[3]

- *Conductive Post*: this section plugs into the nose of the electrosurgical pencil to complete the electrical connection.

When the conductive post of the active electrode is completely inserted into the pencil housing, the electrode is totally insulated except for the electrode tip. Consequently, the electrosurgical current will exit only through the tip (to the intended target tissue) causing hemostasis or tissue vaporization. On the other hand, if the active electrode tip is not fully inserted into the pencil housing, the uninsulated conductive post may be exposed. **Exposure of this metal post can result in the escape of electrosurgical current to unintended areas resulting in a potential alternate site burn to the patient.** This can be further potentiated in the presence of conductive fluid, which creates a pathway for the electrical current and increases the chance for injury to the patient or staff. Injury may also result when attempting to increase electrode length by deliberately not seating the active electrode completely into the pencil housing. This practice increases the risk of arcing and should be avoided.

Electrosurgical current conduction at the junction of the active electrode to pencil interface can occur for several reasons.

- Improper or incomplete electrode insertion can happen with any new product having pre-loaded electrodes from the manufacturer or, more commonly, during electrode replacement. According to ECRI, full electrode insertion depth is about 1 to 1-1/4 in. (25-32 mm) inside the nose of the electrosurgical pencil, but there may be several distinct points of resistance encountered before insertion is actually complete. These points of tactile resistance could convey to the customer that insertion is complete when in actuality it is not.

  A recent ECRI investigation revealed at least two points of resistance. The first point of resistance may be encountered as the uninsulated conductive post meets the electrical contact receptacle within the nose of the electrosurgical pencil. This receptacle is smaller in diameter than the nose opening of the pencil and initially offers resistance to the conductive post. The second point of resistance may occur as the insulated shaft of the active electrode passes within the nose of the pencil. ECRI states that resistance will also increase if the electrode is not properly aligned with the pencil housing during insertion. Bear in mind these points of resistance can vary between products and product manufacturers.

  Another consideration noted by ECRI contributing to the difficult or improper insertion of the active electrode can be attributed to surgical gloves that become wet and slippery during the course of a surgical procedure. Wet gloves may prevent the surgical staff member from obtaining a secure grip on the electrode, potentially hindering full insertion.

- Incompatibility between the active electrode and the electrosurgical pencil is possible, if both products do not come from the same manufacturer. Mixing products, although not recommended, is not uncommon. This practice is in response to cost cutting efforts as well as to provide the specialty items needed and required by the surgeon.

  Although most electrode posts are of standard diameter, ECRI indicates that not all posts will fit all pencils because of incompatibilities caused by either the length or diameter of the conductive post or the design of the pencil's receptacle. These incompatibilities can result in an active electrode being too loose or too tight.

  Active electrode tip design may also affect whether or not the electrode is fully inserted within the nose of the pencil. For example, a needle electrode is sharp and requires attentive handling. As normal resistance to the needle electrode is encountered, efforts to insert the electrode may be too tentative in an attempt to avoid personal injury.

- Wear and damage such as cracks, pinholes, worn spots, or other defects in the electrode insulation can occur as the result of the manufacturing process, reprocessing, normal wear, or damage to the electrosurgical pencil. These potential defects could contribute to electrosurgical current being conducted from the pencil-to-electrode interface as well as through other pathways.

Suggested Recommendations:

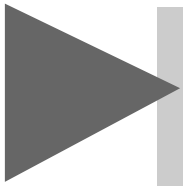
1. Alert product users to the potential dangers (to patients and staff) associated with damaged or improperly seated active electrodes.
2. Carefully inspect all electrosurgical pencils and removable active electrodes prior to use for evidence of damage or wear. Do not use worn or damaged products. Report any signs of wear or damage to the manufacturer and return any affected product.
3. To assure proper insertion:
   - Educate users about the points of resistance they may encounter when seating an active electrode. As previously stated, these points of resistance may suggest the active electrode is completely seated when it is not. Some effort is required on the part of the user to overcome this normal resistance in order to seat the electrode properly.
   - Check the fit between the electrosurgical pencil and the active electrode to ensure the interface is secure and not loose. A loose electrode should be replaced with one that fits securely.
   - Before and during the surgical procedure, check that the active electrode (whether pre-packaged with the pencil or a replacement electrode) is fully inserted into the pencil. While inserting the active electrode, ECRI suggests visually confirming that the electrode insulation is advanced into the nose of the pencil about 1/4 in. (6 or 7 mm). There should be no visible gap (metal exposure) between the insulation and the nose of the pencil. Exposed metal may result in electric shock or burn to the patient or surgical personnel.
   - Try to use electrosurgical pencils and active electrodes from the same manufacturer. If this is not possible, verify the compatibility of the two components with the electrode manufacturer and document the verification. Be familiar with the instructions for use and the cautions and warnings packaged with each manufacturer's product.
   - Wear dry gloves to check and/or replace an active electrode to ensure adequate grip.
   - Avoid using the active accessory for retraction, especially in the area where the active electrode interfaces with the electrosurgical pencil. Do not allow any portion of the active accessory to come in contact with tissue other than the target tissue or patient injury could result. Use added caution in small, enclosed surgical spaces.

To assist in the identification of potential manufacturing problems, it is advisable to report all electromedical device incidents to the appropriate parties (device manufacturer, FDA, ECRI, etc.) according to policy established by your facility. Proper care and handling of electrosurgical equipment and accessories is essential to patient and personnel safety.

1) HOTLINE Newsletter, Alternate Site Lesions, Vol. 5, Issue 4, December 2000.

2) HOTLINE Newsletter, Body Jewelry…to Remove or not Remove, That is the Question, Vol. 5, Issue 2, June 2000.

3) ECRI Hazard Report. Alternate-Site Burns from Improperly Seated Electrosurgical Pencil Active Electrodes. Health Devices 2000 Jan.; Vol. 29 (1) , 24-27.



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