

A study on the type of lesions achieved by three electrosurgical methods and their way of healing

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Advances in medical devices have produced different and competing electrosurgical technologies. The goals of such new electrosurgical units are to improve post-operative outcomes, to shorten hospital stays and improve physiological healing of surgical wounds. The purpose of this experimental study is to compare the healing process of wounds inflicted by three types of electrosurgical devices frequently used in ENT surgery and other disciplines: i.e. standard electrosurgery, radiofrequency and CO₂ laser.

Methods: The investigation was carried out on 12 albino Wistar rats in conformity with the approval of the Ethics Research Committee of the University of Medicine and Pharmacy of Târgu Mures. Dorsal skin incisions were systematically performed using each device on each rat under general anaesthetics. The following devices were employed: the CO₂ laser (EU Laser), the Erbe ICC50 electrosurgical generator (Erbe, Germany) and the CURIS® 4 MHz radiofrequency generator (Sutter, Germany).

The settings were: CO₂ laser at 2.5 watts, Erbe ICC50 at 35 watts cut mode, CURIS® 4 MHz radiofrequency generator at 10 Watt CUT 1 mode.

Groups of three rats were anaesthetized and the wounds with surrounding tissue were resected after 24 hours, three days, five days and seven days with cold steel techniques. The harvested tissue samples were placed in 10 % neutralized formalin solution and then sectioned and stained with Hemotoxylin and Eosin (HE) and subsequently analysed microscopically.

Results: The first two phases of wound healing (inflammatory and proliferation) were evaluated and compared for the three devices. The histopathological changes in the epidermis, dermis, hypodermis and subcutaneous soft tissues are described for the three lesion types. On the first day the cutaneous injury produced by the standard electrosurgical generator and the CO₂ laser looked similar with focal coagulative necrosis affecting the full thickness of the epidermis

and destruction of the basal membranes, as well as the dermis. The epidermal and dermal injuries produced by radiofrequency presented similar changes; the basal membrane and basal layers of the epithelium were, however, intact.

On the third day the typical changes for the proliferation phase could be witnessed: the formation of a cloth consisting of fibrin meshwork. These changes were most noticeable for the CURIS® 4 MHz radiofrequency induced wounds. On day three, the occurrence of the reepithelialization phenomenon in the radiofrequency-induced wounds could already be noticed.

On day five, this second phase of wound healing was also recognizable in the laser-induced incisions. The lesions produced by standard electrosurgery were extensive and the epithelialization was delayed.

On day seven, both the radiofrequency and laser-induced incisions had healed completely. The radiofrequency wounds had some mild degree of inflammation in the depth. The electrosurgery wounds were not healed on day seven. Epithelialization was incomplete, and abundant inflammation persisted with focal suppurations.

Discussion: Radiofrequency is a refined form of electrosurgery. The very high frequency (4 MHz versus 300 KHz) leads to less tissue impedance. Incisions produced by radiofrequency are less profound as evidenced by the preservation of the basal membrane and deep layers of the epithelium responsible for cell generation. While there was some mild



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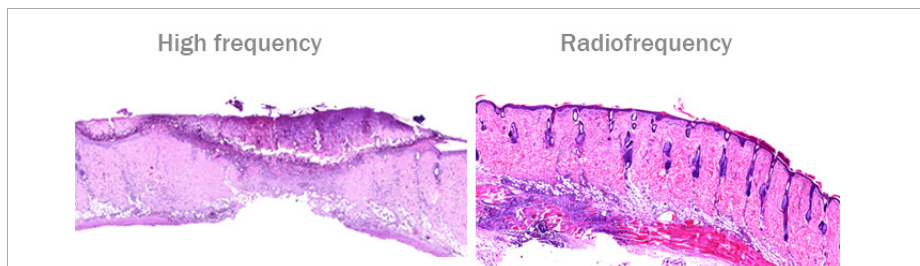
inflammation in the deeper layers, radiofrequency wounds started healing earliest and were healed by day seven. Radiofrequency proved to be the least coagulative necrosis, thermal damage, and cell disruption.

Conclusions: Ironically, although standard electrosurgery unquestionably has disadvantages compared with radiofrequency and the CO₂ laser, it remains the most widely used technology. Incisions were more invasive, more disrupted and healed significantly later. Radiofrequency and CO₂ laser are more refined technologies with the second phase of wound healing starting and being completed earlier than in standard electrosurgery.



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References: Muehlfay G., Horváth K.U., et al., A study on the type of lesions achieved by three electrosurgical methods and their way of healing, Romanian Journal of Morphology & Embryology, 2015, 56(4): 1383-1388



Day three: **High frequency versus radiofrequency incisions** (HE staining x 50 magnification). RF shows intact basal membrane and basal layers of the epithelium in contrast to conventional electrosurgery.

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