CO2 Laser use in Socket Preservation

Yuki Daigo

Introduction

Tooth extraction often tends to decrease residual alveolar crest height, so it is essential to preserve this height and facilitate rapid wound healing after the extraction. This is the concept behind socket preservation. The U.S. Food and Drug Administration guidelines for the use of dental lasers state that CO2 lasers are effective for "coagulation of extraction sites". In recent years, laser irradiation aimed at accelerating wound healing and achieving reliable blood retention in the extraction socket has been reported to minimize alveolar bone resorption in the clinical setting. However, the usefulness of CO2 lasers remains unclear because few relevant studies have been conducted in laboratory animals. In this study, we investigated the socket preserving effect of using a CO2 laser for high-intensity laser therapy (HILT) combined with photobiomodulation therapy (PBMT) after tooth extraction in rats, in a manner mimicking the clinical procedure. The socketpreserving effect was evaluated by histopathological examination of extraction sockets. The extraction socket of the maxillary first molar in 5-week-old male Wistar rats was examined histopathologically. Observation time points were days 3, 7 and 21 postextraction. Rats were divided into two groups depending on postextraction treatment: no laser irradiation (control group) and combination HILT and PBMT using a CO2 laser (CO2 group). Rats in both groups were anesthetized by intraperitoneal administration of pentobarbital sodium and underwent tooth extraction using rat-use elevator forceps and mosquito forceps.

Yuki Daigo, Department of Geriatric Dentistry, Osaka Dental University, Japan email: qpmayo24@yahoo.co.jp

Extraction sockets in the control group were compressed with dry cotton balls to achieve hemostasis, whereas in the CO2 group coagulation was achieved using HILT without compression hemostasis. The following day, the sockets were disinfected with the benzalkonium derivative Germitol and then only the CO2 group underwent PBMT. Sockets are almost completely filled with coagulated blood in the control group, while there is progression of organization from the socket walls in the CO2 group. (b, f) Magnified views of the socket walls showing few osteoclast-like cells in the control group but many in the CO2 group, as well as findings indicative of active bone resorption in the CO2 group. [Day 7 postextraction] (c, g) The control group has the lowest amount of cancellous bone and immature cancellous bone. The CO2 group has new bone formation from the middle to shallow layer with a cross-linking pattern. [Day 21 postextraction] (d, h) Extraction sockets are filled with mature new dense cancellous bone in both groups. However, concavity is apparent at the center of the alveolar crest in the control group. New bone formation in the extraction socket starts usually from the fundus. As a result, the mucosal epithelium around the extraction wound invades the extraction socket and concavity is apparent at the center of the alveolar crest, with a corresponding. Early in the healing process after tooth extraction, laser stimulation causes many osteoclast-like cells to appear and active bone resorption to occur from the shallow to middle layers of the extraction socket wall (activation of bone remodeling). • The stimulated osteoblasts produce collagen fibers associated with bone formation. Also, the osteoblasts migrate on the fibers forming a scaffold for new bone formation. • The formation of new bone cross-linked using a collagen fiber scaffold is observed at the same site. • Formation of the bone lining under the mucosa of the extraction wound suppresses the depression in the mucosal epithelium and also preserves the alveolar crest height. ➡ Penetration depth of the CO2 laser light is shallow, at 0.05 mm, so that the photobioactive reaction caused by the irradiation can be concentrated on the surface of the extraction socket.