Clinical Differences in Autofluorescence Between Viable and Nonvital Bone: A Case Report With Histopathologic Evaluation Performed on Medication-Related Osteonecrosis of the Jaws

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Medication-related osteonecrosis of the jaws (MRONJ) is an adverse side effect of several drug therapies, including bisphosphonates (BPs). Osteonecrosis of the jaw specifically related to BP therapy is usually referred to using the acronym BRONJ. However, no consensus has yet been reached regarding the most appropriate management of BRONJ. The greatest success rates have been recorded with surgical removal of necrotic bone. In particular, erbium:yttrium-aluminum-garnet (Er:YAG) laser-assisted surgery has shown significantly better results than conventional surgical approaches. According to a position paper reported by the American Association of Oral and Maxillofacial Surgeons in 2007, the identification of necrotic bone margins during osteonecrosis removal can be very difficult. In 2015, a review of treatment perspectives for MRONJ reported that both surgical debridement and resection cannot be standardized owing to the lack of guidance to define the necrotic margins. Recently, the use of autofluorescence (AF) of the bone as a possible suitable guide to visualize necrotic bone during surgical debridement or resection was proposed. It seems that vital bone could be highlighted by its very strong AF. In contrast, necrotic bone loses AF and, thus, appears much darker. The molecular sources of the phenomenon of AF are the specific amino acids of the collagen molecules that show AF when irradiated by ultraviolet or blue light. The use of AF as an intraoperative diagnostic tool is entirely new in the management of MRONJ, although it has been used for several years in other fields (eg, intervertebral disc surgery). The aim of the present report was to describe a case of mandibular BRONJ treated with a new surgical approach performed with an Er:YAG laser and guided by AF. The histopathologic evaluation of the removed hypofluorescent bone block and hyperfluorescent surrounding bone has also been reported in detail.

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Medication-related osteonecrosis of the jaws (MRONJs) is an adverse side effect of several drug therapies, including bisphosphonates (BPs). Osteonecrosis of the jaw specifically related to BP therapy is usually referred to using the acronym BRONJ.[1] No consensus has yet been reached regarding the most appropriate

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management of BRONJ.[2] The greatest success rates have been recorded with surgical removal of the necrotic bone. In particular, ertium:yttrium-aluminum-garnet (Er:YAG) laser-assisted surgery has shown significantly better results than conventional surgical approaches.[3,4]

According to a position paper published by the American Association of Oral and Maxillofacial Surgeons (AAOMS) in 2007, the identification of necrotic bone margins during osteonecrosis removal can be very difficult.[5] In 2014, Ristow and Pauke[6] performed a review of the treatment perspectives for MRONJ and reported that both surgical debridement and resection cannot be standardized owing to the lack of guidance that defines the necrotic margins. Recently, Ristow et al[7] and Vescovi et al[8] proposed the use of autofluorescence (AF) of the bone as a possible suitable guide to visualize necrotic bone during surgical debridement and resection. It seems that vital bone can be highlighted by its very strong AF and that necrotic bone loses AF, thus appearing much darker. The molecular sources of the phenomenon of AF are specific amino acids of the collagen molecules that show AF when irradiated by ultraviolet or blue light.[9] The use of AF as an intraoperative diagnostic tool is entirely new in the management of MRONJ, although it has been used for several years in other fields (eg, intervertebral disc surgery).[10]

The aim of the present report was to describe a case of mandibular BRONJ treated with a new surgical approach performed with the Er:YAG laser and guided by AF. The histopathologic evaluation of the removed hypofluorescent bone block and hyperfluorescent surrounding bone is also reported in detail.

Patient and Methods

A 65-year-old female patient affected by osteoporosis had received 84 doses of alendronic acid intramuscularly. The medical history did not reveal any other pathologic entities. Stage 2 nonexposed osteonecrosis (according to the AAOMS 2014 staging system) of the right mandible was diagnosed (Fig 1). The dental history revealed that the premolars and first molar in the same area had been extracted 4 months earlier. Computed tomography scans showed necrosis involving the vestibular and lingual plates (Fig 2).

Surgical treatment, consisting of resection of the necrotic bone, was performed with the patient under local anesthesia. Antibiotic therapy with amoxicillin (2 g/day) and metronidazole (1 g/day) was administered from 3 days before to 3 weeks after surgery. No preoperative tetracycline labelling was performed.

After bone exposure through a mucoperiosteal flap, the VELscope system (LED Medical Diagnostics, Inc, Barnaby, BC, Canada) was used to induce and detect AF of the mandibular bone. It was evident that the areas clinically displaying necrotic features showed pale or no AF (Figs 3A,B). Osteotomy was performed using a Lindeman bur (Figs 4A,B). After removal of the necrotic bone block, AF visualization was used to guide marginal bone osteoplasty, performed using a traditional ball-shaped bur, which is a nontraumatic procedure for soft tissue and useful for the removal of the sharp edges of bone. Using the AF image obtained after osteoplasty, an Er:YAG laser (Fidelis Plus, Fotona, Ljubljana, Slovenia; parameters: 300 mJ, 30 Hz, fluence of 60 J/cm^2) was used to vaporize necrotic bone, until the detection of strongly AF bone.

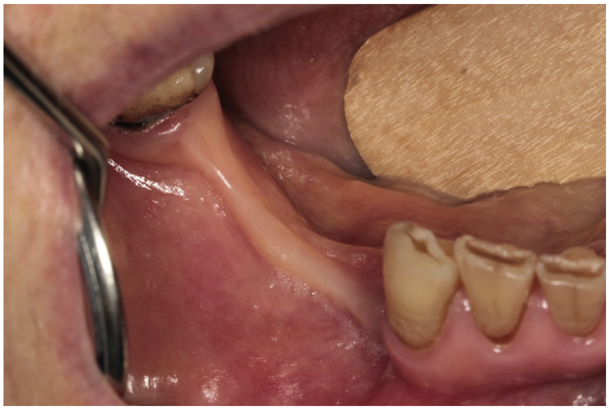

FIGURE 1. Intraoral view showing stage 2 nonexposed osteonecrosis.

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Er:YAG laser is very useful for additional removal of bone after osteoplasty. Owing to the extremely superficial penetration of Er:YAG lasers, it is possible to intervene in the areas in which no fluorescence or hypofluorescence is present. Two further samples of hyperfluorescent bone were taken in an adjacent area (Figs 5A,B). Histopathologic evaluation was performed to investigate whether a correlation was present between bone vitality and fluorescence.

The patient received intraoperative irrigation with 10% povidone-iodine solution. Low-level laser therapy (LLLT; neodymium:YAG [Nd:YAG] laser, 1064 nm; Fidelis Plus; Fotona; power, 1.25 W; frequency, 15 Hz; fiber diameter, 320 μm) was administered in nonfocused mode at a distance of 2 mm from the tissues for 1 minute (power density 1562.5 W/cm^2, fluence 7 J/cm^2) and repeated 5 times.

Tension-free wound closure was achieved using a continuous locking suture. The patient received weekly applications of LLLT for 3 weeks after surgery.

Results

Histopathologically, the hypofluorescent tissues (Fig 6) corresponded to a large lacuna characterized by fibrous tissue with the coexistence of chronic and