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## Correspondence

# Conventional surgery combined with the liquid nitrogen cryosurgery: An innovative treatment approach for the medication-related osteonecrosis of the jaw (MRONJ)

## KEYWORDS

MRONJ;  
Conventional surgery;  
Liquid nitrogen  
cryosurgery;  
Osteomyelitis

The medication-related osteonecrosis of the jaw (MRONJ) is a challenging condition associated with the use of anti-resorptive medications like bisphosphonates and denosumab, which are often prescribed to treat osteoporosis and some cancers.<sup>1,2</sup> The effective treatment modalities for the MRONJ are a few but the recurrence is a big problem after treatment. Thus, to find a new effective therapeutic modality for the MRONJ is very important.<sup>3</sup> We reported two cases of the MRONJ treated by a combination of the surgical removal of the sequestrum and the liquid nitrogen cryosurgery for the residual maxillary bone surface with promising results of the reduction of recurrences and the improvement of the recovery process (see Fig. 1).

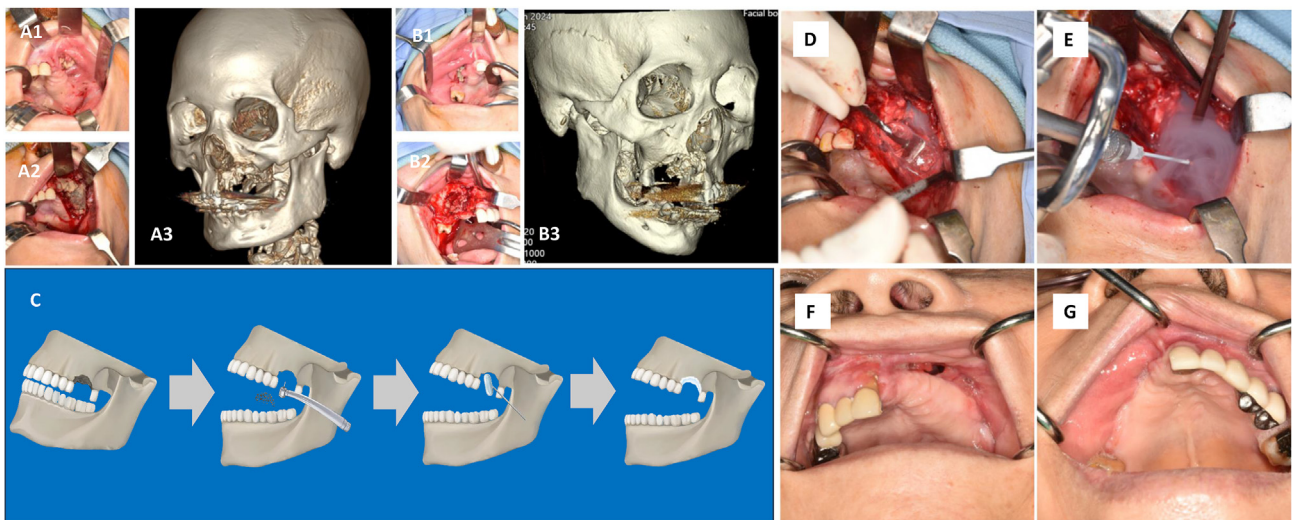
The first case was a 74-year-old woman with the MRONJ of the left maxilla, which developed five years after the treatment of osteoporosis with risendronate sodium Reosteo®. The computed tomography (CT) imaging studies disclosed the sequestrum formation in the left maxilla involving the left maxillary sinus. The conventional surgery was performed to remove the necrotic bone and its surrounding granulation tissue. The second case was a 72-year-old female patient who had developed the MRONJ in the right maxilla after four-year treatment with Zometa after the breast cancer surgery. The CT scans revealed the dead bones in the right maxilla extending to the nasal floor and

the right maxillary sinus. The sequestra were removed by the conventional surgery. In both cases, the liquid nitrogen gel was applied to the residual maxillary bone surface followed by the spray with liquid nitrogen after the sequestrum removal so that there were none of the blind spots that could be missed for the proper treatment of the whole area. Then, irrigation of the wounds with the normal saline was performed followed by a reconstruction with the buccal fat pad-advanced mucosal flap. Although there was exposure to the floor of the nose with oro-antral communication in both cases after the surgery and cryotherapy, both cases showed uneventful surgical wound healing without any evidence of recurrence during the follow-up period of one year.

The treatments of MRONJ vary from conservative methods like antibiotic coverage and repeated rinses of the jawbone lesional area to aggressive surgeries for removal of the involved jawbone. No single treatment is universally effective, as recurrence is common. In this respect, the liquid nitrogen cryosurgery may provide an effective adjunct to the conventional surgery for its potential destruction of the sequestrum-adjacent unhealthy jawbone cells and subsequent induction of the healing with the new bone formation. A previous study suggested that the cryosurgery can kill the residual giant cell tumor of the bone and then provokes a slow but progressive re-ossification.<sup>4</sup>

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**Figure 1** (A) A 74-year-old woman with the MRONJ of the left maxilla: (A1) Pre-operation intraoral view. (A2) The lesion was exposed during the surgery. (A3) The 3D image reconstructed from the computed tomography (CT) data of the first patient. (B) A 72-year-old female patient who had developed the MRONJ in the right maxilla: (B1) Pre-operation intraoral view. (B2) The lesion was exposed during the surgery. (B3) The 3D image reconstructed from the CT data of the second patient. (C) The procedure of the surgery: Exposure of the lesion in the first step, removal of the sequester in the second step, the liquid nitrogen application to the residual maxillary bone surface in the third step, and completion of the surgical procedure in the fourth step. The treatment with the liquid nitrogen gel (D) or the liquid nitrogen spray (E) after the conventional surgery to remove the sequester. The post-operation 6-month follow-up of the first case (F) and the second case (G) showing the complete healing of the intraoral surgical sites.

Usually, a couple of days following the cryosurgery, maximum tissue necrosis can be observed, and after roughly four weeks there is a gradual regrowth of the new bone. It seems that the cryosurgery is pretty effective because the recurrence of the bone lesion is less likely to occur.

Our findings indicate that the combination of the conventional surgery for removal of the sequester and the subsequent liquid nitrogen cryotherapy is very effective for treatment of the MRONJ and in turn improves the quality of life of the patient.<sup>5</sup> This combination surgery not only reduces the recurrence rate, but also shortens the healing period. Thus, although further studies have to be done, this novel treatment modality may represent a step toward a new definition of the standards of care for the MRONJ. We hope that this novel treatment modality may provide more functional long-term solutions for patients crippled by the disease of MRONJ.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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