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Original Article

Conservative surgical management of stage III medication-related osteonecrosis of the jaw in the mandible: A retrospective study with particular emphasis on anterior mandible

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KEYWORDS
Medication-related osteonecrosis of the jaw;
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Bone healing;
Treatment outcome

Abstract *Background/purpose:* Medication-related osteonecrosis of the jaw (MRONJ) is a severe complication associated with anti-resorptive therapy, and surgical intervention remains an effective treatment strategy regardless of disease stage. While extensive surgical resection is considered the standard approach for advanced-stage MRONJ, it may not be suitable for elderly patients or those with systemic comorbidities. This study evaluated the outcomes of conservative surgical management in patients with stage III MRONJ affecting the anterior mandible.
Materials and methods: A retrospective study was conducted on patients with stage III MRONJ of the anterior mandible. All patients underwent conservative surgical treatment, including sequestrectomy, debridement of inflamed soft tissue, and bone curettage. Clinical outcomes, radiographic bone healing, and long-term follow-up data were analyzed.
Results: Among 77 patients with MRONJ of the mandible, four with advanced stage III MRONJ involving the inferior border and genial tubercle were included. Two patients underwent conventional conservative surgical treatment, while two patients with preoperative pathologic fractures underwent stabilization with a reconstruction plate and conservative surgical treatment. The mean follow-up period was 41.5 months, and no recurrence, mandibular fractures, or mechanical failure of the reconstruction plate was observed. Radiographic findings demonstrated restoration of mandibular structural integrity and reinforcement throughout the follow-up period.

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Conclusion: Conservative surgical management may be a viable alternative to extensive resection in stage III MRONJ of the anterior mandible, particularly when aggressive surgical resection is not feasible. Preserving viable bone is essential for bone healing and functional recovery, and thorough intraoperative assessment is crucial for achieving successful treatment outcomes.

Introduction

Medication-related osteonecrosis of the jaw (MRONJ) is a well-recognized condition associated with use of antiresorptive drugs (ARDs), which are commonly prescribed for the treatment of osteoporosis and management of cancer-related conditions.[1,2] It is known to be triggered by invasive dental procedures, such as tooth extractions or dentoalveolar surgery, or from underlying infections and inflammatory conditions. Although MRONJ can affect both the maxilla and mandible, it is more frequently observed in the mandible, particularly in the posterior region.

Management of MRONJ ranges from conservative approaches including systemic antibiotics, antimicrobial rinses, and regular dental care, to more invasive surgical procedures such as extensive surgical resection with or without microvascular reconstruction.[3] Surgical intervention has demonstrated higher clinical success and healing rates than non-surgical methods.[4] In advanced stages, aggressive procedures such as partial maxillectomy or mandibulectomy may be necessary,[5] with extensive resections generally providing better outcomes than simple curettage.[5,6]

The anterior mandible plays a vital role in functions such as swallowing, chewing, speech, and respiration. The suprahyoid muscle group, including the genioglossus and geniohyoid muscles, is critical for tongue movement, hyoid mobility, and airway maintenance.[7,8] Extensive resections involving the anterior mandible, particularly with loss of the genial tubercle, may cause detachment of these muscles, resulting in postoperative complications such as dysphagia and respiratory issues. Although free flap reconstruction using fibula or iliac bone can restore mandibular continuity, functional impairments such as swallowing or speech difficulties often persist, negatively impacting quality of life.[9] Additionally, advanced age and systemic comorbidities can increase surgical risks and reduce the feasibility of extensive resections with free flap reconstruction.

While extensive resection is often recommended, it may not always be suitable for patients with advanced anterior mandibular MRONJ, particularly those with multiple comorbidities or advanced age. In such cases, conservative surgical approaches, such as sequestrectomy or curettage, may effectively control the disease while preserving function and minimizing surgical morbidity. However, research on the outcomes and bone healing patterns following conservative management of anterior mandibular MRONJ remains limited. This study presented the radiological characteristics, treatment outcomes, and bone healing of patients with advanced MRONJ affecting the anterior mandible and extending to the genial tubercle who underwent conservative surgical management without mandibular resection. The findings highlight the potential of conservative approaches as a practical alternative for patients who are poor candidates for extensive resection and free flap reconstruction due to advanced age or systemic conditions.

Materials and methods

This study was conducted in accordance with the principles of the Helsinki Declaration. All patients included in the study provided informed consent prior to participation. The study protocol was approved by the Institutional Review Board of Seoul National University Dental Hospital (Approval No.: ERI25011).

A retrospective analysis was conducted on 77 consecutive patients who underwent treatment for MRONJ affecting the anterior mandible at Seoul National University Dental Hospital from October to December 2024. Patients who met the following inclusion criteria were included in the study: 1) underwent conservative surgical treatment for management of MRONJ; 2) presence of lesions in the anterior mandible between the left lower canine and right lower canine; 3) lesions extending to the genial tubercle and inferior mandibular border; 4) minimum follow-up period of six months; and 5) availability of radiographic imaging during the follow-up period. Exclusion criteria were as follows: 1) MRONJ lesions outside the anterior mandible; 2) lesions confined to the alveolar bone without involvement of the inferior mandibular border; and 3) follow-up period less than 6 months or lack of postoperative radiographic imaging.

All treatments were performed by a single oral and maxillofacial surgeon. Patient electronic medical records were reviewed to collect data on the type, duration, route, and purpose of ARD therapy, as well as age, sex, and systemic comorbidities. Additionally, panoramic radiographs and computed tomography (CT) scans were evaluated to assess preoperative lesion location and severity and to analyze postoperative bone healing.

Results

Among the 77 patients, 13 (16.9 %) presented with MRONJ in the anterior mandible. In six cases, MRONJ extended deeply along the lingual cortical plate, involving the genial tubercle, and reaching the inferior border of the mandible.

Due to absence of postoperative follow-up radiographs for one patient and follow-up loss in another, four cases were included in this study. All patients exhibited intraoral fistulas with purulent discharge, and three had orocutaneous fistulas that traced to the inferior mandibular border. Conservative surgical treatment, including surgical curettage, sequestrectomy, and decortication, was performed for all patients. Postoperatively, all patients showed no recurrence during the postoperative follow-up period, with a mean duration of 41.5 months. Details of the cases are provided in Table 1.

Case 1

A 73-year-old female patient was referred for treatment of MRONJ in the anterior mandible (Fig. 1). She had been previously diagnosed with MRONJ at a local hospital, where extensive mandibular resection and reconstructive surgery were recommended. Her medical history included hypertension, diabetes mellitus, and osteoporosis, for which she had been treated with ibandronate for five years, followed by prescription of a selective estrogen receptor modulator for 1.5 years. Clinically, the patient presented with significant submental swelling and purulent extraoral discharge. Radiographic examination revealed extensive osteolysis and sequestration affecting both the buccal and lingual aspects of the anterior mandible, extending to the right mandibular region and the inferior border. Due to her advanced age and the potential risks associated with extensive surgical resection and free flap reconstruction, the patient opted for a conservative surgical treatment.

Under general anesthesia, the procedure involved sequestrectomy followed by reconstruction using a reconstruction plate (Fig. 2). Crestal and vertical intraoral mucosal incisions were made, and subperiosteal dissection exposed the lesion. To prevent additional mandibular fractures, a temporary 9-hole reconstruction plate was first secured to the anterior mandible. Floating sequestrum and inflamed soft tissue were removed, and necrotic bone was debrided using a vulcanite bur. An additional extraoral incision was made around the fistula in the chin region to expose the inferior border of the mandible. The remaining inflamed tissue was removed, and the viability of the inferior mandibular border was assessed through grinding. A permanent reconstruction plate was then secured using bicortical locking screws via a transbuccal approach, and the temporarily fixed plate was removed. Primary intraoral closure was achieved following a periosteal releasing incision. The mentalis muscle was anchored to the anterior portion of the reconstruction plate using 2-0 polydioxanone sutures. A closed suction drain was placed in the neck wound, followed by extraoral layered closure and pressure dressing.

Postoperative CT imaging at two years and serial panoramic radiographs demonstrated progressive bone healing, with the formation of a bone bridge restoring mandibular continuity. No complications or recurrence were observed over a 44-month follow-up period.

Case 2

A 77-year-old female patient presented with signs and symptoms of osteomyelitis in the right mandible (Fig. 3). Six months prior, she had undergone implant placement at the right lower first premolar site, which had been removed two weeks later. At the same time, the right lower canine was extracted, and an immediate implant was placed at the extraction site. She had received zoledronic acid injections for osteoporosis treatment for several years, and her medication had been switched to denosumab one year prior to her visit, with injections administered every six months. The most recent injection had been one week prior to her visit.

Clinically, purulent discharge was observed both intraorally and extraorally. Preoperative CT imaging revealed sequestrum formation along the lingual aspect of the anterior mandible, extending to the inferior border. Conservative surgical treatment was performed under general anesthesia

Table 1 Characteristics of the patients included in this study.

No.	Age/sex	Reason for ARD	Type of ARD	Duration of ARD	Comorbidities	Clinical findings	Pathologic fracture
1	73/F	Osteoporosis	Ibandronate	1 year	DM, HTN, CKD	Intraoral and orocutaneous fistula with purulent discharge	+
2	77/F	Osteoporosis	Zolendronate + denosumab	Unknown	DM, HTN, HL	Intraoral and orocutaneous fistula with purulent discharge	−
3	79/M	Osteoporosis	Risedronate	5 years	DM, HTN, HL	Intraoral and orocutaneous fistula with purulent discharge	+
4	62/F	Breast cancer with multiple metastasis	Zolendronate	More than 3 years	Chemotherapy and hormone therapy	Intraoral fistula with purulent discharge	−

ARD, anti-resorptive drug; DM, diabetes mellitus; HTN, hypertension; CKD, chronic kidney disease; HL, hyperlipidemia.

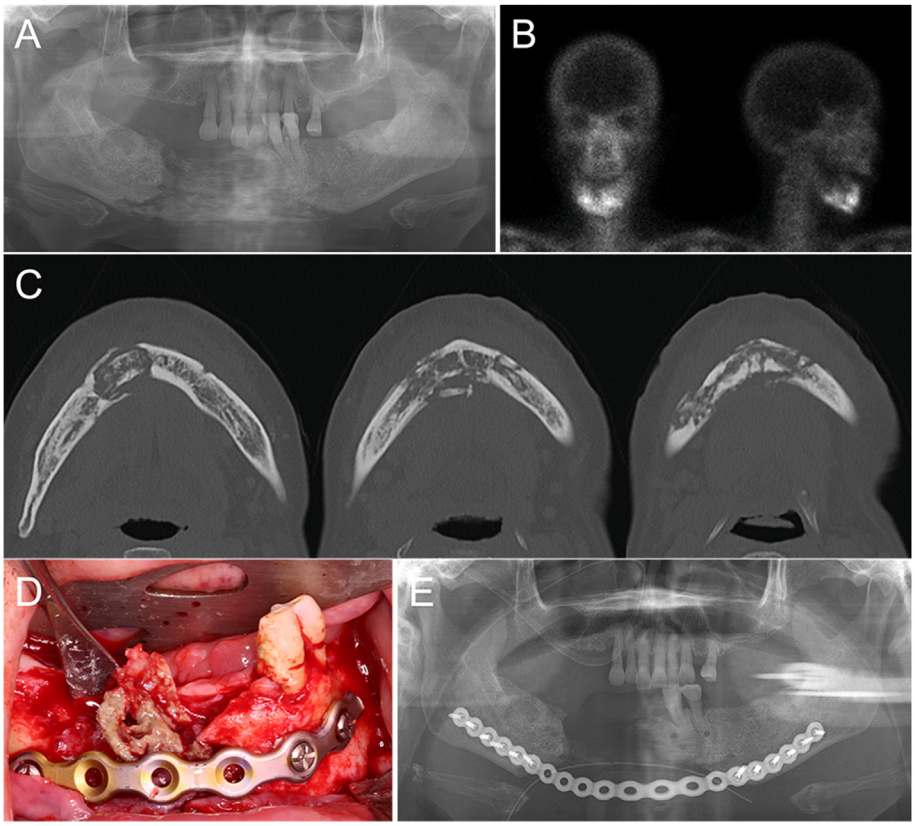

Figure 1 Perioperative radiographs of Case 1. (A) Preoperative panoramic view, (B) bone scan, and (C) computed tomography images showing extensive osteolysis and sequestration with a pathologic fracture. (D) Intraoperative clinical photograph and (E) immediate postoperative panoramic view showing stabilization of the mandibular fracture using a reconstruction plate and conservative surgical treatment.

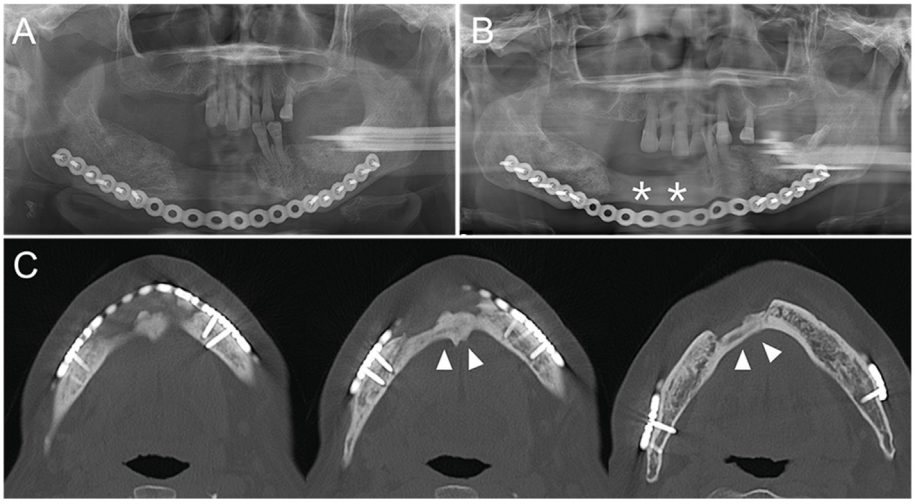

Figure 2 Postoperative radiographs of Case 1. (A) Panoramic view at one year after surgery, (B) panoramic view at three years, and (C) computed tomography images at two years postoperatively showing progressive bone healing with formation of a bone bridge (asterisk and arrowhead) restoring mandibular continuity.

(Fig. 4). An intraoral mucosal incision was made along the alveolar crest from the left lower first premolar to the right lower first premolar. A full-thickness mucoperiosteal flap was elevated, preserving the mental nerve. Floating sequestrum and granulation tissue were removed, and the remaining buccal bone was conservatively ground to assess its viability. A submental incision was made for an additional extraoral approach, exposing the inferior mandibular border. Inflamed soft tissue and residual sequestra were meticulously removed. The mandibular defect at the inferior border was

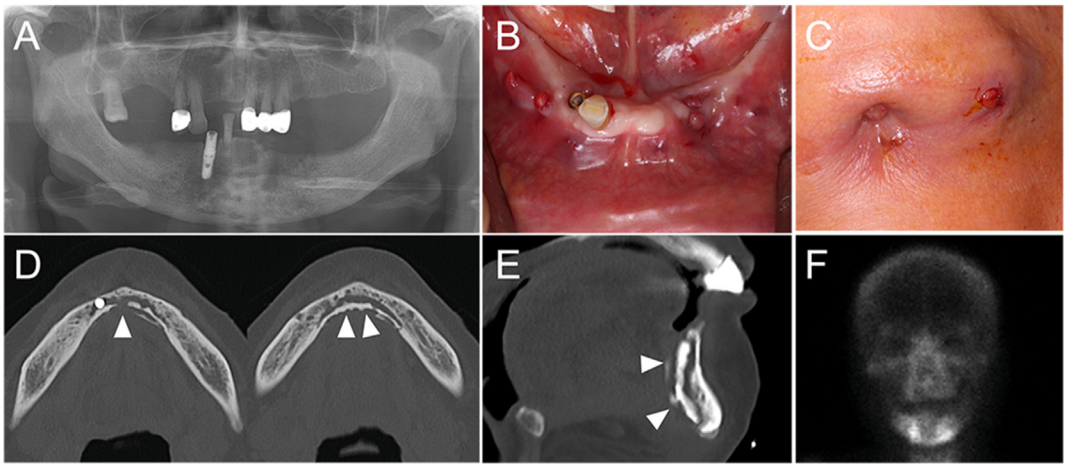

Figure 3 Preoperative radiographs and clinical photographs of Case 2. (A) Panoramic view. (B) Intraoral clinical photograph. (C) Extraoral clinical photograph. (D, E) Computed tomography images showing sequestrum formation (arrowhead) along the lingual aspect of the anterior mandible, extending to the inferior border. (F) Bone scan.

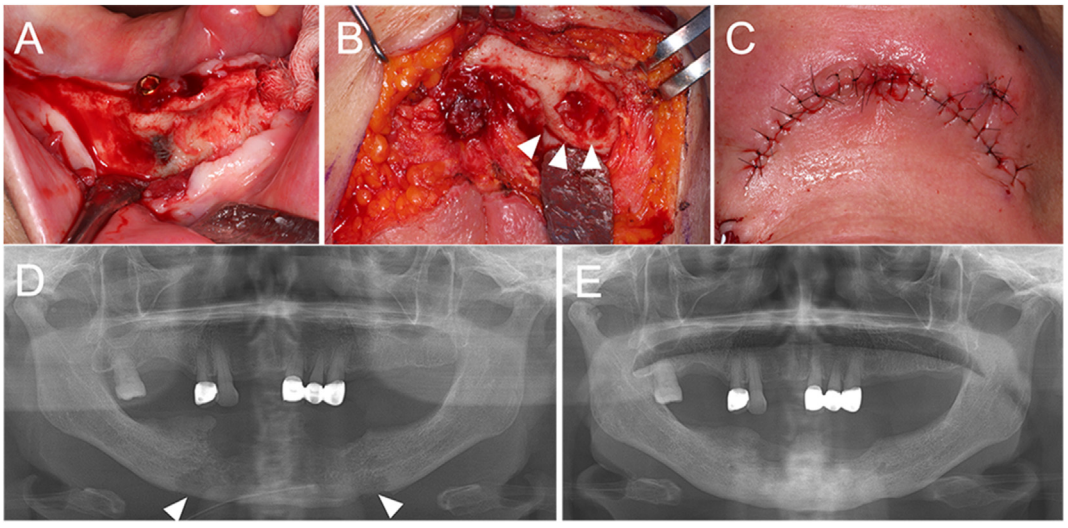

Figure 4 Intraoperative clinical photographs and postoperative radiographs of Case 2. (A–C) Intraoral clinical photographs showing conservative removal of the sequestrum and inflamed tissue in the area involving the inferior border of the mandible with preservation of surrounding viable bone. (D) Immediate postoperative panoramic view showing an extensive bone defect (arrowhead) extending to the inferior border. (E) Panoramic view at 9 months postoperatively.

found to be continuous with the intraoral resection site. Bone removal was continued intraorally and extraorally until fresh bleeding was identified. Sharp bony edges were trimmed to facilitate healing. Although multiple intraoral fistulas were present, there was no significant bone exposure in the oral cavity, allowing primary closure of the intraoral wound. Following fistulectomy in the submental area, the extraoral wound was closed in layers.

Postoperative panoramic radiographs demonstrated progressive bone healing with increased bone density at the resection site. No postoperative complications or recurrence were observed during the 3.5-year follow-up period.

Case 3

An 82-year-old male patient was referred for management of osteomyelitis initially diagnosed at a local dental clinic. Clinical and radiographic examinations revealed a pathological fracture in the left mandibular parasymphysis, with purulent discharge from an extraoral fistula in the left chin region (Fig. 5). He previously had been treated with risedronate for osteoporosis for six years, which had been discontinued 10 months prior to his visit.

A partial mandibulectomy and reconstruction with a reconstruction plate and radial forearm free flap or osteocutaneous free flap were planned. However, given the patient's advanced age and general condition, he declined extensive surgical intervention, and a conservative surgical approach was planned. Under general anesthesia, all sequestra were removed until fresh bleeding was observed. Since the lingual cortex and inferior mandibular border consist of dense cortical bone, which may not readily exhibit fresh bleeding despite being viable, these structures were preserved to maintain inter-segmental bone

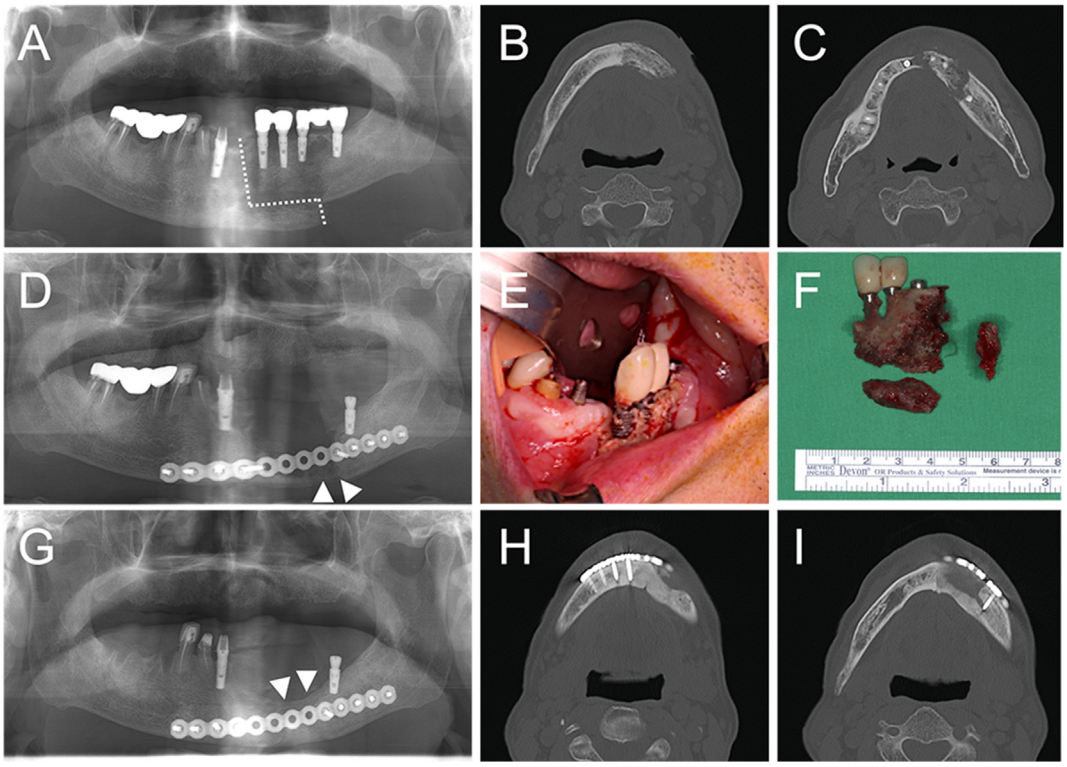

Figure 5 Perioperative imaging data of Case 3. (A) Preoperative panoramic view (dotted line, fracture line). (B, C) Preoperative computed tomography images. (D) Immediate postoperative panoramic view showing realigned fracture segments with direct bony contact (arrowhead) to restore mandibular continuity. (E) Intraoperative clinical photograph. (F) Removed sequestrum. (G) Panoramic view at two years postoperatively showing complete bone healing (arrowhead), restored continuity, and increased bone volume. (H, I) Computed tomography images at 7 months postoperatively.

contact. The fractured segments were carefully aligned to restore mandibular continuity, ensuring direct bony contact for optimal healing. A reconstruction plate was then secured for stabilization, and surgical wounds were closed in layers with releasing incisions for tension-free closure.

Postoperative follow-up radiographs exhibited complete bone healing with restored mandibular continuity and increased bone volume. Over approximately four years of follow-up, no recurrence or postoperative complications were noted.

Case 4

A 62-year-old female patient was referred for management of MRONJ affecting the mandible (Fig. 6). The patient had a history of breast cancer with bone and lung metastases and had been receiving monthly zoledronic acid injections for three years, along with chemotherapy and hormone therapy. Intraorally, extensive bone exposure was noted in the anterior mandible. Radiographic evaluation revealed severe bone destruction extending to the inferior mandibular border, with a pronounced periosteal reaction along the cortical bone, leading to reactive bone consolidation. While partial mandibulectomy with an osteocutaneous flap was indicated, a conservative surgical approach was chosen due to the patient's deteriorating general condition.

Under general anesthesia, necrotic bone fragments and inflamed soft tissue were carefully removed, along with conservative grinding of adjacent affected bone. Radiographic evaluation initially revealed a significant postoperative bone defect in the anterior mandible; however, follow-up assessments demonstrated progressive bone healing and reinforcement of the inferior mandibular border (Fig. 7). No mandibular fractures or recurrence were observed during the approximately three-year follow-up period.

Discussion

This study demonstrated that conservative surgical management can be a viable alternative to extensive surgical resection with microvascular reconstruction for advanced MRONJ in the anterior mandible, particularly when involving the genial tubercle and the inferior mandibular border.

The management of MRONJ includes non-operative and operative approaches across all disease stages.[1,4,10] While non-operative management is generally considered for early-stage disease or patients unable to tolerate surgery, spontaneous sequestration of exposed, necrotic bone without disease progression is often unpredictable.[4] In many cases, MRONJ tends to progress over time, necessitating surgical intervention. Furthermore, surgical treatment offers advantages such as complete mucosal coverage, improved quality of life, and the possibility of resuming ARD therapy.[3] Consequently, recent studies increasingly support surgical intervention as an effective strategy across all MRONJ stages.[1,10]

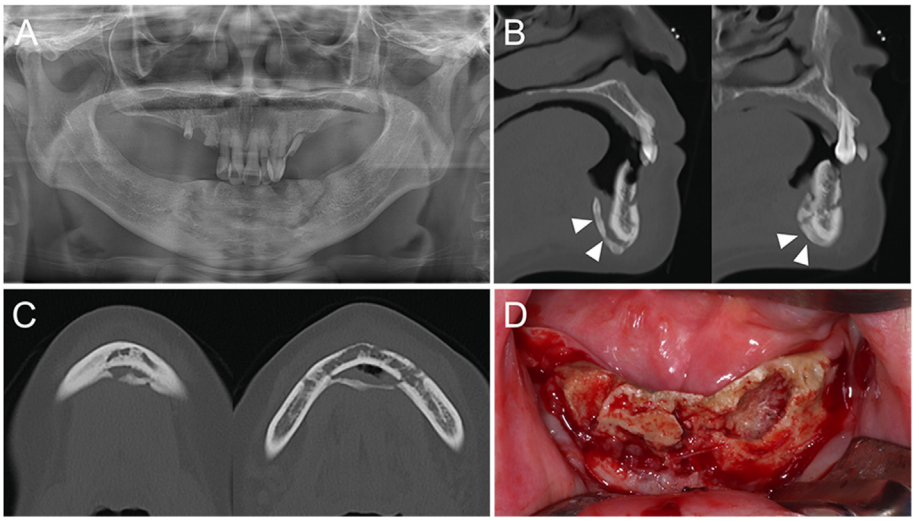

Figure 6 Preoperative radiographs and clinical photographs of Case 4. (A) Preoperative panoramic view. (B, C) Preoperative computed tomography images showing severe bone destruction extending to the inferior mandibular border, with pronounced periosteal reaction along the cortical bone, leading to consolidation (arrowhead). (D) Intraoperative clinical photograph.

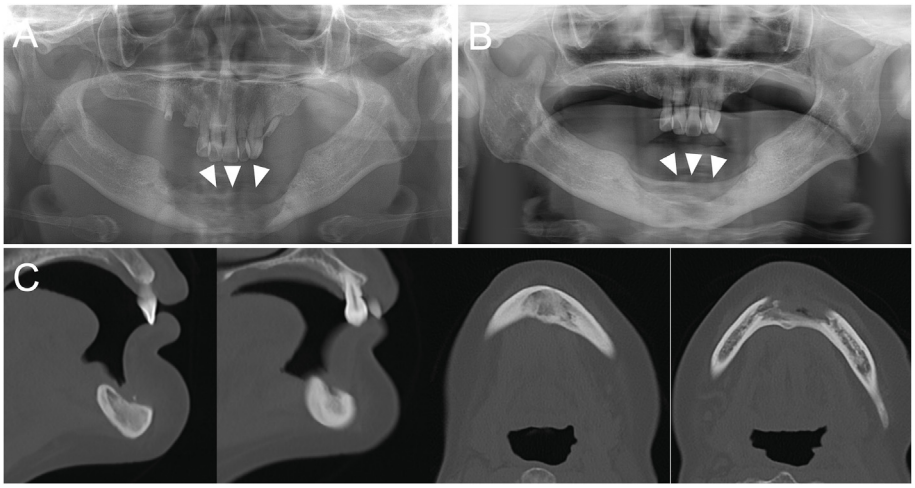

Figure 7 Postoperative radiographs of Case 4. (A) Panoramic view immediately after surgery showing postoperative bone defect (arrowhead). (B) Panoramic view at 32 months postoperatively, showing favorable bone healing with increased density and volume at the defect site (arrowhead). (C) Computed tomography images at 14 months postoperatively.

Surgical treatment options for MRONJ range from conservative curettage and sequestrectomy to partial maxillary or mandibular resection. The extent of surgery should be determined based on factors such as type, dosage, and administration route of ARDs, as well as the purpose of administration. Nonetheless, disease progression remains a key criterion for surgical decision-making. In advanced stage III MRONJ with involvement of the inferior border of mandible, extensive procedures such as segmental mandibulectomy are frequently indicated to secure clear margins, reduce recurrence risk, and increase cure rates.[5,6] Although wide bone resection with viable bleeding margins has been associated with favorable outcomes, such extensive interventions inevitably compromise mandibular continuity, resulting in functional impairments related to mastication, speech, and aesthetics.[3] Consequently, immediate reconstruction is often required. Microvascular free flap reconstruction using fibular or iliac bone is considered the gold standard for functional restoration; however, it entails prolonged operative time, specialized surgical expertise, and increased perioperative morbidity.[11,12] Alternatively, reconstruction using load-bearing plates has been employed, through this approach is prone to mechanical complications including plate fracture, deformation, and screw loosening, which may adversely affect long-term stability and functional outcome.[13,14] When segmental resection involves the anterior mandible, additional challenges arise due to the detachment of the geniohyoid and genioglossus muscles, often leading to substantial functional deficits. Even with subsequent muscle suspension techniques, complete restoration of function remains difficult. These considerations underscore the importance of a surgical strategy that not only ensures disease control

but also prioritizes the preservation of mandibular structure and function.

Osteoporosis predominantly affects the elderly, and MRONJ in this population is often accompanied by multiple systemic comorbidities, limiting their tolerance for extensive surgical procedures and prolonged anesthesia. Similarly, in cancer patients, factors such as widespread metastasis, poor general condition, and ongoing chemotherapy frequently preclude aggressive surgical intervention. Given these challenges, recent studies have suggested conservative surgical treatment as a valid therapeutic option for such patients.[3,15] Nisi et al.[15] reported that conservative surgical treatment achieved complete healing in 91.8 % of MRONJ patients who had received oral bisphosphonates for osteoporosis over a two-year follow-up period. Additionally, a systematic review by Vanpoecke et al.[3] suggested that, while the conservative surgical approach does not always result in full mucosal healing, it remains a reasonable alternative for patients who are unable to tolerate major surgical procedures. In our study, the mean age of patients with MRONJ occurring during osteoporosis treatment was 76.3 years, indicating a predominantly elderly population. One patient undergoing chemotherapy and hormone therapy for metastatic cancer also received conservative surgical treatment following a comprehensive risk-benefit assessment and consideration of patient preference. While most previous reports have focused on stage II MRONJ or cases involving oral bisphosphonates, our findings suggest that conservative surgery may also be effective in selected patients with advanced stage III MRONJ associated with intravenous bisphosphonates or cancer therapy. Moreover, favorable radiographic bone healing indicated not only clinical stability but also meaningful bone regeneration over time.

Conservative surgical treatment primarily involves sequestrectomy, debridement of inflamed soft tissue, and bone curettage.[3,15,16] In our study, we aimed to preserve mandibular structural integrity and enhance postoperative bone healing through conservative surgical approaches. While necrotic bone and inflamed soft tissue can be easily identified and removed intraoperatively, successful conservative treatment requires critical intraoperative decision-making beyond simple debridement. Even in cases where radiographic findings suggest significant bone destruction requiring extensive resection, intraoperative assessment often reveals viable bone with sufficient blood supply, particularly in areas with muscle attachments. As preservation of such bone is advantageous for postoperative healing, accurate intraoperative evaluation is essential. Additionally, as seen in Case 2, sequestration in the lingual cortex is often observed when MRONJ occurs in the anterior mandible.[17] Although such osteolytic pattern extending to the mandibular inferior border may initially appear to necessitate extensive surgery, a conservative approach preserving the labial bone can achieve favorable bone healing and functional recovery without recurrence. Therefore, a thorough preoperative evaluation of sequestration and osteolysis pattern is crucial for optimizing treatment strategies. In cases with pathologic fracture, direct bone contact between segments through conservative debridement rather than segmental resection can be beneficial for restoring mandibular continuity. As demonstrated in Case 3, despite limited initial bone contact, stabilization with a reconstruction plate allowed successful restoration of mandibular continuity and structural integrity within six months, followed by substantial bone regeneration and reinforcement during the postoperative period. Since occlusal forces tend to concentrate on the reconstruction plate, mechanical failures are frequent. However, as demonstrated in our cases, once mandibular continuity is re-established, the regenerated bone contributes to load sharing with the reconstruction plate, potentially contributing to long-term treatment success.

Despite the advantages of conservative surgical treatment, it is crucial to recognize the inherent limitations in MRONJ management. Achieving a clear surgical margin relies heavily on the surgeon's clinical judgment and experience. Typically, the extent of necrotic bone is assessed intraoperatively based on bleeding from the remaining bone. However, in areas with dense cortical structures, such as the lingual cortex and the inferior border of the mandible, bone bleeding may not always be readily observed, even if the bone is viable. When surgical margins are determined solely based on the presence of bone bleeding, there is a risk of unnecessary over-resection, which may compromise muscle attachments on the lingual side of the mandible and result in functional impairment.[14] In the present study, although selective bone grinding was utilized intraoperatively to continuously assess bone viability based on the surgeon's experience, and no recurrence was observed, inherent limitations remain in the accuracy of intraoperative evaluation. Therefore, adjunctive methods may be necessary to enhance surgical precision and ensure optimal bone preservation.

This study has several limitations. First, the number of included patients was small. MRONJ most frequently occurred in the posterior mandible, and cases confined to the anterior region were rare. Among the anterior cases, stage III lesions that extended beyond the alveolar bone to the genial tubercle or the inferior mandibular border were particularly uncommon. Second, it was difficult to perform both quantitative and qualitative assessments of treatment outcomes and bone healing. Although serial CT imaging and histological analysis of regenerated bone can provide valuable information, such evaluations were not feasible due to the lack of consistently acquired CT data and ethical limitations. To address these limitations, it is necessary that future studies include larger patient cohorts and incorporate both objective assessments, such as serial radiographic analysis, and subjective evaluations, including patient-reported outcome measures. This will ultimately contribute the development of optimal treatment strategies and improved treatment outcomes for patients with MRONJ.

In conclusion, this study demonstrates that conservative surgical management can serve as an alternative treatment approach to aggressive surgical treatment in patients with stage III MRONJ involving the anterior mandible. Furthermore, it highlights the importance of establishing a surgical strategy that optimally preserves viable bone and facilitates bone healing, as well as thorough intraoperative assessment to ensure successful treatment outcomes.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

Acknowledgments

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