Prediction and assessment of response to anti-inflammatory therapy in medication-related osteonecrosis of the jaw using harmonized quantitative bone SPECT/CT: A multicenter study

Kazuhiro Kitajima[1] MD,
Yu Iwabuchi[2] MD,
Yoshitaka Inui[3] MD,
Takashi Norikane[4] MD,
Kimiteru Ito[5] MD,
Hiromitsu Kishimoto[6] DDS, Hidetaka Miyashita[7] DDS,
Tetsuro Shiina[8] DDS,
Yumiko Ohbayashi[9] DDS,
Takao Ueno[10] DDS,
Hiromitsu Daisaki[11] PhD

1. Department of Radiology, School of Medicine, Hyogo Medical University, Nishinomiya, Japan.
2. Department of Radiology, Keio University School of Medicine, Tokyo, Japan.
3. Department of Radiology, Fujita Health University School of Medicine, Aichi, Japan.
4. Department of Radiology, Faculty of Medicine, Kagawa University, Kagawa, Japan.
5. Department of Diagnostic Radiology, National Cancer Center Hospital, Tokyo, Japan.
6. Department of Oral and Maxillofacial Surgery, School of Medicine, Hyogo Medical University, Nishinomiya, Japan.
7. Department of Dentistry and Oral Surgery, Keio University School of Medicine, Tokyo, Japan.
8. Department of Dentistry and Oral-Maxillofacial Surgery, Fujita Health University School of Medicine, Aichi, Japan.
9. Department of Oral and Maxillofacial Surgery, Faculty of Medicine, Kagawa University, Kagawa, Japan.
10. Department of Density, National Cancer Center Hospital, Tokyo, Japan.
11. Department of Graduate School of Radiological Technology, Gunma Prefectural College of Health Sciences, Maebashi, Japan.

Keywords: Medication-related osteonecrosis of the jaw - Therapeutic response - Prediction - Bone SPECT/CT - SUV

Corresponding author:
Kazuhiro Kitajima MD, PhD
Department of Radiology, Hyogo Medical University, 1-1 Mukogawa-cho, Nishinomiya, Hyogo, 663-8501 Japan
Phone: +81-798-45-6883,
Fax: +81-798-45-6262
kazu10041976@yahoo.co.jp

Received:
26 April 2026
Accepted revised:
30 June 2026

Abstract

Objective: The utility of harmonized quantitative bone single-photon emission computed tomography/computed tomography (SPECT/CT) parameters for prediction and assessment of treatment response to anti-inflammatory therapy for medication-related osteonecrosis of the jaw (MRONJ) was investigated in a multicenter study conducted in Japan. **Subjects and Methods:** Thirty-eight patients (40 lesions) clinically diagnosed with MRONJ underwent bone SPECT/CT scanning before initiation of anti-inflammatory therapy and again after at least three months of treatment at five hospitals. Using the GI-BONE software package, quantitative parameters including standard uptake value (SUV) parameters (SUVmax, SUVpeak, and SUVmean), metabolic bone volume (MBV), and total bone uptake (TBU) were calculated. Changes in quantitative parameters between the first and second SPECT/CT examinations were analyzed using the Wilcoxon test in both responders (downstaged lesions) and non-responders (upstaged lesions or no stage change). Pre-treatment values were compared between responders and non-responders using Student's t-test. **Results:** Following therapy, harmonized SUVmax, SUVpeak, SUVmean, MBV, and TBU values decreased significantly in the 23 responder lesions ($P<0.0001$ for all). In contrast, no significant reductions were observed in the 17 non-responder lesions ($P=0.18$, $P=0.26$, $P=0.19$, $P=0.86$, and $P=0.31$, respectively). Changes in harmonized SUVmax differentiated responders from non-responders with a sensitivity of 91.3% and specificity of 88.2%, using an optimal cut-off value of -17.0%. The corresponding sensitivity and specificity values for harmonized TBU change were 82.6% and 94.1%, respectively, with an optimal cut-off value of -38.0%. Pre-treatment harmonized SUVmax and SUVpeak were significantly higher in responders than in non-responders ($P=0.049$ and $P=0.047$, respectively). **Conclusions:** Harmonized quantitative bone SPECT/CT parameters, including SUV-derived parameters, MBV, and TBU, were useful for predicting and assessing anti-inflammatory therapeutic response in patients with MRONJ. Furthermore, higher pre-treatment SUVmax and SUVpeak were associated with a favorable response to anti-inflammatory therapy.

Hell J Nucl Med 2026; 29(2): 70-75 *Epub ahead of print: 6 August 2026* *Published online: 31 August 2026*

Introduction

A potentially severe adverse effect of antiresorptive therapy is medication-related osteonecrosis of the jaw (MRONJ), which significantly impacts the quality of life of affected individuals [1]. Diagnostic criteria include current or previous treatment with an antiresorptive or antiangiogenic agent, exposed bone or bone that can be probed through an intraoral or extraoral fistula in the maxillofacial region persisting for more than eight weeks, and absence of a history of radiation therapy to the jaws or obvious metastatic disease. Due to the widespread use of antiresorptive agents for a variety of clinical applications, MRONJ prevalence has significantly increased in recent years. A three-stage classification system was proposed by the American Association of Oral and Maxillofacial Surgeons (AAOMS) based on the extent and severity of bone infection, together with corresponding treatment strategies [2]. Management of MRONJ remains difficult, as available therapeutic options are limited to conservative methods such as prolonged antibiotic treatment, or surgical intervention including debridement, decortication, bone grafting, and partial jaw resection in advanced cases. Although control of local infection and inflammation is recognized as a key component for suppression as well as treatment of MRONJ, no objective index has been established for evaluating response to anti-inflammatory therapy in affected patients.

A study published in 2009 demonstrated the high sensitivity of bone scintigraphy for detecting MRONJ [3]. More recent studies using hybrid single photon emission compu-

ted tomography/computed tomography (SPECT/CT) have demonstrated improved diagnostic accuracy and enhance delineation of disease extent [4, 5]. Furthermore, CT-based attenuation correction along with advanced image reconstruction techniques has enabled quantitative analysis using SPECT/CT [6, 7]. This approach allows for calculation of parameters such as standardized uptake value (SUV) and metabolic lesion volume. The clinical utility of quantitative bone SPECT/CT for detection and staging of MRONJ has been reported [8-10].

For assessment of response to anti-inflammatory therapy for MRONJ, visual and qualitative evaluations based on bone scintigraphy and SPECT/CT findings have been reported [11], while another group presented a method for adjusting quantitative values obtained from SPECT examinations [12]. Although use of quantitative values derived from bone SPECT/CT has been reported for assessment of therapeutic response or MRONJ progression [13], no known multicenter clinical study has evaluated the utility of a harmonization strategy across different SPECT/CT systems for response assessment. Furthermore, the usefulness of predicting anti-inflammatory therapy response has not been established. The present study examined the utility of harmonized quantitative parameters derived from bone SPECT/CT imaging for predicting and evaluating treatment response to anti-inflammatory therapy in patients with MRONJ treated at several different institutions.

Subjects and Methods

Patients

This retrospective multicenter study of bone SPECT/CT findings in patients with MRONJ was conducted at Hyogo College of Medicine Hospital, Keio University Hospital, Fujita Health University Hospital, Kagawa University Hospital, and National Cancer Center Hospital. The study protocol was approved by the Ethics Review Committee of Hyogo Medical University (No. 4388) and the requirement for informed consent was waived. In addition, ethical approval was obtained from the participating institutions in accordance with the central ethical review standards of Hyogo Medical University. The study included 38 patients (8 males, 30 females; mean age 75.8±11.5 years, range 35-96 years) diagnosed with MRONJ according to the AAOMS criteria and treated between February 2015 and August 2024 at the participating hospitals. The diagnosis was confirmed by specialists certified by the Japanese Society of Oral and Maxillofacial Surgeons. Bone SPECT/CT scan examinations performed before initiation of anti-inflammatory therapy, and again during or after at least three months of treatment were included in the analysis. The AAOMS criteria [2] were used to confirm the diagnosis of MRONJ and determine disease stage (stages 1-3).

The study cohort consisted of 26 patients without malignancy who were receiving treatment for osteoporosis and 12 with bone metastasis (breast cancer, n=8; prostate cancer, n=2; lung cancer, n=2). Low-dose bone modifying agent (BMA) were administered in 36 treatment courses (alendronate, n=12; ibandronate, n=7; denosumab, n=6; risedronate, n=6; minodronate, n=3; etidronate, n=2) and high-dose BMA treatments in 18 (denosumab in 14, zoledronate in four), including treatment changes. A total of 40 MRONJ lesions were identified, including 35 located in the mandible and five in the maxilla. All patients received antibiotic therapy, while 21 underwent curettage and/or sequestrectomy between the first and second bone SPECT/CT examinations. For therapeutic response analysis, the 40 lesions were classifed as responders or non-responders. The responder group was comprised of lesions showing remission or downstaging, and the non-responder group included lesions showing progression or no change in stage.

Bone scintigraphy

Bone scintigraphy was performed three to four hours after intravenous administration of 555MBq of technetium-99m hydroxymethylene diphosphonate (^{99m}Tc-HMDP) at the five participating institutions using six SPECT/CT systems. These included two Discovery MM/CT 670 scanners (GE Healthcare), two Symbia T16 SPECT/CT scanners (Siemens Healthineers), and two Symbia T6 SPECT/CT scanners (Siemens Healthineers). Our previous report presented a summary of the imaging protocols and reconstruction conditions utilized [14].

Data analysis

Volume of interest (VOI) delineation was performed using the commercially available GI-BONE software package (Nihon Medi-Physics Co., Ltd., Tokyo, Japan) by a physician board-certified in both nuclear medicine and radiology. This software provides quantitative parameters, including maximum SUV (SUVmax), representing the highest metabolic activity within a lesion, peak SUV (SUVpeak), defined as the mean activity concentration within a 1-cm^3 spherical VOI centered on the hottest voxel within the lesion, metabolic bone volume (MBV), defined as the volume of metabolically active bone, and total bone uptake (TBU), calculated as SUVmean × MBV. Using the histogram method, each VOI was manually placed over the region of increased tracer uptake [8, 13, 15], a function that is incorporated into the GI-Bone software package. The threshold value was automatically calculated from a histogram generated for the target region by adding 0.5 standard deviation (SD) to the base value. The base value was defined as the pixel value correspond to 95% of the most frequently occurring value in the histogram.

As described in our previous report [14], a median value ±30% was used as the harmonization criterion in the present study. The optimal full width at half maximum (FWHM, mm) of a 3D Gaussian filter was then determined using the RC tool for harmonization (Nihon Medi-Physics Co., Ltd., Tokyo, Japan) so that the SUV of all hot spheres were within the predefined harmonization criterion.

Statistical analysis

All values are presented as mean ±SD. The Wilcoxon test was used to compare quantitative parameters between the first and second SPECT/CT examinations in both responders (downstaged lesions) and non-responders (upstaged lesions

or lesions with no stage change). To determine the optimal cut-off values for discriminating between responders and non-responders, receiver operating characteristic analysis was performed. Differences in pre-treatment quantitative parameters between the responder and non-responder groups were analyzed using Student's t-test. For statistical analysis, SAS, version 9.3 (SAS Institute Inc., Cary, NC, USA), was used, with P<0.05 considered to indicate statistical significance.

Results

The second SPECT/CT examination was performed a mean of 10.7±5.0 months (range, 3.1-21.9 months) after the initial examination. Before starting anti-inflammatory therapy, 10 lesions (25.0%) were classified as stage 1, 25 (62.5%) as stage 2, and five (12.5%) as stage 3. Among the 40 MRONJ lesions, 23 were classified as responders and 17 as non-responders. The responder group comprised lesions showing remission (n=13) or downstaging (n=10), while the non-responder group comprised lesions showing stage progression (n=7) or no change in stage (n=10). Curettage and/or sequestrectomy procedures were performed for 16 lesions (69.6%) in the responder group and five (29.4%) in the non-responder group, with a significantly higher frequency noted in the responder group (P<0.0001). Representative findings are shown in Figure 1.

Evaluation of treatment response

Harmonized SUVmax was significantly decreased in the 23 responder lesions following therapy (P<0.0001), with mean values of 10.64±5.96 (range, 3.46-24.61) and 5.58±2.65 (1.79-12.64) at the first and second SPECT/CT examinations, respectively, corresponding to a mean reduction rate of -43.2±20.2% (range, -71.3% to -1.7%) (Figure 2a). In contrast, no significant change in harmonized SUVmax was observed in the 17 non-responder lesions after therapy (P=0.18), with mean values at the first and second SPECT/CT examinations of 7.64±3.98 (3.37-16.94) and 7.39±3.47 (2.89-15.16), respectively, corresponding to a mean reduction rate of -1.23±14.6% (-22.9% to 28.1%) (Figure 3a). Changes in harmonized SUVmax differentiated responders from non-responders, with a sensitivity of 91.3% (21/23) and specificity of 88.2% (15/17) using an optimal cut-off value of -17.0%.

Harmonized SUVpeak decreased significantly in the 23 responder lesions following therapy (P<0.0001), with mean values of 9.18±5.18 (2.92-20.95) and 4.74±2.27 (1.51-10.82) at

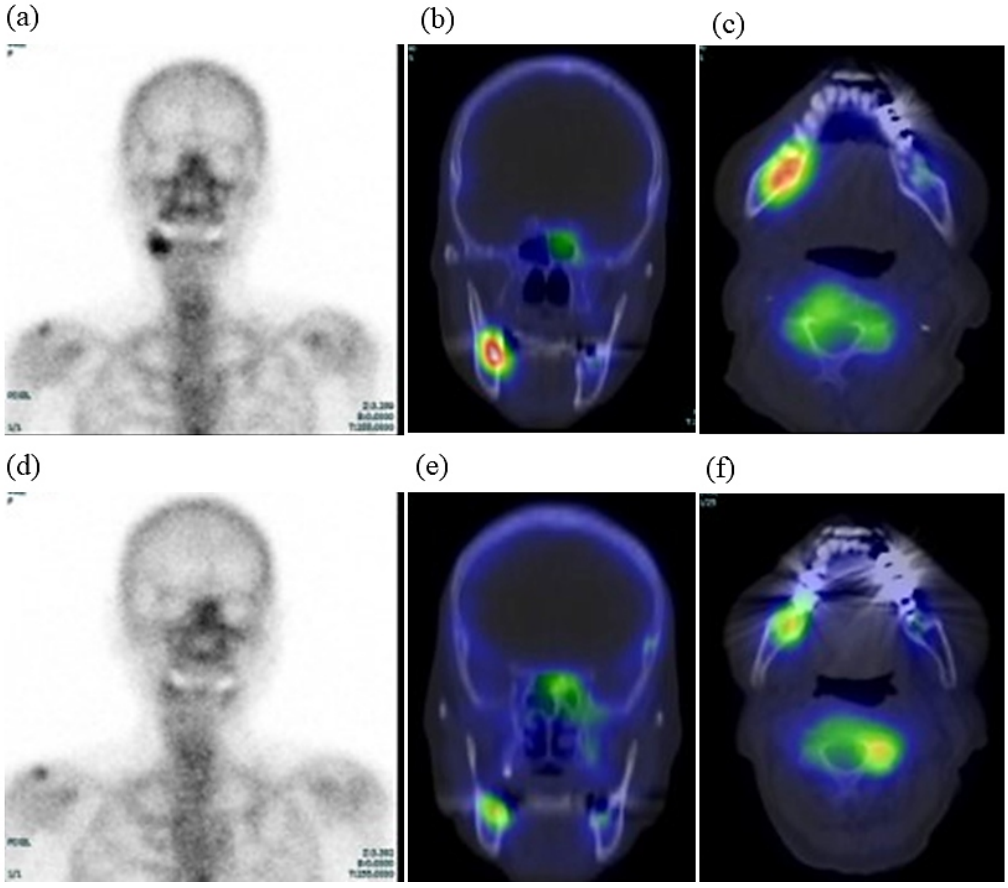

Figure 1. Pre- and post-treatment bone SPECT/CT findings in 88-year-old female with stage 2 MRONJ. (a-c) Pre-treatment and (d-f) post-treatment SPECT/CT images of the right mandible are shown (a, d: planar; b, e: coronal bone SPECT/CT; c, f: axial bone SPECT/CT). Before treatment, SUVmax, SUVpeak, SUVmean, MBV, and TBU values were 7.83, 6.44, 4.58, 8.23 mL, and 37.71, respectively. Following antimicrobial therapy, those were decreased to 2.98, 2.56, 1.79, 5.16 mL, and 9.23, respectively, consistent with treatment response.

the first and second SPECT/CT examinations, respectively, corresponding to a mean reduction rate of -43.9±20.2% (-73.7% to 2.99%) (Figure 2b). In contrast, no significant change in harmonized SUVpeak was observed in the 17 non-responder lesions after therapy (P=0.26), with mean values at the first and second SPECT/CT examinations of 6.39±3.28 (2.97-13.64) and 6.43±2.92 (2.53-12.13), respectively, corresponding to a mean reduction rate of 3.02±17.5% (-18.4% to 36.9%) (Figure 3b). Changes in harmonized SUVpeak differentiated responders from non-responders, with a sensitivity of 91.3% (21/23) and specificity of 100% (17/17) using an optimal cut-off value of -20.0%.

Harmonized SUVmean also decreased significantly in the 23 responder lesions following therapy (P<0.0001), with mean values of 6.03±2.98 (2.11-12.04) and 3.24±1.34 (1.02-5.91) at the first and second SPECT/CT examinations, respectively, corresponding to a mean reduction rate of -41.4±21.1% (-73.1% to -0.57%) (Figure 2c). In contrast, no significant change in harmonized SUVmean was observed in the 17 non-responder lesions after therapy (P=0.19), with mean values at the first and second SPECT/CT examinations of 4.64±2.30 (2.06-9.71) and 4.50±1.96 (2.05-8.94), respectively, corresponding to a mean reduction rate of -0.15±13.4% (-18.6% to 22.2%) (Figure 3c). Changes in harmonized SUVmean differentiated responders from non-responders, with a sensitivity of 86.9% (20/23) and specificity of 100% (17/17) using an optimal cut-off value of -20.0%.

Harmonized MBV (cm^3) decreased significantly in the 23 responder lesions following therapy (P<0.0001), with mean values of 16.46±8.02 (6.91-43.14) and 13.3±7.86 (3.41-39.34) at the first and second SPECT/CT examinations, respectively, corresponding to a mean reduction rate of -21.6±21.2% (-72.1% to 22.7%) (Figure 2d). In contrast, no significant change in harmonized MBV was observed in the 17 non-responder lesions (P=0.86), with mean values at the first and second SPECT/CT examinations of 17.07±10.0 (3.04-46.8) and 16.87±10.58 (3.04-46.8), respectively, corresponding to a mean reduction rate of -2.41±13.3% (-31.1% to 16.8%) (Figure 3d). Changes in harmonized MBV differentiated responders from non-responders, with a sensitivity of 60.9% (14/23) and specificity of 94.1% (16/17), using an optimal cut-off value of -15.0%.

Harmonized TBU decreased significantly in the 23 responder lesions following therapy (P<0.0001), with mean values of 109.8±101.53 (19.43-464.08) and 47.65±40.74 (5.51-181.82) at the first and second SPECT/CT examinations, respectively, corresponding to a mean reduction rate of -53.7±22.8% (-83.7% to -7.92%) (Figure 2e). In contrast, no significant change in harmonized TBU was observed in the 17 non-responder lesions (P=0.31), with mean values at the first and second SPECT/CT examinations of 92.36±80.58 (9.91-266.48) and 83.66±80.60 (6.77-285.29), respectively, corresponding to a mean reduction rate of -14.8±21.7% (-39.3% to 37.9%) (Figure 3e). Changes in harmonized TBU differentiated responders from non-responders, with a sensitivity of 82.6% (19/23) and specificity of 94.1% (16/17) using an optimal cut-off value of -38.0%.

Prediction of treatment response

Pre-treatment harmonized SUVmax and SUVpeak values were significantly higher in the responder group than in the non-responder group (P=0.049 and P=0.047, respectively). Pre-treatment harmonized SUVmean was also higher in the responder group, though the difference did not reach statistical significance (P=0.10). In contrast, pre-treatment harmonized MBV and TBU values were comparable between the responder and non-responder groups (P=0.83 and P=0.55, respectively).

Discussion

To the best of our knowledge, this multicenter study is the first to demonstrate that harmonized quantitative bone SPECT/CT parameters derived from different imaging systems can provide an objective means of assessing response to anti-inflammatory therapy in patients with MRONJ. Specifically, post-treatment changes in SUVmax, SUVpeak, SUVmean, MBV, and TBU values were useful for distinguishing responder from non-responder lesions. In addition, higher pre-treatment SUVmax and SUVpeak values were found to be associated with a favorable therapeutic response, whereas SUVmean, MBV, and TBU were not predictive of treatment response.

Three previous reports that evaluated bone scintigraphy results for assessment of treatment response have been presented [11-13]. Heimann et al. (2021) [11] studied the results of 34 osteomyelitis patients who underwent bone SPECT/CT and assessed tracer uptake qualitatively using a four-point scale (0, no uptake; 1, low uptake; 2, moderate uptake; 3, high uptake) rather than quantitative parameters. Their findings demonstrated the usefulness of bone SPECT/CT for monitoring treatment response, disease progression, and osteomyelitis-related complications of the jaw. Hata et al. (2020) [12] analyzed bone SPECT findings in 15 patients with MRONJ using adjusted SUVmax, calculated as the lesion SUVmax minus the mean SUVmax of bilateral cranial bones, and MBV, for which the threshold was defined as the mean SUVmax of the bilateral cranial bones +3. They found significant reductions in adjusted SUVmax (P=0.04) and MBV (P=0.01) following anti-inflammatory therapy when all MRONJ lesions were analyzed collectively. Thereafter, Moridera et al. (2023) [13] evaluated 18 MRONJ lesions in 16 patients who underwent quantitative bone SPECT/CT examinations before and during or after anti-inflammatory therapy. Significant reductions in SUVmax, SUVpeak, SUVmean, MBV, and TBU were observed in 11 responder lesions (P=0.003, P=0.006, P=0.004, P=0.003, and P=0.002, respectively), whereas no significant changes were noted in the seven non-responder lesions (P=0.17, P=0.16, P=0.26, P=0.96, and P=0.12, respectively). All three studies were conducted at a single institution and using a single SPECT/CT system.

Although multicenter studies generally provide stronger clinical evidence than single-center investigations, variabilities in SUV measurements obtained among different SPECT/CT systems have limited multicenter studies. To address this issue, our group previously established a software-based harmonization approach that standardizes quantitative values across scanners without compromising clinical

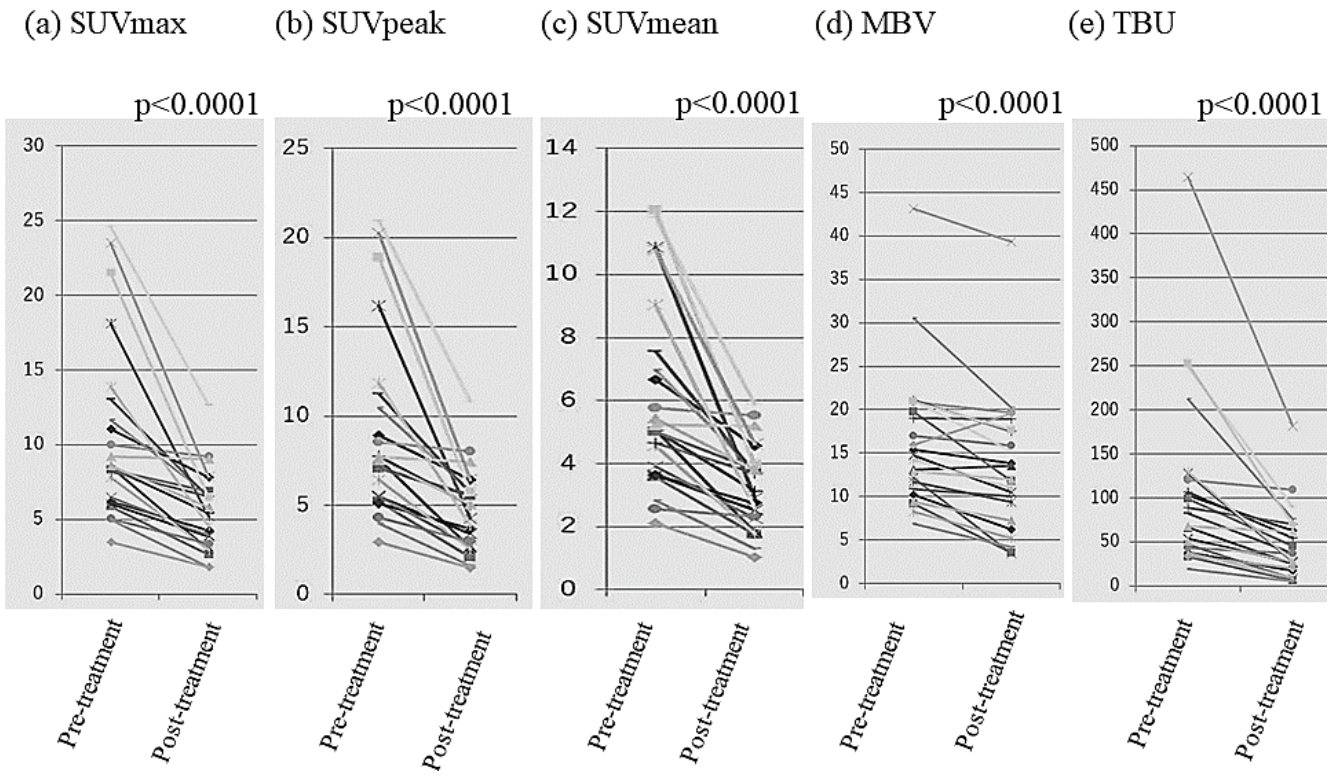

Figure 2. Transition line graphs showing changes in (a) harmonized SUVmax, (b) harmonized SUVpeak, (c) harmonized SUVmean, (d) harmonized MBV, and (e) harmonized TBU between the first and second SPECT/CT examinations in the 23 responder lesions.

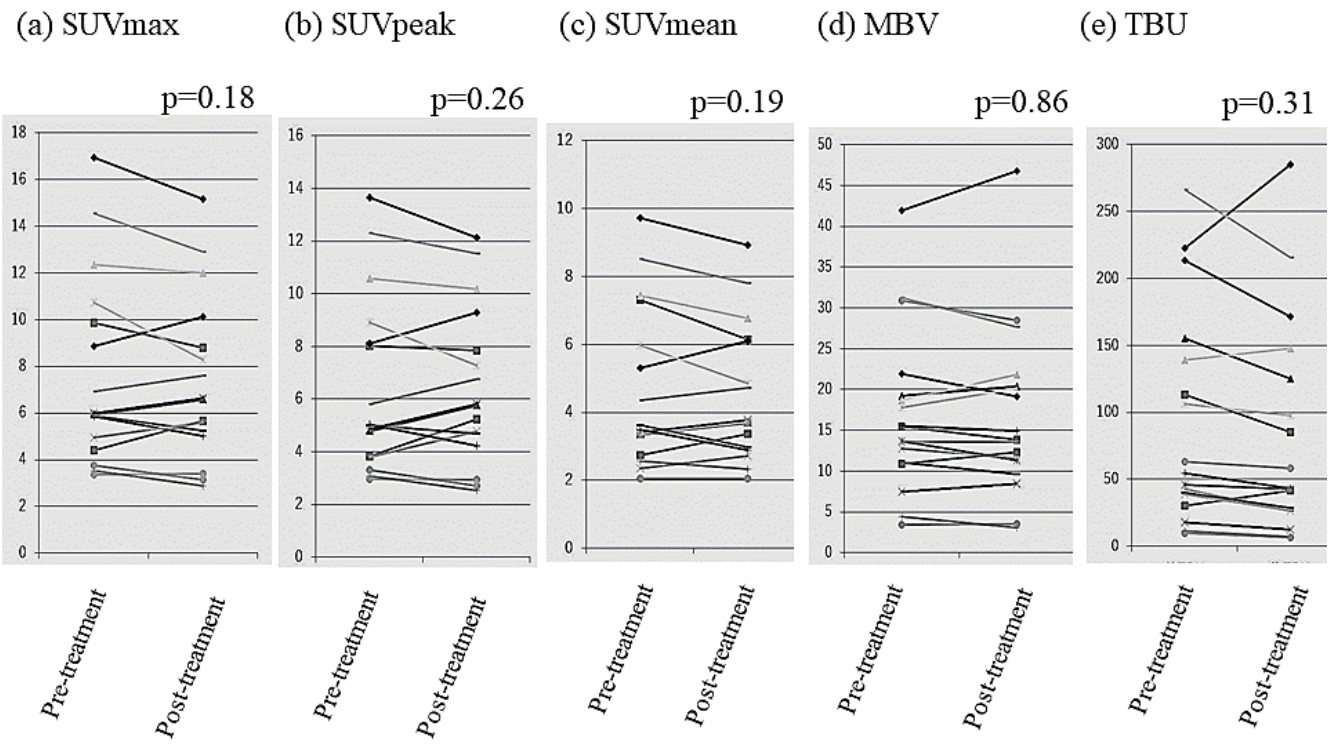

Figure 3. Transition line graphs showing changes in (a) harmonized SUVmax, (b) harmonized SUVpeak, (c) harmonized SUVmean, (d) harmonized MBV, and (e) harmonized TBU between the first and second SPECT/CT examinations in the 17 non-responder lesions.

image quality or requiring additional image reconstruction [14]. This harmonization strategy has facilitated multicenter investigations with different SPECT/CT scanners. Furthermore, Kitajima et al. (2026) [16] demonstrated that harmonized SUVmean and TBU values obtained from quantitative bone SPECT/CT examinations performed at multiple institutions were objective and reliable indicators of MRONJ disease activity and staging.

Consistent with the findings reported by Moridera et al. (2023) [13], all of the evaluated parameters (SUVmax, SUVpeak, SUVmean, MBV, and TBU) showed comparable performance for assessing response to anti-inflammatory therapy and none of those was found to be superior. In contrast, pre-treatment SUVmax and SUVpeak were predictive of anti-inflammatory therapy response, whereas SUVmean, MBV, and TBU were not. Further studies to determine the most informative SPECT/CT parameter for assessing MRONJ activity, disease staging, treatment response, and prognosis are needed.

Several limitations of the present study should be noted. First, the relatively small sample size may have limited the statistical power to detect significant associations. Prospective studies with larger patient cohorts are needed to further validate the utility of quantitative bone SPECT/CT for MRONJ. Second, because of the retrospective design, the interval between SPECT/CT examinations to assess response was not standardized. However, all surgically treated cases underwent follow-up SPECT/CT at least one month after surgery, thus it is unlikely that postoperative inflammatory changes related to surgical intervention substantially affected the imaging findings.

In conclusion, harmonized quantitative parameters derived from bone SPECT/CT, including SUVmax, SUVpeak, SUVmean, MBV, and TBU, provide objective and useful clinical information for evaluating response to anti-inflammatory therapy in patients with MRONJ. Furthermore, higher pre-treatment harmonized SUVmax and SUVpeak values were found to be associated with a favorable therapeutic response, suggesting their potential utility as predictive imaging biomarkers.

Kazuhiro Kitajima and Hiromitsu Daisaki have received research grants from Nihon Medi-Physics Co., Ltd. (Tokyo, Japan). The sponsor of this study had no role in its design or conduct, data collection or interpretation, or preparation of the report. There are no other potential conflicts of interest relevant to this study to be reported.

Compliance with Ethical Standards

All procedures performed in this study involving human participants were conducted in accordance with ethical standards of the institutional review board and the principles of the Declaration of Helsinki. This retrospective study was approved by the institutional review board and the requirement for informed consent was waived.

Funding Source

This study was supported by a JSPS KAKENHI grant (26K10601).

Bibliography

1. Khan AA, Morrison A, Hanley DA et al. Diagnosis and management of osteonecrosis of the jaw: a systematic review and international consensus. *J Bone Miner Res* 2015; 30: 3-23.
2. Ruggiero SL, Dodson TB, Aghaloo T et al. American Association of Oral and Maxillofacial Surgeons' Position Paper on Medication-Related Osteonecrosis of the Jaws-2022 Update. *J Oral Maxillofac Surg* 2022; 80: 920-43.
3. O'Ryan FS, Khoury S, Liao W et al. Intravenous bisphosphonate-related osteonecrosis of the jaw: bone scintigraphy as an early indicator. *J Oral Maxillofac Surg* 2009; 67: 1363-72.
4. Assaf AT, Zrnc TA, Remus CC et al. Intraindividual comparison of preoperative ^{99m}Tc-MDP SPECT/CT and intraoperative and histopathological findings in patients with bisphosphonate- or denosumab-related osteonecrosis of the jaw. *J Craniomaxillofac Surg* 2015; 43: 1461-9.
5. Miyashita H, Shiba H, Kawana H, Nakahara T. Clinical utility of three-dimensional SPECT/CT imaging as a guide for the resection of medication-related osteonecrosis of the jaw. *Int J Oral Maxillofac Surg* 2015; 44: 1106-9.
6. Zeintl J, Vija AH, Yahil A, et al. Quantitative accuracy of clinical ^{99m}Tc SPECT/CT using ordered-subset expectation maximization with 3-dimensional resolution recovery, attenuation, and scatter correction. *J Nucl Med* 2010; 51: 921-8.
7. Bailey DL, Willowson KP. An evidence-based review of quantitative SPECT imaging and potential clinical applications. *J Nucl Med* 2013; 54: 83-9.
8. Okui T, Kobayashi Y, Tsujimoto M et al. Quantitative evaluation of antiresorptive agent-related osteonecrosis of the jaw using bone single photon emission computed tomography in clinical settings: relationship between clinical stage and imaging. *Ann Nucl Med* 2020; 34: 620
9. Ogawa R, Ogura I. Analysis of medication-related osteonecrosis of the jaw with bone SPECT/CT: relationship between patient characteristics and maximum standardized uptake value. *Dentomaxillofac Radiol* 2021; 50: 20200516.
10. Moridera K, Kitajima K, Yoshikawa K et al. Usefulness of quantitative bone SPECT/CT for medication-related osteonecrosis of the jaw in clinical settings. *Jpn J Radiol* 2022; 40: 492-9.
11. Heimann I, Kuttenberger J, Della Chiesa A et al. Monitoring jaw osteomyelitis therapy with single-photon emission computed tomography/computed tomography. *Nucl Med Commun* 2021; 42: 51-7.
12. Hata H, Kitao T, Sato J et al. Monitoring indices of bone inflammatory activity of the jaw using SPECT bone scintigraphy: a study of ARONJ patients. *Sci Rep* 2020; 10: 11385.
13. Moridera K, Kitajima K, Yoshikawa K et al. Usefulness of quantitative bone SPECT/CT for evaluating medication-related osteonecrosis of the jaw treatment response. *Jpn J Radiol* 2023; 41: 760-7.
14. Kuromori I, Daisaki H, Owaki Y et al. Harmonization of Quantitative Values in Bone SPECT/CT for Medication-Related Osteonecrosis of the Jaw. *J Nucl Med Technol* 2025; 53: 345-52.
15. Ogura I, Kobayashi E, Nakahara K et al. Quantitative SPECT/CT imaging for medication-related osteonecrosis of the jaw: a preliminary study using volume-based parameters, comparison with chronic osteomyelitis. *Ann Nucl Med* 2019; 33: 776-82.
16. Kitajima K, Iwabuchi Y, Inui Y et al. Harmonized quantitative bone SPECT/CT parameters for risk assessment of medication-related osteonecrosis of the jaw - Multicenter study. *EJNMMI Res* 2026; 16: 60.