

Medical and Dental Professions' Varying Levels of Awareness Regarding Medication-related Osteonecrosis of the Jaw in Saudi Arabia? A Cross-sectional Study

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ABSTRACT

Aims: This study aimed to assess the awareness of the risk of medication-related osteonecrosis of the jaw (MRONJ) among general dental practitioners (GDPs) and primary care physicians (PCPs), focusing on the clinical implications and coordination of treating or identifying high-risk patients.

Materials and methods: Two Google Forms electronic questionnaires were distributed to 724 GDPs and 617 PCPs in primary care settings. One for PCPs with eight multiple choice questions and the other for GDPs with 10 multiple choice questions. A clinical case scenario and a section on open-ended comments were included in both questionnaires. The data obtained from each group were statistically analyzed and compared.

Results: A total of 239 GDPs and 220 PCPs participated in the study, with a response rate of 34.23%. The mean age of participants was 29.5 years and 54.35% were females (51.2% and 57.5% in the GDPs and PCPs group, respectively). Most participants had graduated from Saudi Arabia. Almost all dentists were aware of osteonecrosis of the jaw (95.1%), 68.3% of them were aware of the guidelines regarding bisphosphonate-related osteonecrosis of the jaw (BRONJ) and MRONJ, 60.5% rated their general knowledge about MRONJ as very poor to poor, and 91.8% did not know any guidelines regarding BRONJ or MRONJ. Among the participants, 75.3% did not know how MRONJ was present in the oral cavity. A total of 69.9% of participants were unaware of other factors associated with an increased risk of MRONJ.

Conclusion: MRONJ risk awareness varies greatly between dentists who diagnose and manage patients in dental clinics and physicians who write about medicines and therapies. Counseling sessions and greater coordination between dental and medical specialists are strongly suggested while prescribing antiresorptive drugs to prevent the consequent development of MRONJ.

Clinical significance: This study shows a significant lack of knowledge regarding MRONJ among GDPs and PCPs, which may affect the prevention and treatment of patients. Therefore, we urge GDPs and PCPs to take more information from scientific sources on this topic and more cooperation from specialties for the benefit of patients.

Keywords: Bisphosphonate, BRONJ, General dental practitioner, Jaw necrosis, Medication-related osteonecrosis of the jaw.

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INTRODUCTION

Bisphosphonates are anti-resorptive substances and were studied to prevent bone loss in the 1960s, leading to its development as a medicine. The Food and Drug Administration (FDA) approved alendronic acid for the treatment of osteoporosis in 1995.¹ The FDA approved intravenous bisphosphonates such as pamidronic acid and zoledronic acid in 1996 and 2002, respectively. Bisphosphonates bind to hydroxyapatite binding sites on bony surfaces, particularly those that are experiencing active resorption, and prevent osteoclastic bone resorption.^{1,2} In 2003, the first case of medication-related osteonecrosis of the jaw (MRONJ) was documented in a patient treated with bisphosphonates.² Subsequently, the literature indicated that the majority of cases were observed in patients receiving intravenous infusions of bisphosphonates for Paget's disease, cancer-related hypercalcemia, osteolytic lesions from multiple myeloma, and solid tumor bone metastases.^{3,4} In 2004, healthcare professionals were alerted to the possibility of MRONJ by Novartis, a company that produces pamidronic and zoledronic acids. In 2005, this applied to all bisphosphonates, including oral formulations. Beginning in 2008, warnings were added to the British National Formulary.² In 2015, the European Medicines Agency urged doctors to provide patients with reminder cards that included information about the risk of MRONJ along with their

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bisphosphonate prescription. Suppression of osteoclast activity or reduction of osteoclast numbers are just two of the many possibilities

Table 1: MRONJ stages, diagnosis, and treatment for each stage²⁰

Stage	Diagnosis	Treatment
Patients at risk	No apparent necrotic bone in patients who have been treated with either oral or IV bisphosphonates	No treatment, but patients must be informed about the symptoms and risk of developing MRONJ
Stage 0	No clinical evidence of necrotic bone, but non-specific clinical findings, radiographic changes, and symptoms	Symptomatic treatment. Analgesics and antibiotics when necessary. These patients must be monitored closely
Stage 1	Exposed and necrotic bone, or fistulae that probes to the bone in patients who are asymptomatic and have no evidence of infection	No treatment is needed, only informing patients and reviewing the indication of BPs. Consider using oral topical chlorhexidine 0.12%
Stage 2	Exposed and necrotic bone, or fistulae that probes to the bone, associated with infection as evidenced by pain and erythema in the region of the exposed bone, with or without purulent drainage	Symptomatic treatment with antibiotics, analgesics, and rinses. Debridement to alleviate the irritation of the soft tissues area and infection control
Stage 3	Exposed and necrotic bone or a fistula that probes to bone in patients with pain, infection, and one or more of the following: exposed and necrotic bone extending beyond the region of alveolar bone (i.e., inferior border and ramus in the mandible, maxillary sinus, and zygoma in the maxilla) resulting in pathologic fracture, extra-oral fistula, oral-antral/oral-nasal communication or osteolysis extending to the inferior border of the mandible of sinus floor	Debridement including resection in conjunction with antibiotic therapy, palliative treatment with resolution of the acute infection and pain

put forth for the mechanism of action of bisphosphonates.^{5,6} In addition, bisphosphonates may prevent angiogenesis.^{7,8} The increased bone resorption in the context of dental disease, along with the thin mucosa on top and a direct pathway through the periodontal ligament with the external environment, make the jaws an ideal breeding ground for MRONJ to develop.^{6,8}

In patients receiving intravenous bisphosphonates, the prevalence ranges from 0.2 to 6.7%, and in patients receiving oral bisphosphonates, the prevalence ranges from 0.004 to 0.2%.⁹ Denosumab, an antiresorptive drug, has an incidence of MRONJ that ranges from 0.7 to 3%.^{10,11}

Current guidelines define MRONJ as “a severe medication side effect characterized by nonhealing exposed bone or bone that may be probed through an extra-oral or intra-oral fistula in the maxilla or mandible and that has been present for longer than 8 weeks, without radiation exposure to the head and neck region, in patients who are currently receiving or have previously received antiresorptive medicine” such as alendronic acid (bisphosphonate), or antiangiogenic therapy such as sunitinib, and typically observed in the maxillofacial area.¹² The MRONJ staging system was developed by Ruggiero et al.¹³ 2006, adopted by the Association of Oral and Maxillofacial Surgeons (AAOMS), and updated in 2014 (Table 1).¹⁴

Despite the known risks and documented complications associated with antiresorptive medications prescribed for the treatment of cancer, Paget’s, osteoporosis, and other diseases that are typically prescribed to patients by medical professionals, there remains a knowledge gap regarding MRONJ risk awareness, follow-up, and coordination between dental professionals and medical specialists. Therefore, in this study, we aimed to evaluate the knowledge of general dental practitioners (GDPs) and primary care physicians (PCPs) about MRONJ and the clinical implications of treatment or identification of patients at high risk for MRONJ. To protect them early before developing MRONJ by periodically reviewing the dentist, identifying cases that may require early intervention by GDPs, and knowing ways to treat simple cases that

can be dealt with in primary clinics to reduce the burden on patients and secondary hospitals.

MATERIALS AND METHODS

Study Setting and Design

In this study, we aimed to determine the awareness of GDPs and PCPs working in family medicine clinics in primary care settings regarding MRONJ and the drugs that might be related to its occurrence. Ethical approval was obtained from the Institutional Review Board (of) General Directorate of Health Affairs in Madinah (IRB log number 23-039).

This study examined whether GDPs would be willing to perform simple extraction on patients taking bisphosphonates, and if not, what might be done to increase their comfort levels while caring for this group of patients. Additionally, whether the PCPs warned their patients before prescribing the medication involved, to minimize the risk of MRONJ.

Study Tools and Study Variables

To assess medical and dental professionals’ knowledge and awareness of MRONJ, two separate electronic questionnaires were created in Google Forms: one for PCPs with eight multiple choice questions and the other for GDPs with 10 multiple choice questions. Both questionnaires included a clinical case scenario and a section for open-ended comments (Tables 2 and 3). Questionnaires were adapted from published articles by Rahman et al.¹⁵ and Tanna et al.²

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were as follows: both GDPs and PCPs who practice and have a full license to practice in Saudi Arabia (regardless of the year of graduation); both GDPs and PCPs should work in a primary care setting; those who are specialized in any discipline in dentistry were excluded; and those not working in a primary care setting were excluded. For sample size calculation, in the selected cities, there were data on how many licensed dentists

Table 2: The statistics collected from the GDPs group's eight questions, with a percentage and analysis for each answer

<i>How would you rate your knowledge about MRONJ in general?</i>					<i>p-value</i>
Very poor "1"	Poor "2"	Fair "3"	Good "4"	Excellent "5"	
19 (7.9%)	41 (17%)	95 (39.7%)	62 (26.1%)	22 (9.3%)	0.119
Are you aware of the term (osteonecrosis of the jaw)?					
Yes (95.1%)		No (1.2%)		I'm not sure (3.7%)	0.000
Other than Bisphosphonates, are you aware of any other drugs that can cause osteonecrosis of the jaw?					
Yes (45.1%)		No (35.4%)		I'm not sure (19.5%)	0.018
Do you think patients on risk of (MRONJ) needs specialized treatment planning?					
Yes (97.6%)		No (0%)		I'm not sure (2.4%)	0.000
Do you know any guidelines regarding Bisphosphonate related osteonecrosis of the jaw (BRONJ)/MRONJ?					
Yes (68.3%)		No (19.5%)		I'm not sure (12.2%)	0.179
Are you aware that other factors are associated with increasing risk of MRONJ?					
Yes (70.7%)		No (14.6%)		I'm not sure (14.6%)	0.168
Do you know the clinical stages of MRONJ?					
Yes (31.7%)		No (39%)		I'm not sure (29.3%)	0.000
A patient attends your clinic for a simple non-surgical extraction. He has been taking oral Alendronic acid for 1 year for osteoporosis. The patient has no other medical problems. Would you be happy to remove the tooth in primary care setting?					
Yes (24.4%)		No (54.9%)		I'm not sure (20.7%)	0.000

Table 3: The data extracted from the 10 questions that were asked of the PCPs group, with a percentage for each answer

<i>How would you rate your knowledge about MRONJ in general?</i>					<i>p-value</i>
Very poor "1"	Poor "2"	fair "3"	Good "4"	Excellent "5"	
81 (36.8%)	52 (23.7%)	55 (25%)	23 (10.5%)	9 (4%)	0.000
Are you aware of the term (osteonecrosis of the Jaw)?					
Yes (65.8%)		No (24.7%)		I'm not sure (9.6%)	0.349
Are you familiar with the term Bisphosphonate related osteonecrosis of the jaw (BRONJ)?					
Yes (61.6%)		No (31.5%)		I'm not sure (6.8%)	0.252
Are you aware of change in terminology from BRONJ to MRONJ?					
Yes (5.5%)		0.000		I'm not sure (11%)	0.000
Other than Bisphosphonates, are you aware of any other drugs that can cause osteonecrosis of the jaw?					
Yes (28.8%)		No (60.3%)		I'm not sure (11%)	0.001
Do you know any guidelines regarding BRONJ/MRONJ?					
Yes (8.2%)		0.000		I'm not sure (4.1%)	0.000
Do you know how MRONJ presents in oral cavity?					
Yes (24.7%)		No (63%)		I'm not sure (12.3%)	0.000
Aware that other factors are associated with increasing risk of MRONJ?					
Yes (30.1%)		No (60.3%)		I'm not sure (9.6%)	0.002
Have you met a patient who developed MRONJ in your care?					
Yes (2.7%)		No (95.9%)		I'm not sure (1.4%)	0.003
A patient attends your clinic, and you want to describe an oral Alendronic acid for osteoporosis. Do you recommend for this patient to see a dentist for clinical examination or regular check-up?					
Yes (35.6%)		No (39.7%)		I'm not sure (24.7%)	0.000

and physicians there were (which was about 27,181 according to the Saudi Commission for Health Specialties), but there was no clear data on how many of them work in primary care. Therefore, the plan was to contact as many GDPs and PCPs as possible and ask them if they work in primary care to include them in this study.

Data Collection Technique

Dental and medical colleagues searched for potential participants on social media platforms, such as WhatsApp, Twitter, and Facebook. When the inclusion/exclusion criteria were met, they were asked to fill out the questionnaires after obtaining consent to

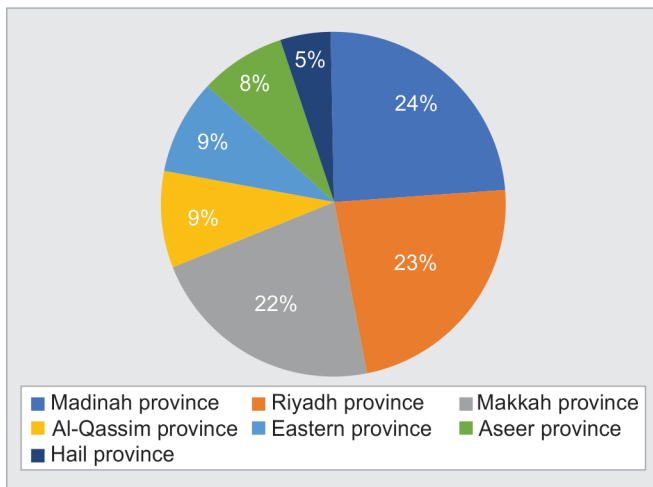


Fig. 1: Percentage of participants from both groups according to different provinces in Saudi Arabia

participate in the study. A total of 1,341 potential participants were contacted (GDPs 724 and PCPs 617) from different cities in Saudi Arabia, including Madinah, Riyadh, Jeddah, Makkah, Al-Qassim, Hail, Dammam, and Abha. The study was conducted from April 25, 2023 to October 30, 2023. IBM SPSS Statistics 29.0 was used to do all the statistical analysis.

RESULTS

A total of 1,341 GDPs and PCPs were contacted (724 GDPs and 617 PCPs). The overall response rate was 34.23%, among which 239 GDPs and 220 PCPs agreed and completed the questionnaire (Fig. 1). The age range was 25–60 years, with the mean age of participants being 29.5 and the median being 30 years. Among the participants, 54.35% were females and 45.64% were males (51.2% in the GDPs group and 57.5% female in the PCPs group). Most of the participants had graduated from Saudi Arabia; however, seven GDPs and three PCPs had graduated from Egypt, and six had graduated from Jordan.

In the GDPs group, when asked about their general knowledge of MRONJ, the majority assessed themselves as having fair-to-good knowledge (65.8%), as given in Table 2. Almost all dentists were aware of jaw osteonecrosis (95.1%; $p = 0.000$). Regarding drugs that could cause osteonecrosis of the jaw apart from bisphosphonates, more than half of the participants did not know or were unsure about them (54.9%, $p = 0.018$). Almost all participants in the GDPs group agreed that patients at risk of MRONJ required specialized treatment planning (97.6%, $p = 0.000$). Among the participants, 68.3% were aware of BRONJ and MRONJ guidelines, additionally, 70.7% of dentists were aware of the increased risk of MRONJ. A total of 68.3% of participants did not know or were unsure about the clinical stages of MRONJ. Finally, 75.6% of the dentists in this group were not confident enough to perform a simple non-surgical extraction for a patient on oral alendronic acid for 1 year for osteoporosis. When the participants were asked why they would not extract such a case, there were various answers. The reasons are as follows: No knowledge about the drug the patient was using, need to consult with the patient’s physician prior to the procedure, underprepared clinic to manage extraction-related complications, managing such a case was not within the scope

of their ability, and the patient should be referred to an oral and maxillofacial surgery clinic.

In the PCPs group, 60.5% of the participants rated their general knowledge of MRONJ as very poor to poor (1–2 out of 5). 65.8% of physicians were aware of the term “osteonecrosis of the jaw” ($p = 0.349$). Among the participants, 61.6% were aware of the term bisphosphonate-related osteonecrosis of the jaw ($p = 0.252$). However, 83.6% were unaware of the change in terminology from BRONJ to MRONJ ($p < 0.05$). Additionally, 71.3% of the participants were unaware of any other drugs that could cause jaw osteonecrosis. A total of 91.8% of the participants did not know any guidelines regarding BRONJ or MRONJ. Among the participants, 75.3% did not know how MRONJ was present in their oral cavities. A total of 69.9% of participants were unaware of other factors associated with an increased risk of MRONJ. A total of 97.3% of participants had never met a patient who developed MRONJ in their care. Finally, when the participants in this group were asked if a patient attended your clinic and wanted to prescribe oral alendronic acid for osteoporosis, do you recommend that this patient see a dentist for a clinical examination or regular check-up? A total of 64.4% said that they would not recommend that the patient undergo a dental examination (Table 3).

Gender differences in knowledge levels were not statistically significant within the GDP group ($p = 0.180$) but were significant within the PCP group ($p = 0.012$) as females had more knowledge. With regard to age, the young adults’ degree of knowledge increased significantly more than that of the older GDP group; however, the PCP group’s level of knowledge was unaffected by age.

DISCUSSION

It was not until 2004 that the warning of the MRONJ risk became official. These drugs were used and approved in 1995. Many factors contribute to the development of MRONJ, including the medication itself, method of administration, duration of drug intake, and the reason for medication.² MRONJ can adversely affect the quality of life of patients.^{16,17}

Bisphosphonates (oral and IV), RANK-L inhibitors such as denosumab, and antiangiogenic drugs including tyrosine kinase inhibitors and humanized monoclonal antibodies are among the drugs known to be associated with MRONJ; it is important to consider the medication itself, the route of administration, and the disease for which the medication is being used.^{18,19} The American AAOMS advised changing the term “medication-related osteonecrosis of the jaw” (MRONJ) to “bisphosphonate-related ONJ (BRONJ)”. Furthermore, evidence shows that patients using intravenous bisphosphonates for cancer treatment have a higher chance of developing MRONJ than those receiving oral or intravenous bisphosphonates for treating osteoporosis. Additionally, evidence indicates that when patients undergo a dental examination and preventative measures are taken before taking the medicine, the incidence of MRONJ is reduced by half.^{19,20} An additional category of antiresorptive medications was shown to have the same risk of jaw osteonecrosis; hence, antiresorptive medications were linked to BRONJ and MRONJ.

In the present study, the data showed that GDP participants were evaluated as having fair-to-good knowledge (65.8%) and were aware of the osteonecrosis of the jaw; patients with the risk of MRONJ needed specialized treatment planning (95.1%). However, they did not know medications apart from bisphosphonates that increase the risk of MRONJ, which could result in the inability to identify

patients who are at risk in busy clinics and could expose patients to dental treatments that may involve manipulation of gingiva and apical tissues, such as scaling, root planning, root canal treatment, and the use of clamps. Moreover, most participants (68.3%) in this group were unaware of the clinical stages of MRONJ, which could lead to misdiagnosis of the lesion or affect treatment outcomes. Lastly, in this group, 75.6% of the participants did not perform simple extractions on patients who were taking alendronic acid for 1 year for osteoporosis, even though the risk of developing MRONJ was low according to the Scottish Dental Clinical Effectiveness Program (SDCEP) Oral Health Management of Patients at Risk of Medication-Related Osteonecrosis of the Jaw.²¹ In such cases, it is not contraindicated to perform extractions in a primary care setting, and if a complication occurs in the early stages of MRONJ (stages 0 and 1), it can be managed in the primary care setting, and refer if a complication occurs in stages 2 and 3, especially in cases where the risk is low. Referring patients may delay their treatment and take a longer time to reach secondary care, which may be accompanied by a risk of infection. In addition, referring patients increases the burden on the hospital, and there is a global trend to make primary care do what is required to help patients effectively; cases are reserved for those who really require it.²²

However, for the PCP group, the data showed a remarkable deficiency in their knowledge regarding MRONJ, as they rated their knowledge of this topic as very poor to poor (60.5%). Even though the AAOMS in 2014 changed the term from BRONJ to MRONJ,²³ 83.6% of the participants were unaware of this change, which may reflect a lack of knowledge about this condition, and affects the appropriate diagnosis or even identification of other medications that could cause MRONJ, thereby affecting the quality of treatment. The lack of knowledge about medications apart from bisphosphonates was clear when the participants were asked if they were aware of other drugs or factors that could cause osteonecrosis of the jaw, and 71.3% did not have this information. Among the participants, 75.3% did not know the presentation of MRONJ in the oral cavity, which could lead to misdiagnosis and delay of treatment, especially in the early stages of MRONJ (stages 0 and 1), thereby worsening the condition and affecting the success of the surgical intervention.^{23,24} Although different guidelines have been published for the management of patients at risk of MRONJ, such as the position paper by the AAOMS,¹⁴ and the oral health management of patients at risk of MRONJ by the SDCEP,²¹ 91.8% of the participants were not aware of these guidelines. Lastly, the literature showed that dental examination and treatment before starting medications that could cause MRONJ are crucial in reducing the incidence of MRONJ;²⁵ however, 64.4% of participants would not recommend that their patients visit a dentist for a dental examination before they prescribe oral alendronic acid for osteoporosis.

The results of this study can be compared with those of other studies conducted in the UK by Rahman et al.¹⁵ 2018 and Tanna et al.² 2017, who evaluated the knowledge of PCPs and GDPs regarding MRONJ and found that there is a lack of knowledge among doctors involved in this aspect, and it is important to increase awareness among them. Therefore, it can be said that the lack of knowledge about this condition among doctors in primary health care is a global problem and must be taken into serious consideration.

Numerous patients regularly receive antiresorptive prescriptions, which have been linked to the emergence of MRONJ. These patients may have been unaware of the minuscule possibility

of developing MRONJ. Currently, prevention is the only proven strategy to reduce the incidence of MRONJ. This study assessed the level of awareness of MRONJ among general dental and medical practitioners in primary care in Saudi Arabia. The results of this study demonstrate that little information exists regarding MRONJ in GDPs and PCPs. Therefore, we have advised the importance of increasing knowledge by giving lectures and brochures with information specific to PCPs and GDPs and reminding them about published guidelines, such as the SDCEP guidelines, as well as the importance of coordinating with different specialties to improve the prevention and treatment of patients at risk for MRONJ. Finally, we would like to point out the importance of educating patients before starting medications and undergoing regular dental visits to reduce the incidence of this condition.

It is important that GDPs and PCPs should be aware of the risks associated with bisphosphonates, RANK-L inhibitors, and antiangiogenic and humanized monoclonal antibodies. While treating patients on these medications, prevention of this condition is crucial.^{2,15} There will be pressure for more dentoalveolar surgeries to be performed in primary care settings as a result of forthcoming changes in the commissioning processes for oral and maxillofacial surgery. To effectively handle these situations and determine when to refer more complex cases or suspected MRONJ lesions, GDPs must ensure that they are skilled and confident in their abilities.²

Patients who take medicines for common illnesses, such as osteoporosis, or those who take medications for the treatment of tumors fall into two categories that are at risk for MRONJ. Patients with osteoporosis are frequently given low-dose oral antiresorptive medications by PCPs (general practitioners). However, oral or intravenous prescription of higher dose antiangiogenic drugs for the treatment of cancer requires specialists, including oncologists and rheumatologists. The risk of developing MRONJ is thought to be substantially lower in individuals using medications for osteoporosis than in those taking cancer medications.^{14,22}

This study has some limitations, including that the sample size is small, many of the GDPs and PCPs could not be reached because they were not active on social media, and it was very difficult to visit them in each primary care setting in Saudi Arabia. Therefore, we recommend more studies with a larger sample size to determine which way could help increase awareness among target GDPs and PCPs.

CONCLUSION

The findings show how GDPs and PCPs in primary care settings view patients at risk for MRONJ and indicate the need for further training to boost the doctors' confidence in executing straightforward exodontia in a primary care setting, and to identify patients at risk by knowing the medications that could cause MRONJ, as well as educating patients and referring them to their dentists before starting these medications. We must ensure that doctors administering these treatments have a better understanding of potential MRONJ concerns and have instructions on when to refer for the provision of dentoalveolar services in primary care continues.

Data Availability Statement

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to data protection guidelines according to ethics approval.

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REFERENCES

- Wang J, Goodger NM, Pogrel MA. Osteonecrosis of the jaws associated with cancer chemotherapy. *J Oral Maxillofac Surg* 2003;61(9):1104–1107. DOI: 10.1016/s0278-2391(03)00328-8.
- Tanna N, Steel C, Stagnell S, et al. Awareness of medication related osteonecrosis of the jaws (MRONJ) amongst general dental practitioners. *Br Dent J* 2017;222(2):121–125. DOI: 10.1038/sj.bdj.2017.79.
- Wooltorton E. Patients receiving intravenous bisphosphonates should avoid invasive dental procedures. *CMAJ* 2005;172(13):1684–1684. DOI: 10.1503/cmaj.050640.
- Baqain ZH, Sawair FA, Tamimi Z, et al. Osteonecrosis of jaws related to intravenous bisphosphonates: The experience of a Jordanian teaching hospital. *Ann R Coll Surg Engl* 2010;92(6):489–494. DOI: 10.1308/003588410X12699663903395.
- Baron R, Ferrari S, Russell RGG. Denosumab and bisphosphonates: different mechanisms of action and effects. *Bone* 2011;48(4):677–692. DOI: 10.1016/j.bone.2010.11.020.
- Russell RGG, Watts NB, Ebetino FH, et al. Mechanisms of action of bisphosphonates: similarities and differences and their potential influence on clinical efficacy. *Osteoporos Int* 2008;19(6):733–759. DOI: 10.1007/s00198-007-0540-8.
- Yamashita J, McCauley LK. Antiresorptives and osteonecrosis of the jaw. *J Evid Based Dent Pract* 2012;12(3 Suppl):233–247. DOI: 10.1016/S1532-3382(12)70046-5.
- Landesberg R, Woo V, Cremers S, et al. Potential pathophysiological mechanisms in osteonecrosis of the jaw. *Ann N Y Acad Sci* 2011;1218:62–79. DOI: 10.1111/j.1749-6632.2010.05835.x.
- Lo JC, O’Ryan FS, Gordon NP, et al. Prevalence of osteonecrosis of the jaw in patients with oral bisphosphonate exposure. *J Oral Maxillofac Surg* 2010;68(2):243–253. DOI: 10.1016/j.joms.2009.03.050.
- Hajeri S, Alturkistany Y. Medication-related osteonecrosis of the jaw after dental clearance: prevalence in an oncology center. *Saudi Dent J* 2022;34(6):479–484. DOI: 10.1016/j.sdentj.2022.06.004.
- Scagliotti GV, Hirsh V, Siena S, et al. Overall survival improvement in patients with lung cancer and bone metastases treated with denosumab versus zoledronic acid: subgroup analysis from a randomized phase 3 study. *J Thorac Oncol* 2012;7(12):1823–1829. DOI: 10.1097/JTO.0b013e31826aec2b.
- Kün-Darbois JD, Fauvel F. Medication-related osteonecrosis and osteoradionecrosis of the jaws: Update and current management. *Morphologie* 2021;105(349):170–187. DOI: 10.1016/j.morpho.2020.11.008.
- Ruggiero SL, Fantasia J, Carlson E. Bisphosphonate-related osteonecrosis of the jaw: Background and guidelines for diagnosis, staging and management. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2006;102(4):433–441. DOI: 10.1016/j.tripleo.2006.06.004.
- Ruggiero SL, Dodson TB, Fantasia J, et al. American Association of Oral and Maxillofacial Surgeons position paper on medication-related osteonecrosis of the jaw—2014 update. *J Oral Maxillofac Surg* 2014;72(10):1938–1956. DOI: 10.1016/j.joms.2014.04.031.
- Rahman Z, Nayani S, Anstey H, et al. A survey evaluating the awareness of MRONJ within the Birmingham GMP community. *Oral Surg* 2018;12(1):22–29. DOI: 10.1111/ors.12372.
- Tenore G, Mohsen A, Rossi AF, et al. Does medication-related osteonecrosis of the jaw influence the quality of life of cancer patients? *Biomedicines* 2020;8(4):95. DOI: 10.3390/biomedicines8040095.
- Vandone AM, Donadio M, Mozzati M, et al. Impact of dental care in the prevention of bisphosphonate-associated osteonecrosis of the jaw: A single-center clinical experience. *Ann Oncol* 2012;23(1):193–200. DOI: 10.1093/annonc/mdr039.
- Kanwar N, Bakr MM, Meer M, et al. Emerging therapies with potential risks of medicine-related osteonecrosis of the jaw: A review of the literature. *Br Dent J* 2020;228(11):886–892. DOI: 10.1038/s41415-020-1642-3.
- Campisi G, Mauceri R, Bertoldo F, et al. Medication-related osteonecrosis of jaws (mronj) prevention and diagnosis: Italian consensus update 2020. *Int J Env Res Pub He* 2020;17(16):5998. DOI: 10.3390/ijerph17165998.
- 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(5):920–943. DOI: 10.1016/j.joms.2022.02.008.
- Medication-related Osteonecrosis of the Jaw. SDCEP. Published March 2017. Accessed December 13, 2021. <https://www.sdcep.org.uk/published-guidance/medication-related-osteonecrosis-of-the-jaw/>.
- Wilmott S, Yates J, Pretty IA. Dental extractions in primary care for patients at risk of MRONJ. *Br Dent J* 2021;75(6):374–380. DOI: 10.1038/s41415-021-3674-8.
- Cerrato A, Zanette G, Boccuto M, et al. Actinomyces and MRONJ: A retrospective study and a literature review. *J Stomatol Oral Maxillofac Surg* 2021;122(5):499–504. DOI: 10.1016/j.jormas.2020.07.012.
- Otto S, Eva Maria Schnödt, Haidari S, et al. Autofluorescence-guided surgery for the treatment of medication-related osteonecrosis of the jaw (MRONJ): A retrospective single-center study. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2021;131(5):519–526. DOI: 10.1016/j.oooo.2020.10.018.
- Owosho AA, Liang STY, Sax AZ, et al. Medication-related osteonecrosis of the jaw: An update on the memorial sloan kettering cancer center experience and the role of premedication dental evaluation in prevention. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2018;125(5):440–445. DOI: 10.1016/j.oooo.2018.02.003.