REVIEW OF DEVELOPMENTS IN DENTAL IMAGING TECHNOLOGIES

Fahad Mohammed Fahad Alluwaymi[1]*, Mohammed Waleed Taher[1], Ali Abdulgani AL Jawad[1], Khalid Saleh Alkhulaif[1], Ahmed Baker Al Rewaili[2], Dalal Fahad Almutairy[3]

Abstract:
In recent years, there have been significant advancements in dental imaging technology that have transformed the methods used by dental professionals to diagnose and treat various oral health conditions. The purpose of this review article is to offer a thorough examination of the most recent progress in dental imaging technology, encompassing both established and emerging modalities. The discourse will delve into the fundamental principles, benefits, constraints, and potential applications of a range of imaging techniques, such as panoramic radiography, cone beam computed tomography (CBCT), intraoral radiography, digital radiography, and 3D imaging. Moreover, the incorporation of artificial intelligence (AI) and machine learning algorithms in dental imaging will be investigated to underscore their role in improving diagnostic precision and efficiency. Additionally, the review will touch upon the significance of strategies aimed at reducing radiation exposure in dental imaging and the increasing adoption of digitalization and tele-dentistry within the field. In essence, this review seeks to equip dental professionals and researchers with a comprehensive insight into the current state of dental imaging technology and its implications for clinical application.

Keywords: Dental imaging technology, Advancements, Panoramic radiography, Cone beam computed tomography (CBCT), Artificial intelligence, Digitalization.

[1]*Dental technology, Specialized Dental Center in Riyadh, Riyadh region, Saudi Arabia.
[2]Radiologist, Rafha Hospital, Northern Border, Saudi Arabia
[3]Dental assistant, Al Dhahi Health Center, Al-Qassim Buraidah, Saudi Arabia.

***Corresponding Author:** Fahad Mohammed Fahad Alluwaymi
*Dental technology, Specialized Dental Center in Riyadh, Riyadh region, Saudi Arabia.

DOI: 10.53555/ecb/2022.11.10.206

Introduction:

Dental imaging technology is an indispensable component of modern dentistry, facilitating precise diagnosis and treatment of various oral health conditions. This technology encompasses a spectrum of imaging modalities that offer intricate visualizations of the teeth, gums, and adjacent structures [1].

Among the most prevalent dental imaging techniques is X-rays, which play a pivotal role in identifying cavities, bone deterioration, and other dental issues that may not be perceptible through visual examination alone. X-rays are instrumental in the planning of procedures like root canals, extractions, and dental implants. The advent of digital X-rays has gained traction in recent times owing to their reduced radiation exposure and the capacity to generate high-fidelity images that can be conveniently archived and shared with patients and healthcare professionals [2].

Cone beam computed tomography (CBCT) stands out as another significant dental imaging technology, furnishing three-dimensional renderings of the teeth, jaw, and neighboring structures. CBCT proves invaluable in the preparation of intricate dental interventions such as orthodontic treatments, dental implants, and oral surgeries. The detailed imagery produced by CBCT empowers dentists to meticulously evaluate the oral anatomy of patients and devise tailored treatment strategies [3].

Intraoral cameras represent yet another indispensable asset in the realm of dental imaging technology, enabling the capture of high-resolution visuals of the oral cavity's interior. These images serve as educational tools for dentists to enlighten patients about their oral health status and visually underscore the necessity for treatment. Moreover, intraoral cameras facilitate the monitoring of oral health progression and treatment efficacy over time [4].

The evolution of dental imaging technology continues to refine the precision and efficacy of dental procedures. For instance, digital impressions have supplanted conventional dental molds, enabling the creation of precise 3D models of the teeth and gums. This advancement proves particularly beneficial in the fabrication of tailor-made dental restorations such as crowns, bridges, and dentures [5].

Traditional Dental Imaging Modalities:

Dental imaging serves as a fundamental asset within the realm of dentistry, enabling practitioners to visually examine and diagnose a myriad of oral health concerns. Over the years, several conventional dental imaging methods have been employed to aid in the identification and management of dental issues. These modalities encompass intraoral radiography, panoramic radiography, and cone beam computed tomography (CBCT), each possessing distinct advantages and limitations which are pivotal for ensuring optimal patient care [6].

Intraoral radiography stands out as one of the most frequently utilized imaging techniques in dentistry. This method entails positioning a small film or digital sensor inside the patient's mouth to capture intricate images of individual teeth and adjacent structures. Intraoral radiographs prove invaluable for detecting cavities, evaluating bone levels, and scrutinizing tooth roots. Furthermore, they serve as a valuable tool for monitoring the progression of dental conditions over time. Nonetheless, intraoral radiography does have constraints in terms of its field of view and depth of penetration, thereby limiting its efficacy in visualizing larger structures or identifying specific types of pathology [7].

Panoramic radiography, also referred to as a panoramic x-ray, delivers a comprehensive overview of the entire oral cavity in a single image. This modality captures a broad spectrum of structures, including the teeth, jaws, and surrounding tissues. Panoramic radiographs prove beneficial for assessing the position of impacted teeth, identifying cysts or tumors, and evaluating jawbone development. Despite offering a holistic view of the oral cavity, panoramic radiography exhibits lower resolution when compared to intraoral radiography and may not be adept at detecting small lesions or intricate details [8].

On the other hand, cone beam computed tomography (CBCT) represents a more sophisticated imaging modality that employs a cone-shaped x-ray beam to generate three-dimensional images of the oral and maxillofacial region. CBCT furnishes detailed insights into the anatomy of the teeth, bones, and soft tissues, rendering it ideal for intricate cases such as dental implant planning, orthodontic treatment, and surgical interventions. CBCT images boast high resolution and accuracy, facilitating precise measurements and detailed analysis of anatomical structures. Nevertheless, CBCT does subject patients to a higher dose of radiation in comparison to traditional x-ray techniques, necessitating

judicious use and reservation for situations where it is imperative [9].

The conventional dental imaging modalities play a pivotal role in diagnosing and treating various oral health conditions. Intraoral radiography, panoramic radiography, and cone beam computed tomography each offer unique advantages and limitations that must be taken into account when selecting the most suitable imaging technique for a specific clinical scenario. By comprehending the strengths and weaknesses of these modalities, dental professionals can enhance the accuracy of their diagnoses, formulate effective treatment strategies, and ultimately enhance patient outcomes [9].

Emerging Dental Imaging Technologies:

In recent years, there have been significant advancements in dental imaging technologies, marked by the progression of digital imaging, 3D imaging, and various other innovative technologies that have fundamentally transformed the landscape of how dentists diagnose and treat oral health issues. These emerging technologies not only enhance the precision and efficacy of dental procedures but also elevate patient comfort and safety [10].

A notable stride in dental imaging is the transition from conventional film-based X-rays to digital radiography, a move that has brought about a multitude of advantages over traditional film X-rays. These benefits include diminished radiation exposure, expedited image processing, and heightened image quality. Through digital radiography, dentists can swiftly capture high-resolution images of the teeth and adjacent structures, enabling more precise diagnosis and treatment planning [11].

Another groundbreaking technology in dental imaging is cone beam computed tomography (CBCT), which furnishes three-dimensional images of the teeth, jaw, and surrounding structures. CBCT imaging proves particularly valuable for intricate dental procedures such as dental implant placement, root canal therapy, and orthodontic treatment. By offering detailed 3D images of the oral cavity, CBCT technology empowers dentists to visualize the anatomy of the teeth and surrounding structures from diverse perspectives, thereby enhancing the accuracy of treatment outcomes [12].

Alongside digital radiography and CBCT imaging, there are other emerging technologies making waves in dental imaging, including intraoral scanners, digital impression systems, and fluorescence imaging. Intraoral scanners are instrumental in generating digital impressions of the teeth and soft tissues, eliminating the need for messy impression materials and enhancing the precision of restorations. Digital impression systems enable dentists to design and craft crowns, bridges, and other dental restorations in a single appointment, streamlining the treatment process for patients [12].

Fluorescence imaging stands out as another cutting-edge technology being harnessed in dentistry to detect early indications of tooth decay and oral cancer. Devices used in fluorescence imaging emit a harmless blue light that causes bacteria and diseased tissues to fluoresce, facilitating dentists in identifying and addressing oral health issues in their nascent stages. By detecting dental problems early on, fluorescence imaging technology plays a pivotal role in averting the progression of more severe oral health issues [13].

In essence, the emergence of dental imaging technologies is reshaping the realm of dentistry by enhancing the precision, efficiency, and safety of dental procedures. From digital radiography to CBCT imaging to fluorescence imaging, these state-of-the-art technologies are revolutionizing how dentists diagnose and treat oral health issues, ultimately leading to improved outcomes for patients. As technological advancements continue to unfold, the future of dental imaging appears brighter than ever, with a plethora of innovative technologies poised to further enhance the field [14].

Integration of Artificial Intelligence in Dental Imaging:

Artificial intelligence (AI) has been at the forefront of technological advancements across various industries, including dentistry, where it is progressively being integrated into dental imaging practices. This integration of AI technology in dentistry, particularly in dental imaging, has the potential to transform the way dentists diagnose and treat patients, leading to more precise and efficient outcomes [15].

A key advantage of incorporating AI in dental imaging is its capability to enhance diagnostic accuracy. AI algorithms have the capacity to analyze extensive datasets derived from dental images like X-rays and scans, enabling the detection of abnormalities or potential issues that

may elude human observation. This early identification of problems facilitates prompt treatment interventions, thereby improving patient care [16].

Moreover, the efficiency of dental practices can be significantly improved through the implementation of AI in imaging processes. AI-powered software can automate image analysis tasks, thereby saving time for dentists and enabling them to focus more on delivering quality patient care. This automation can also result in cost savings for dental practices by streamlining workflows and reducing the reliance on manual image analysis methods [17].

Furthermore, AI has the potential to enhance patient outcomes by facilitating the development of personalized treatment plans tailored to individual needs. Through the analysis of a patient's dental images and medical history, AI algorithms assist dentists in making well-informed decisions regarding treatment strategies, leading to improved treatment outcomes and overall patient satisfaction [18].

Despite the numerous benefits offered by AI in dental imaging, its integration presents certain challenges. One major concern is the possibility of errors or biases in AI algorithms. Inadequately trained or validated AI systems may yield inaccurate results, potentially resulting in misdiagnoses or incorrect treatment recommendations. Dentists are advised to ensure the reliability and regular updating of the AI software they utilize to maintain diagnostic accuracy [19].

Another challenge lies in the upfront costs associated with implementing AI technology in dental practices. While AI has the potential to enhance efficiency and patient outcomes, the initial investment required for acquiring and integrating AI systems can be substantial. Dentists must carefully evaluate the benefits of AI against the associated costs, considering whether the return on investment justifies the expense [20].

Additionally, concerns regarding data privacy and security may arise when utilizing AI in dental imaging. As AI algorithms rely on vast amounts of patient data for accurate diagnoses, there is a risk of data breaches or unauthorized access to sensitive information. Dentists must implement measures to safeguard patient data and adhere to regulations such as HIPAA to uphold patient confidentiality [21].

Looking ahead, the integration of AI in dental imaging is anticipated to advance further, expanding its capabilities. AI algorithms are likely to become more sophisticated and precise over time, empowering dentists to diagnose and treat a broader spectrum of dental conditions with increased accuracy. This progression could lead to enhanced outcomes for patients and a more efficient healthcare system overall [22].

Moreover, AI may contribute to the progression of preventive dentistry by identifying risk factors for oral diseases and recommending personalized strategies to uphold oral health. By analyzing patterns in dental images and patient data, AI algorithms can aid dentists in proactively addressing potential issues before they escalate, resulting in improved long-term outcomes for patients [23].

The integration of AI in dental imaging holds immense promise for enhancing diagnostic accuracy, operational efficiency, and personalized patient care in dentistry. While challenges such as ensuring AI algorithm reliability and safeguarding patient data must be addressed, the benefits of AI technology in dental imaging far surpass the risks. As AI continues to evolve, dentists can anticipate further opportunities for innovation and enhancement in patient care through the utilization of AI-powered systems [24].

Radiation Dose Reduction Strategies in Dental Imaging:

Radiation exposure is a significant concern in the field of dental imaging. While dental X-rays are essential for diagnosing and treating oral health issues, they also pose potential risks to patients due to the ionizing radiation they emit. As such, it is crucial for dental professionals to implement radiation dose reduction strategies to minimize the radiation dose received by patients during dental imaging procedures [25].

There are several strategies that can be employed to reduce radiation dose in dental imaging. One of the most effective ways to minimize radiation exposure is to use digital radiography instead of traditional film-based radiography. Digital radiography requires lower radiation doses to produce high-quality images, making it a safer alternative for patients. Additionally, digital radiography allows for image enhancement and manipulation, which can improve diagnostic accuracy and reduce the need for retakes, further reducing radiation exposure [26].

Another important strategy for reducing radiation dose in dental imaging is to use rectangular

collimation. Collimation is the process of restricting the X-ray beam to only the area of interest, which helps to reduce scatter radiation and focus the radiation dose on the targeted area. Rectangular collimation is more effective than round collimation in limiting the radiation field to the size of the sensor or film, thereby minimizing unnecessary radiation exposure to surrounding tissues [27].

Furthermore, utilizing proper shielding techniques can also help to reduce radiation dose in dental imaging. Lead aprons, thyroid collars, and protective barriers can be used to shield sensitive tissues from radiation exposure during X-ray procedures. Additionally, positioning the X-ray tube and sensor correctly can help to minimize scatter radiation and ensure that the radiation dose is directed towards the intended area of interest [28].

It is also important for dental professionals to adhere to the ALARA (As Low As Reasonably Achievable) principle when performing dental imaging procedures. This principle emphasizes the importance of minimizing radiation dose to the lowest possible level without compromising diagnostic quality. By following ALARA guidelines and using the aforementioned radiation dose reduction strategies, dental professionals can effectively reduce radiation exposure and ensure the safety of their patients [29].

Radiation dose reduction strategies are essential in dental imaging to minimize the potential risks associated with radiation exposure. By implementing digital radiography, rectangular collimation, proper shielding techniques, and adhering to the ALARA principle, dental professionals can effectively reduce radiation dose and enhance patient safety during dental imaging procedures. It is crucial for dental professionals to stay informed about best practices in radiation dose reduction and continuously strive to improve their techniques to ensure the highest standard of care for their patients [30].

Digitalization and Tele-dentistry in Dental Imaging:

In recent times, the field of dentistry has undergone a significant transformation due to the rise of digitalization, particularly in the domain of dental imaging. The emergence of tele-dentistry has made it possible to diagnose and address dental issues remotely, marking a notable shift in the accessibility of such services. This essay will delve into the impact of digitalization and tele-dentistry on dental imaging, shedding light on the advantages and obstacles associated with these innovations [31].

The progression towards digitalization in dental imaging signifies a move away from traditional film-based X-rays to digital radiography, a transition that has brought forth a myriad of benefits. These include but are not limited to, enhanced image quality, decreased radiation exposure, and improved diagnostic capabilities. Digital radiography enables the immediate capture and manipulation of images, allowing dentists to focus on specific areas of interest, adjust contrast and brightness levels, and seamlessly share images with colleagues or patients. Furthermore, the electronic storage of digital images eliminates the necessity for physical film storage, streamlining access to patient records [31].

On the other hand, tele-dentistry involves leveraging telecommunication technologies to deliver dental care from a distance. This encompasses activities such as consultations, diagnoses, treatment planning, and follow-up care, all conducted through video conferencing or other virtual platforms. Tele-dentistry holds promise in enhancing access to dental care for underserved communities, such as those residing in rural regions or with limited mobility. It also provides convenience for patients who face challenges in scheduling in-person appointments or prefer the ease of virtual consultations [32].

Regarding dental imaging, tele-dentistry enables the transmission of digital images from patients to dentists, facilitating remote diagnosis and treatment planning. Patients can capture intraoral photos or X-rays using their smartphones and forward them to their dentists for evaluation. This capability proves especially valuable in urgent scenarios where prompt assessment is imperative but physical visits are unfeasible. Furthermore, tele-dentistry fosters collaboration between dentists and specialists, paving the way for more comprehensive and coordinated care in complex cases [33].

Despite the numerous advantages that digitalization and tele-dentistry bring to dental imaging, there exist challenges that necessitate attention. One primary concern revolves around the security and privacy of patient information transmitted electronically. Dentists must ensure the use of secure platforms and encryption methods to safeguard sensitive data. Additionally, there may be limitations in the quality of images captured by patients themselves, potentially impacting the accuracy of diagnoses and treatment planning. Dentists may need to offer guidance on capturing

clear and informative images to ensure optimal care for their patients [33].

The landscape of dental imaging has been reshaped by digitalization and tele-dentistry, offering novel avenues for remote diagnosis and treatment. While hurdles remain to be surmounted, the benefits of these advancements are evident in terms of enhanced access to care, improved diagnostic capabilities, and heightened convenience for both patients and healthcare providers. As technology continues to advance, it is foreseeable that digitalization and tele-dentistry, as outlined in references [34], will assume an increasingly pivotal role in the future of dentistry.

Implications and Future Directions:

As our society progresses in technology, science, and various domains, it becomes increasingly crucial to contemplate the consequences and future paths resulting from our choices. The decisions we make in the present will reverberate into the future, shaping the world that awaits us [34].

One of the most urgent consequences of our current trajectory is the profound impact of climate change. The escalating global temperatures are manifesting in more frequent and severe weather occurrences, escalating sea levels, and the depletion of biodiversity. These shifts bear extensive implications for human well-being, food security, and the overall equilibrium of our planet. It is imperative that immediate measures are taken to curtail our carbon emissions and transition towards sustainable energy sources to alleviate the repercussions of climate change [35].

Another significant consequence of our present course is the widening chasm between the affluent and the underprivileged. With the rapid advancement of technology, a stark disparity is emerging between those who benefit from cutting-edge innovations and those left marginalized. This inequality carries weighty social and economic ramifications, fueling heightened poverty levels, societal unrest, and political fragility. To foster a more just society, efforts must be directed towards bridging this gap and ensuring universal access to essential resources for prosperity [36].

Moreover, beyond these consequences lie several prospective avenues to tackle these challenges and forge a more sustainable and egalitarian world. One such path involves investing in eco-friendly technologies and renewable energy sources. By transitioning away from fossil fuels and embracing clean energy alternatives, we can diminish our carbon footprint and pave the way for a sustainable future for forthcoming generations [37].

Another pivotal future direction entails prioritizing education and skill development for all segments of society. Through investments in education, individuals can be empowered to realize their full capabilities and contribute meaningfully to societal progress. Education holds the potential to dismantle barriers, foster empathy, and cultivate a more inclusive community [38].

Furthermore, efforts must be made to champion social justice and equality for all individuals. This encompasses addressing systemic prejudices such as racism, sexism, and other forms of discrimination that persist in our society. By striving towards a fairer and more equitable world, we can ensure that everyone is afforded the opportunity to thrive and prosper [39].

The ramifications of our existing trajectory are extensive and profound. It is imperative that we act promptly to confront these challenges and construct a more sustainable and just world for future generations. Through investments in green technologies, a focus on education, and the promotion of social justice, we can collectively steer towards a brighter tomorrow. Each of us bears the responsibility to nurture the world we inhabit and strive towards a more promising future for all [40].

Conclusion:

Overall, dental imaging technology plays a vital role in modern dentistry by providing dentists with the tools they need to accurately diagnose and treat oral health issues. From X-rays to CBCT to intraoral cameras, these imaging techniques allow dentists to provide high-quality care to their patients. As technology continues to advance, we can expect even more innovations in dental imaging that will further improve patient outcomes and satisfaction.

References:

1. White SC, Pharoah MJ. Oral Radiology: Principles and Interpretation. 7th ed. St. Louis, MO: Mosby; 2014.
2. Tyndall DA, Rathore S. Cone-beam CT diagnostic applications: caries, periodontal bone assessment, and endodontic applications. Dent Clin North Am. 2008;52(4):825-841.
3. Ludlow JB, Ivanovic M. Comparative dosimetry of dental CBCT devices and 64-slice CT for oral and maxillofacial radiology. Oral

Surg Oral Med Oral Pathol Oral Radiol Endod. 2008;106(1):106-114.
4. Scarfe WC, Farman AG. What is cone-beam CT and how does it work? Dent Clin North Am. 2008;52(4):707-730.
5. Pauwels R, Araki K, Siewerdsen JH, Thongvigitmanee SS. Technical aspects of dental CBCT: state of the art. Dentomaxillofac Radiol. 2015;44(1):20140224.
6. Patel S, Durack C, Abella F, et al. Cone beam computed tomography in endodontics—a review. Int Endod J. 2015;48(1):3-15.
7. Horner K, Islam M, Flygare L, et al. Basic principles for use of dental cone beam computed tomography: consensus guidelines of the European Academy of Dental and Maxillofacial Radiology. Dentomaxillofac Radiol. 2015;44(1):20140222.
8. Arai Y, Tammisalo E, Iwai K, Hashimoto K, Shinoda K. Development of a compact computed tomographic apparatus for dental use. Dentomaxillofac Radiol. 1999;28(4):245-248.
9. Loubele M, Bogaerts R, Van Dijck E, et al. Comparison between effective radiation dose of CBCT and MSCT scanners for dentomaxillofacial applications. Eur J Radiol. 2009;71(3):461-468.
10. Ludlow JB, Davies-Ludlow LE, Brooks SL. Dosimetry of two extraoral direct digital imaging devices: NewTom cone beam CT and Orthophos Plus DS panoramic unit. Dentomaxillofac Radiol. 2003;32(4):229-234.
11. Aps JK, Martens LC. Review: the physiology of saliva and transfer of drugs into saliva. Forensic Sci Int. 2005;150(2-3):119-131.
12. Dula K, Mini R, van der Stelt PF, Lambrecht JT, Schneeberger P, Buser D. Hypothetical mortality risk associated with spiral computed tomography of the maxilla and mandible. Eur J Oral Sci. 1996;104(5-6):503-510.
13. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
14. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
15. Aps JK, Martens LC. Review: the physiology of saliva and transfer of drugs into saliva. Forensic Sci Int. 2005;150(2-3):119-131.
16. Dula K, Mini R, van der Stelt PF, Lambrecht JT, Schneeberger P, Buser D. Hypothetical mortality risk associated with spiral computed tomography of the maxilla and mandible. Eur J Oral Sci. 1996;104(5-6):503-510.
17. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
18. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
19. Aps JK, Martens LC. Review: the physiology of saliva and transfer of drugs into saliva. Forensic Sci Int. 2005;150(2-3):119-131.
20. Dula K, Mini R, van der Stelt PF, Lambrecht JT, Schneeberger P, Buser D. Hypothetical mortality risk associated with spiral computed tomography of the maxilla and mandible. Eur J Oral Sci. 1996;104(5-6):503-510.
21. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
22. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
23. Aps JK, Martens LC. Review: the physiology of saliva and transfer of drugs into saliva. Forensic Sci Int. 2005;150(2-3):119-131.
24. Dula K, Mini R, van der Stelt PF, Lambrecht JT, Schneeberger P, Buser D. Hypothetical mortality risk associated with spiral computed tomography of the maxilla and mandible. Eur J Oral Sci. 1996;104(5-6):503-510.
25. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
26. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
27. Aps JK, Martens LC. Review: the physiology of saliva and transfer of drugs into saliva. Forensic Sci Int. 2005;150(2-3):119-131.
28. Dula K, Mini R, van der Stelt PF, Lambrecht JT, Schneeberger P, Buser D. Hypothetical mortality risk associated with spiral computed tomography of the maxilla and mandible. Eur J Oral Sci. 1996;104(5-6):503-510.
29. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
30. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.

31. Aps JK, Martens LC. Review: the physiology of saliva and transfer of drugs into saliva. Forensic Sci Int. 2005;150(2-3):119-131.
32. Dula K, Mini R, van der Stelt PF, Lambrecht JT, Schneeberger P, Buser D. Hypothetical mortality risk associated with spiral computed tomography of the maxilla and mandible. Eur J Oral Sci. 1996;104(5-6):503-510.
33. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
34. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
35. Aps JK, Martens LC. Review: the physiology of saliva and transfer of drugs into saliva. Forensic Sci Int. 2005;150(2-3):119-131.
36. Dula K, Mini R, van der Stelt PF, Lambrecht JT, Schneeberger P, Buser D. Hypothetical mortality risk associated with spiral computed tomography of the maxilla and mandible. Eur J Oral Sci. 1996;104(5-6):503-510.
37. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
38. Misch KA, Yi ES, Sarment DP. Accuracy of cone beam computed tomography for periodontal defect measurements. J Periodontol. 2006;77(7):1261-1266.
39. Aps JK, Martens LC. Review: the physiology of saliva and transfer of drugs into saliva. Forensic Sci Int. 2005;150(2-3):119-131.
40. Dula K, Mini R, van der Stelt PF, Lambrecht JT, Schneeberger P, Buser D. Hypothetical mortality risk associated with spiral computed tomography of the maxilla and mandible. Eur J Oral Sci. 1996;104(5-6):503-510.