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AĞIZ, DİŞ VE ÇENE RADYOLOJİSİ ALANINDA TEORİ VE UYGULAMALAR

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İÇİNDEKİLER

BÖLÜM 1

Diş Hekimliğinde Radyoloji Tabanlı Yapay Zekâ Uygulamaları

Menduh Sercan Kaya [1]

Giriş

Günümüzde yapay zekanın (YZ) gelişimi birçok sektöre etki etmiştir. YZ tabanlı modeller sesli asistanlar, sürücüsüz arabalar ve finansal analiz sistemleri gibi birçok alanda kullanılmaya başlanmıştır. Birçok alana etki eden bu gelişmelerin sağlık alanına da etki etmesi kaçınılmazdır. Bu sebeple tıp ve diş hekimliği alanlarında YZ kullanımı gün geçtikçe önem kazanmaktadır (F. a. Schwendicke, Samek, & Krois, 2020; Sitaras et al., 2025). YZ' nin sağlık alanındaki entegrasyonu ver işleme, görüntüleme teknolojilerindeki gelişmeler daha işlevsel algoritmaların gelişimi ile artmıştır. Diş hekimliği radyoloji alanında özellikle görüntülerin yorumlanması görsel desen tanımlamaya dayandığı için YZ uygulamaları önemli bir kullanım alanıdır. Radyolojik yaklaşımla birlikte kullanılan YZ modelleri diş hekimliğinin diğer alanlarında da kullanılmaktadır. İlk olarak kullanılan YZ modelleri hesaplama gücü ve veri setlerine ulaşılabilirliğin kısıtlı olması dolayısıyla sınırlı bir yapı göstermekle birlikte günümüz YZ sistemleri için temel oluşturmuştur. YZ modellerinin ve dijital görüntüleme teknolojilerinin zaman içerisindeki gelişimi ile birlikte diş hekimliğinde YZ daha geniş uygulama alanları bulup günlük iş akışlarına daha fazla dahil olmaya başlamıştır (Araidy, Batshon, & Mirochnik, 2025; Hung et al., 2022; Khanagar et al., 2021).

Temel olarak YZ karar alma, doğal dil süreçlerini işleme, tanıma ve algılama gibi insan zekasının gerektiren işlevleri yerine getirebilen makineler yaratma alanında çalışan bilgisayar ve mühendislik bilimi olup makine öğrenme, yapay nöral ağlar ve derin öğrenme gibi alt alanları bulunmaktadır (Carrillo-Perez et al., 2022; Sitaras et al., 2025).

Makine öğrenme sistemlerin açık bir şekilde insan programlanması olmadan deneyim yoluyla performansını arttırmasını sağlayan algoritmaları tanımlamak için Arthur Samuel tarafından meydana getirilmiştir. Makine öğreniminde öğrenme mekanizmalarına bağlı olarak denetimsiz, denetimli, yarı denetimli ve pekiştirmeli algoritmalar kullanılabilmektedir. Makine öğrenimi için büyük veri tabanları gerekli olup bu veri tabanlarının genişliği, veri tabanı kalitesi ve algoritmalar makine öğrenmenin başarısını etkilemektedir (Agrawal, Nikhade, &

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Nikhade, 2022; Araidy et al., 2025; Choudhary, Malik, Kaul, Sharma, & Gupta, 2023; Mohammad, Ahmad, Kurniawan, & Mohd Yusof, 2022; Park & Park, 2018).

Yapay nöral ağlar biyolojik sinir ağlarına ve insan beynine benzeyen bir akış ile yapay nöronlar aracılığıyla sinyalleri yorumlayan algoritma yapısıdır. Bu ağlardaki bağlantılar sayesinde verilerdeki doğrusal olmayan bilgiler keşfedilip giriş bilgisindeki temel desenler tanımlanabilir. Böylece uygun çıktı oluşup yanıt oluşturulur. Temel olarak yapay sinir ağları bir veya daha fazla girdi değişkeni oluşturan girdi katmanına, verilerin çıkışını yapan çıktı katmanına ve bu katmanlar arasındaki ilişkiyi sağlayan gizli katmana sahiptir (Brickley, Shepherd, & Armstrong, 1998; Sitaras et al., 2025). Bu yapay sinir ağları derin öğrenme yaklaşımlarının temelini oluşturmaktadır (Araidy et al., 2025; Shahnavazi & Mohamadrahimi, 2023).

Derin öğrenme yapay sinir ağları temelli makine öğrenmeni bir alt dalı olarak sayılabilir. Kullanılan verilerdeki doğrusal olmayan kalıpları tespit edebilmek ve yüksek düzeylerde çıktı alabilmek için ham veriye çoklu işlem katmanları uygulanmaktadır. Derin öğrenme metodlarında farklı mimariler kullanılabilmektedir. Bu mimarilerden en sık kullanılanı konvolüsyonel sinir ağıdır. Bu mimari birden fazla gizli katman kullanarak görüntülerdeki verilerin kenar, köşe ve makroskobik desenleri gibi görüntü özelliklerini tespit edebilir. Derin öğrenme makine öğrenmeye göre matematiksel olarak daha karmaşık olup güçlü bir performans için büyük veri setlerinin kullanılması gerekmektedir (Araidy et al., 2025; Hwang, Jung, Cho, & Heo, 2019; F. Schwendicke, Golla, Dreher, & Krois, 2019).

YZ teknolojisinin gelişimi ile diş hekimliği uygulamalarında bazı değişiklikler oluşmuş ve tanı süreçleri başta olmak üzere klinik işleyiş farklılaşmıştır (F. a. Schwendicke et al., 2020). Diş hekimliğine bu teknolojinin entegrasyonu ile birçok alanda benzersiz fırsatlar oluşmaktadır (He et al., 2019).

Diş hekimliğinde görüntüleme yöntemleri aracılı yapay zekâ kullanım alanları

- Ortodonti alanında radyoloji tabanlı yapay zekâ kullanımı

YZ son zamanlardaki gelişimiyle birlikte hastaların görüntüleri üzerinde dijital tanı imkânı sunmaktadır. Özellikle sefalometrik analiz ortodonti için hayati öneme sahiptir. Bu analiz sayesinde büyüme desenlerinin tahmini, yüzün yumuşak dokularının analizi, iskelet ve dentoalveolar yapıların sagittal düzlemdeki analizi mümkün olup tedavi başarısında sefalometrik analiz büyük önem göstermektedir. Klasik olarak manuel işaretlemeler yoluyla yapılan sefalometrik analiz zaman alıcı olup yanlılık potansiyeline sahiptir. YZ' nin diş hekimliğine entegre olmasıyla makine öğrenme ve derin öğrenme algoritmalarıyla gözlemci yanlılığını azaltarak yüksek hassasiyetlerde sefalometrik analiz yapılabilmektedir. Sefalometrik analizin yanı sıra YZ ortodontide servikal vertebra maturasyonunun incelenmesi, adenoid hipertrofisinin otomatik teşhisi, hava yolu açıklığının değerlendirilmesi, otomatik segmentasyon işlemleri ve klinik karar süreçlerine destek amaçlı kullanılmaktadır (Del Real, Del Real, Sardina, & Oyonarte, 2022; Kök, Izgi, & Acilar, 2021; H. Lee, Park, & Kim, 2017; Makaremi, Lacaule, & Mohammad-Djafari, 2019; Sitaras et al., 2025; Subramanian, Chen, Almalki, Sivamurthy, & Kafle, 2022; Zhao et al., 2021).

- Restoratif ve protetetik diş hekimliği alanında radyoloji tabanlı yapay zekâ kullanımı

Restoratif işlemler ve protetik işlemler multidisipliner yaklaşım gerektirebilmektedir. Dişlerin prognozu ağız yapısı ve hastaya ait değişkenler gibi birçok faktöre bağlıdır. YZ sistemleri ile diş prognozu ve tedavi süreçleri ile ilgili karar verme süreci kolaylaşmaktadır (S. J. Lee et al., 2022). Çeşitli YZ modelleri ile dişlerin segmentasyonları mümkün olmaktadır. Bu yöntem ile radyograflar üzerinden çürük teşhisi mümkün olmaktadır. Kızıl ötesi transilüminasyon gibi görüntülerin verilerininde analiz edilmesi sonucu dişlerdeki çürükler tespit edilebilmektedir (Kühnisch, Meyer, Hesenius, Hickel, & Gruhn, 2022; Revilla-León et al., 2022; Reyes, Knorst, Ortiz, & Ardenghi, 2022).

- Periodontoloji alanında radyoloji tabanlı yapay zekâ kullanımı

Periodontitisin ilerlemesi sonucu diş çevre dokularında tahribat oluşmaktadır. Bu süreç sonucunda diş eti, alveolar kemik ve periodontal bağ dokularda kayıplar izlenebilmektedir. Bu sebeple bu hastalıkların erken teşhisi oldukça önemlidir. Periodontitisin teşhisi ve sınıflandırılması amacıyla YZ uygulamaları gerçekleştirilmiş ve sonuçlar tatmin edici bulunmuştur. Günümüzde bu hastalıklardaki akut – kronik ayırımı, hastalığın derecesi, şiddeti ve hastalığın ilerleme durumu YZ modelleri ile tespit edilebilmektedir. Son zamanlarda introoral floresan biyomarker görüntüleme ile periodontitisin ilişkili olduğu osteoporoz, diyabet ve sistemik hastalıklar inceleme sürecine dahil edilecek şekilde periodontitis ve sistemik sağlık durumu arasındaki ilişkiyi otomatik değerlendiren bir işleyiş geliştirilmiştir (Ozden, Ozgonenel, Ozden, & Aydogdu, 2015; Sitaras et al., 2025).

- Endodonti alanında radyoloji tabanlı yapay zekâ kullanımı

YZ endodonti alanında temel olarak periapikal lezyonların, pulpal kalsifikasyonların ve kök kırıklarının tespitinde başarıyla kullanılmıştır. Bunlara ek olarak kanal sisteminin konfigürasyonunun anlaşılması konusunda klinisyene yardımcı olmaktadır (S. J. Lee et al., 2025; Mallishery, Chhatpar, Banga, Shah, & Gupta, 2020). Tüm bu özelliklerinin yanı sora endodontik tedavilerde kritik önem arz eden minör apikal foramenin yerinin tespitinde ve ek kök kanallarının tespitinde YZ tatmin edici sonuçlar göstermiştir (Hiraiwa et al., 2019; Saghiri et al., 2012).

- Oral ve maksillofasiyal cerrahi alanında radyoloji tabanlı yapay zekâ kullanımı

YZ modelleri cerrahi alanında da kullanılmaktadır. Skuamöz hücreli karsinom, odontojenik keratokist, dentigeröz kist ve periapikal kistleri teşhisi amacıyla kullanılan yapay zeka modellerinin girdilerini sıklıkla iki boyutlu ve üç boyutlu görüntülerden elde edilmektedir. Böylelikle oral bölgeyi ilgilendiren lezyonlar, Sjögren sendromu gibi durumlar ve lenf nodu metastazları gibi yöntemler YZ modelleri ile incelenebilmektedir (Kise et al., 2020; J. H. Lee, Kim, & Jeong, 2020; Poedjiastoeti & Suebnukarn, 2018). Ayrıca YZ modelleri ortognatik cerrahi sonucunda oluşacak değişiklikleri tespit etme amacıyla kullanılmakta ve yüz simetrisindeki değişiklikleri tahmin edebilmektedir. Tüm bunların yanı sıra anatomik rehberlik saplama ve hastalara ait prognozu tahmin etme amacıyla da kullanılmaktadır. İmplant tedavilerinde de osseointegrasyonun değerlendirilmesi, çevre anatomik yapılar ile implant arasındaki ilişkinin değerlendirilmesi, implant konumunun ve implantın angulasyonunun incelenmesi amacıyla YZ modellerine başvurulabilmektedir (S. J. Lee et al., 2025; Mohaideen et al., 2022; Revilla-León et al., 2023).

- Pedodonti alanında radyoloji tabanlı yapay zekâ kullanımı

Çocuk hastalarda sıklıkla panoramik radyograflar kullanılmaktadır. Bu radyograflar üzerinden YZ modelleri ile dentisyon aşamaları, diş anomalileri ve diş numaralarının tespiti amacıyla kullanılmıştır. Ayrıca çocuklarda izlenen diş plağını tespit etme amacıyla YZ modelleri geliştirilmiştir (Kılıc et al., 2021; You, Hao, Li, Wang, & Xia, 2020).

- Adli odontoloji alanında radyoloji tabanlı yapay zekâ kullanımı

Adli odontoloji doğası bakımından sıklıkla yaş tahmini, cinsiyet tahmini, yüz rekonstrüksiyonları ve kimliklendirme çalışmaları üzerinde yoğunlaşmaktadır. Günümüzde YZ modelleri geliştirilerek kimliklendirme konusunda çalışmalar ümit verici sonuçlar doğurmaktadır (Karcioglu, Yilmaz, Yaganoglu, Almohammad, & Laloglu, 2025).

- Ağız, diş ve çene radyolojisi alanında yapay zekâ kullanımı

YZ ile ilgili metodlar genellikle görüntüler üzerinden uygulandığından dolayı bu metodlar ağız, diş ve çene radyolojisi alanında sık kullanılmaktadır. Klinikte sık karşılaşılan bir durum olan diş çürüklerinin tespiti oldukça önemlidir. İlerleyen bir süreç olan diş çürükleri erişelemeyen bölgelerde bulunup tespit edilmesi zor olabilir. Bu durumda çürük lezyonlarının tespiti için farklı görüntüleme teknikleri kullanılmaktadır. Periapikal, bitewing ve kızılötesi transilluminasyon görüntüleme yöntemleri aracılığıyla YZ modelleri üzerinden çürük teşhisi yapılabilmektedir (Cantu et al., 2020; J.-H. Lee, Kim, Jeong, & Choi, 2018; F. Schwendicke, Tzschoppe, & Paris, 2015). YZ modelleri ayrıca osteoporöz gibi sistemik hastalıklarının teşhisi, gömülü dişlerin çevre anatomik yapılarla ilişkisinin tespiti, temporomandibulara etkileyen osteoartrit gibi durumların değerlendirilmesi, Sjogren sendromunun tespit edilmesi, maksiller sinüs hastalıklarının tespit edilmesi, dental restoratif materyallerin değerlendirilmesi, oral lezyonların değerlendirilmesi, prekanseröz veya malign lezyonların sebep olabilecekleri mukoza değişikliklerinin değerlendirilmesi gibi birçok alanda kullanılmaktadır (Abdalla-Aslan, Yeshua, Kabla, Leichter, & Nadler, 2020; Aliaga et al., 2020; Chakravorty et al., 2024; Choi, Kim, Lee, & Park, 2021; Kise et al., 2020; Murata et al., 2019; Vinayahalingam, Xi, Bergé, Maal, & De Jong, 2019).

Sonuç

Diş hekimliğinde YZ modelleri diğer tüm alanlarda olduğu gibi son yıllarda hızlı bir gelişim göstermiştir. Makine öğrenmesi, yapay sinir ağları ve derin öğrenme temelli sistemlerinin diş hekimliğinin her alanında yaygınlaşması klinik süreçlerin daha hızlı, verimli ve standardize şekilde yürütülmesini sağlamaktadır. Bu avantajlarının yanı sıra YZ modellerinin uygun şekillerde eğitilmesi için kaliteli girdi veri setine ihtiyacı bulunmaktadır. Doğası gereği YZ modelleri görüntülerdeki desenleri tespit etme konusunda oldukça kullanışlıdır. Bu bakımdan diş hekimliğinin her alanını etkilemesinin yanı sıra özellikle ağız, diş ve çene radyolojisi alanında kullanımı hızla yaygınlaşmaktadır. Gelecekte var olan YZ modellerindeki evrimin devam edeceği düşünülüp YZ modellerinin daha kapsamlı ve kişiselleştirilmiş olarak gelişmesi mümkündür. Sonuç olarak YZ' nın tanı konusunda diş hekimliğinde güçlü bir yardımcı araç olarak diş hekimliğinin geleceğine önemli katkılar sunması muhtemeldir.

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BÖLÜM 2

Systematic Reporting of Cone-Beam Computed Tomography Images in Dentistry

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1. Introductıon

1.1. The Role of Cone-Beam Computed Tomography in Dentistry

Radiological imaging forms the backbone of the diagnostic process in dentistry. For decades, periapical and panoramic radiographs met this need; however, the superimposition and geometric distortion inherent to two-dimensional imaging have at times misled clinicians (Gharat et al., 2025; Alshomrani, 2024). These limitations — the inevitable consequence of compressing anatomically complex structures such as the maxillofacial complex into a single plane — have steadily reinforced the need for three-dimensional imaging technologies.

Cone-Beam Computed Tomography (CBCT) has emerged as one of the most transformative responses to this need. With a radiation dose considerably lower than that of medical CT, high spatial resolution, and a cost profile suited to the clinical setting, CBCT enables submillimetre three-dimensional reconstruction (Gharat et al., 2025). The ability to examine anatomical structures with 1:1 geometric accuracy across multiplanar sections has established this technology as the de facto standard of contemporary dental radiology (Gharat et al., 2025; Wong et al., 2025).

The clinical applications of CBCT are remarkably broad. In endodontics, particularly in cases involving complex root canal anatomy, CBCT provides clinicians with a reliable and objective basis for defining treatment boundaries and detecting root fractures (Wong et al., 2025; Trindade et al., 2025). Three-dimensional localization of impacted teeth and detailed craniofacial analysis in orthodontics are simply not feasible without this technique (Polizzi et al., 2024). In oral surgery, preoperative delineation of the relationship between the

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mandibular canal and root apices — especially in the extraction of impacted lower third molars — substantially reduces the risk of inferior alveolar nerve injury (Robbins et al., 2022). When integrated with modern intraoral scanners, CBCT data also play a pivotal role in developing multidisciplinary treatment plans (Frąckiewicz et al., 2024).

The convergence of artificial intelligence and deep learning algorithms with CBCT analysis in recent years has opened the door to a qualitative transformation in dental radiology (Mureșanu et al., 2023; Fan et al., 2023). Models developed for automated anatomical segmentation, lesion detection, and image quality enhancement are both accelerating and standardising the diagnostic process. However, the extent to which these systems should be incorporated into clinical decision-making remains a contested area. In sum, CBCT has transcended its role as a mere radiological examination and become an indispensable component of evidence-based dentistry, digital workflows, and surgical navigation systems (Gharat et al., 2025; Frąckiewicz et al., 2024; Mureșanu et al., 2023; Fan et al., 2023).

1.2. Clinical and Medicolegal Significance of Reporting

While CBCT offers clinicians unparalleled diagnostic advantages for three-dimensional assessment of the maxillofacial region, it simultaneously imposes an obligation to examine and report all anatomical structures within the field of view without exception (Heller et al., 2024; Abesi et al., 2024). Comprehensive meta-analyses in the literature have demonstrated that as many as 69.1% of CBCT scans contain at least one incidental finding, with an average of 1.48 incidental findings per scan (Abesi et al., 2024). Systematic reporting of these unexpected anomalies is of critical importance both for early diagnosis and treatment management and for the clinician's legal obligations (Heller et al., 2024; Abesi et al., 2024).

Accurate classification and management of incidental findings directly affects the patient's clinical course (Kadkhodayan et al., 2024; Braun et al., 2022). In children and adolescents, these findings may present as airway obstructions, impacted tooth anomalies, or developmental variations (Vogiatzi et al., 2025), while in adults they span a wide spectrum including sinonasal pathologies and temporomandibular joint degeneration (Abesi et al., 2024; Braun et al., 2022). Over-reporting of clinically insignificant variations creates unnecessary patient anxiety and diagnostic burden, whereas failure to identify meaningful pathology can have consequences that are difficult to remedy from both a medical and legal standpoint (Heller et al., 2024; Abesi et al., 2024).

The medicolegal dimension of this issue represents one of the most serious areas of risk clinicians face in modern dental practice (Heller et al., 2024). Under applicable legal and ethical regulations, a dentist who orders or interprets a CBCT image is held legally accountable for all data within the volumetric boundaries of that image. Focusing exclusively on the dentoalveolar region of interest while overlooking pathology within the FOV can directly expose the clinician to malpractice and negligence claims (Heller et al., 2024). A high level of awareness regarding radiation safety and image interpretation competence is therefore of considerable legal importance for dentists who use CBCT (Coşkun Albayrak & Özdemir, 2025).

1.3. Aim and Scope of the Chapter

Ordering a CBCT image with the correct indication, acquiring it at adequate technical quality, and then systematically evaluating and reporting the entire volumetric dataset are three distinct competencies — sequential steps in which none can substitute for another. The integrated application of all three in clinical practice remains an area that has yet to be brought within a standardised framework.

The aim of this chapter is to provide an evidence-based and practical guide to the systematic reporting of CBCT images in dentistry. To this end, the chapter addresses the clinical and medicolegal significance of reporting, the fundamental principles of CBCT reporting, technical quality assessment, and region-by-region reading protocols. Structured report templates covering implantology, endodontics, temporomandibular joint pathologies, and incidental findings are also included to translate theoretical knowledge into concrete practice.

2. Fundamental Prıncıples Of Cbct Reportıng

2.1. Indication-Based Imaging and Reporting

The correct use of CBCT in clinical practice rests above all on the medical justification of the imaging — the justification principle. According to this principle, no radiological examination should be performed unless the expected clinical benefit clearly outweighs the radiation risk to the patient (American Dental Association & AAOMR Expert Panel, 2026; Oenning et al., 2018). The effective dose of CBCT can reach approximately four times that of panoramic radiography, generating an unnecessary radiation burden in cases of unjustified use (Heller et al., 2024).

Within this framework, the ALARA (As Low As Reasonably Achievable) principle has for decades served as the cornerstone of radiation safety in dental radiology (American Dental Association & AAOMR Expert Panel, 2026).

However, the specific requirements of CBCT technology have prompted the adoption of the ALADA (As Low As Diagnostically Acceptable) principle, which takes this concept one step further (Oenning et al., 2018). The ALADAIP (As Low As Diagnostically Acceptable being Indication-oriented and Patient-specific) model advances this further still, emphasising the need to account for indication-specific and patient-specific parameters and thereby placing personalised radiation optimisation at the forefront (Jacobs et al., 2021).

Regardless of the indication, evaluating and reporting all structures within the FOV is mandatory (Heller et al., 2024; American Dental Association & AAOMR Expert Panel, 2026). According to the joint consensus statement of the ADA and AAOMR, the dentist who orders or uses CBCT is both professionally and legally obligated to interpret all findings within the scanned volume — including those outside the primary region of interest (American Dental Association & AAOMR Expert Panel, 2026).

2.2. FOV Selection and Reporting Scope

Field of view (FOV) selection is among the most critical technical parameters in CBCT, directly determining both the radiation dose and the scope of reporting. The FOV should encompass the smallest volume sufficient to meet the diagnostic need; anatomical areas that are not clinically necessary should not be included in the field of view (Oenning et al., 2018; Jacobs et al., 2021). Clinical evidence demonstrates that smaller FOV sizes both reduce radiation dose and improve image quality (Kamburoğlu et al., 2023).

2.2.1. Small FOV

The small field of view, typically ranging from 5×5 cm to 10×10 cm, encompasses a single tooth or a limited anatomical unit (Kamburoğlu et al., 2023). This configuration is the preferred standard for endodontic and periodontal assessments due to its high spatial resolution and minimised radiation dose (Oenning et al., 2018; Jacobs et al., 2021). Detection of complex root canal anatomy, evaluation of root fractures, delineation of periapical lesions, and detailed examination of periodontal bone defects constitute the primary indications for this category. Even in small FOV images, comprehensive evaluation of all structures entering the field of view remains mandatory (Heller et al., 2024; American Dental Association & AAOMR Expert Panel, 2026).

2.2.2. Medium FOV

The medium field of view, ranging from approximately 8×8 cm to 15×15 cm, is designed to cover single or double jaw anatomy (Kamburoğlu et al., 2023). Dental implant planning, three-dimensional localization of impacted teeth, and evaluation of jaw cysts are the most common clinical indications in this category. Clinical data indicate that clinically significant incidental findings are detectable in over 60% of CBCT examinations performed solely for implant planning (Braun et al., 2022). This rate clearly underscores the necessity of systematically evaluating the entire image volume in medium FOV scans.

2.2.3. Large / Full FOV

The large field of view, with dimensions exceeding 15 cm, is the most comprehensive CBCT category, encompassing the entire maxillofacial complex, temporomandibular joints, cervical vertebrae, and paranasal sinuses (Kamburoğlu et al., 2023). Orthognathic surgery planning, comprehensive orthodontic treatment analysis, bilateral TMJ assessment, and airway morphology examination constitute the primary indications for this field of view. Given that large FOV scans contain an average of 2.6 incidental findings per scan and affect 78.6% of all scans (Braun et al., 2022), the reporting obligation is greatest in this category (Kadkhodayan et al., 2024; Braun et al., 2022).

2.3. The Imaging Chain

A CBCT examination gains its full meaning not merely through image acquisition, but through the complete and sequential execution of a series of interconnected steps extending from referral to reporting. This structure, referred to in the literature as the "imaging chain," defines a systematic workflow in which each link corresponds to a distinct area of responsibility (Patel & Harvey, 2021; Tan et al., 2025).

The process begins with justification: the medical rationale for the radiological examination must be documented, and the reasons why two-dimensional imaging is insufficient must be recorded (American Dental Association & AAOMR Expert Panel, 2026; Patel & Harvey, 2021). Next, the FOV size, voxel dimensions, and acquisition parameters must be optimised in accordance with ALADA/ALADAIP principles (Oenning et al., 2018; Jacobs et al., 2021), and imaging must be performed to the required technical quality standards. In the final and most critical step — reporting — the entirety of the acquired volumetric data is systematically evaluated and a structured report is generated (Patel & Harvey, 2021; Tan et al., 2025).

According to the EADMFR guidelines, this chain defines three distinct roles: "Prescriber" (the referring clinician), "Practitioner" (the person acquiring and justifying the image), and "Operator" (the person performing the technical acquisition) (Tan et al., 2025). Any break in the imaging chain undermines the clinical and legal integrity of the entire process (Heller et al., 2024; American Dental Association & AAOMR Expert Panel, 2026; Tan et al., 2025).

2.4. Clinician Report and Radiology Specialist Report

The question of who should report CBCT images continues to be debated in international dental practice (Coşkun Albayrak & Özdemir, 2025; Tan et al., 2025). According to the EADMFR training framework, Level 1 training defines the mandatory basic competency for all dentists who use CBCT, while Level 2 training determines the competency required for independent reporting (Brown et al., 2014). A comprehensive survey conducted in Singapore found that approximately 48% of dentists using CBCT reported their own scans independently, and that the great majority did not systematically review the full volumetric data (Tan et al., 2025). Where reporting capacity is insufficient, referral to an oral and maxillofacial radiology specialist represents the most appropriate approach from the standpoints of both clinical safety and medicolegal responsibility (Heller et al., 2024; Patel & Harvey, 2021).

2.5. Structural Components of the Report

For a CBCT report to fulfil its clinical and legal functions completely, it must contain five essential components (Patel & Harvey, 2021):

(1) patient and examination information — identity, date, indication, and justification;

(2) technical parameters — device, FOV, voxel size, kV/mA, and artifact information;

(3) findings — the primary region of interest and all anatomical structures within the FOV (including paranasal sinuses, airway, TMJ, and cervical vertebrae);

(4) interpretation — clinical significance and differential diagnosis recommendations;

(5) recommendations and signature — multidisciplinary referral, follow-up protocol, and the signature of the reporting clinician (Patel & Harvey, 2021; Tan et al., 2025).

This comprehensive report format serves as written evidence that the clinician has fulfilled their legal and professional reporting obligations (Heller et al., 2024; American Dental Association & AAOMR Expert Panel, 2026; Patel & Harvey, 2021).

3. Technıcal Qualıty Assessment

3.1. Factors Affecting Image Quality

The reliability of CBCT reporting is directly linked to image quality. A report produced from a diagnostically inadequate image loses its clinical and medicolegal validity regardless of how carefully it is prepared. Systematic assessment of image quality therefore constitutes the first and indispensable step in reporting (Schulze et al., 2011; European Commission, 2012).

3.1.1. Technical Parameters

The fundamental parameters determining CBCT image quality are tube voltage (kVp), tube current (mA), voxel size, and rotation angle (Schulze et al., 2011). Tube voltage determines the contrast resolution of the image; higher kVp values reduce metal artifacts, whereas lower kVp values enhance soft tissue contrast. Tube current directly affects the signal-to-noise ratio; in accordance with the ALADA principle, it should be set at the lowest mA value that preserves diagnostic adequacy (Oenning et al., 2018; Jacobs et al., 2021). Small voxel sizes (0.075–0.15 mm) provide high resolution enabling endodontic and periodontal assessment, but increase radiation dose. Full rotation (360°) yields higher image quality while increasing acquisition time and thereby the risk of motion artifact (Schulze et al., 2011).

3.1.2. Artifact Types

Artifacts encompass all forms of image degradation in a CBCT image that do not originate from actual anatomical structures. Recognising artifacts is a critical competency for the reporting clinician in order to avoid false-positive or false-negative findings (Schulze et al., 2011).

Metal Artifact

Metal artifact is the most frequently encountered artifact type in CBCT imaging and the one that most markedly impairs diagnostic quality (Schulze et al., 2011). Amalgam restorations, metal crowns, implants, orthodontic appliances, and endodontic posts are the main sources. Beam hardening arises when low-energy photons in polychromatic X-rays are preferentially absorbed as the beam passes through dense metallic structures, producing dark streaks and bright areas around the metal. Extinction artifact occurs when the beam is unable to penetrate a metallic structure at all, appearing as completely black areas at the detector (Schulze et al., 2011). In the image, metal artifact manifests as a "blooming" appearance and blurring of adjacent tissue margins, causing significant limitations in the assessment of bone quality around implants (Schulze et al., 2011; Bohner et al., 2025). The report must clearly state the presence of the artifact, the anatomical areas affected, and the extent to which it limits diagnostic interpretation.

Motion Artifact

Motion artifact results from patient movement during image acquisition; the risk increases markedly in protocols with acquisition times exceeding 10 seconds (Schulze et al., 2011). It manifests as blurring of sharp anatomical margins, a double-contour appearance of the cortical bone outline, and a reduction in overall image contrast. In cases of pronounced movement, the entire image volume may lose its diagnostic value; motion artifact must therefore always be documented in the report as a parameter that directly reduces the image quality score (Schulze et al., 2011; European Commission, 2012).

Scatter and Other Artifacts

Scatter artifact is generated when photons deflected from the primary X-ray beam reach the detector, resulting in loss of overall image contrast and increased background noise; scatter increases as FOV size grows (Schulze et al., 2011). Partial volume effect arises from averaging the density values of more than one tissue type within a single voxel and may distort true anatomical boundaries — particularly in the assessment of thin cortical bone walls and the periodontal ligament space. Ring artifact appears as concentric rings in the image due to detector defects and generally indicates a device-specific calibration problem (Schulze et al., 2011).

3.2. SEDENTEXCT Quality Classification

The SEDENTEXCT guidelines published by the European Commission propose a two-tier classification system for the quality assessment of CBCT images (European Commission, 2012). Grade 1 (Acceptable) indicates that the image is of sufficient quality to answer the primary indication; artifacts may be present but do not impede the assessment. Grade 2 (Unacceptable) indicates that the primary indication cannot be evaluated due to pronounced artifacts or advanced noise related to technical parameters (European Commission, 2012). The SEDENTEXCT guidelines recommend keeping the proportion of Grade 2 images below 10% as a quality audit target. The reporting clinician should clearly state the image quality grade in the technical parameters section of the report; for Grade 2 images, the scope of diagnostic limitations must be elaborated.

3.3. Viewing Conditions

Image quality depends not only on the acquisition stage but also on the environmental conditions under which the image is assessed (Patel & Harvey, 2021). The viewing monitor must be medical-grade, with a minimum resolution of 1–2 megapixels and a wide greyscale range. Regular monitor calibration and maintenance of calibration records are important for preserving clinical quality. Performing the assessment in a dimly lit or light-controlled environment protects the eye's adaptation and prevents low-contrast pathologies from being overlooked.

3.4. Reporting an Inadequate Image

Reporting an image of inadequate quality is not something the clinician can avoid; it is a professional responsibility that must be assumed (Patel & Harvey, 2021; European Commission, 2012). The principal medicolegal risk lies in interpreting a suboptimal image as though it were a fully valid examination without explicitly stating its limitations. Limitations must be expressed in the relevant section of the report in clear, documentary language:

"Image quality is limited due to pronounced beam hardening artifact originating from the metal crown on tooth 46. This artifact affects the periapical region around the mesial root, and the findings reported below should be interpreted in light of this limitation."

"Moderate motion artifact has been identified in the image. Cortical margins cannot be resolved with sufficient clarity; interpretations pertaining to fine anatomical structures should therefore be regarded with caution."

4. Systematıc Anatomıcal Assessment

Anatomical assessment is the most time-consuming stage of CBCT reporting and the one requiring the greatest degree of clinical judgement. Every structure entering the field of view must be examined with systematic attention; a single missed finding can render the entire report ineffective (Patel & Harvey, 2021; Bornstein et al., 2024). The recommended approach for each anatomical region in this chapter is as follows: first, establish a clear mental picture of the normal radiological appearance, then contextualise variants and pathological findings against that baseline.

4.1. Maxilla

4.1.1. Normal Anatomy and Radiological Appearance

On CBCT, the maxilla is visualised with distinct cortical plates on the buccal and palatal surfaces, with trabecular bone in between. Given the wide interindividual variation in trabecular density, definitive conclusions about bone quality should not be drawn solely from the bone density observed in a single image (Bornstein et al., 2024). In a healthy sinus, the mucosa is either not visible in the image or measures less than 1 mm (Bornstein et al., 2024; Dogan et al., 2024). The nasopalatine canal is considered normal within a diameter range of 2–6 mm (Bornstein et al., 2024).

4.1.2. Anatomical Variants

Maxillary sinus septa (Underwood septa) are critical variations that must be reported prior to sinus lift and implant procedures (Bornstein et al., 2024). Haller cell, concha bullosa, and a nasopalatine canal exceeding 6 mm in diameter are clinically significant variants that should be documented in the report.

4.1.3. Pathological Findings

Osseous Lesions

Osseous lesions must be evaluated jointly in terms of margin characteristics, internal structure, cortical integrity, and relationship to adjacent teeth. Well-defined, corticated lesions favor an odontogenic cyst diagnosis, whereas cortical destruction and a multilocular appearance are alerting signs for malignant pathology. In such cases, the report should include a recommendation for differential diagnosis and histopathological evaluation (Bornstein et al., 2024).

Sinus Pathology

In mucosal thickening, values below 2 mm are considered normal, 2–10 mm represents moderate thickening, and above 10 mm indicates advanced thickening (Dogan et al., 2024). A flat pattern suggests chronic inflammation, while a polypoid pattern raises the possibility of a mucosal polyp or retention cyst (Dogan et al., 2024). When the apices of upper posterior teeth are in close proximity to the sinus floor, an odontogenic origin must always be considered (Küçükkurt, 2025).

"Diffuse mucosal thickening of the flat type, predominantly at the sinus floor level, is observed in the right maxillary sinus (maximum thickness: 7 mm). The mesiobuccal root apex of tooth 16 is in direct contact with the sinus floor; the possibility of odontogenic sinusitis is considered to warrant clinical evaluation."

Periapical and Periodontal Pathology

In describing periapical lesions, the size, margin characteristics, lamina dura integrity, and relationship to the cortical plate must be systematically documented (Wong et al., 2025; Patel & Harvey, 2021). In cases of periodontal bone loss, the pattern — vertical or horizontal — affected teeth, defect depth, and furcation involvement are indispensable components of the report (Discepoli et al., 2025).

4.2. Mandible

4.2.1. Normal Anatomy and Radiological Appearance

The mandibular canal, a corticated tubular structure originating in the ramus and terminating at the mental foramen, carries critical information regarding its buccolingual position, diameter, and distance from adjacent structures for implant planning and impacted tooth surgery (Peña-Cardelles et al., 2025). The mental foramen is typically located in the region of the second premolar; the presence of an accessory foramen should be reported, as it may affect the efficacy of nerve block anesthesia (Pelé et al., 2021).

4.2.2. Anatomical Variants

Bifid mandibular canal is rarely detected on panoramic radiography, whereas CBCT studies have reported its prevalence reaching approximately half of all patients in some series (Göller Bulut et al., 2024). Dental and retromolar types, which course close to surgical sites, are high-risk variants. Torus mandibularis should be documented with regard to prosthetic planning.

4.2.3. Pathological Findings

Mandibular Canal-Related Pathology

In implant planning, the crest-to-canal distance should be reported in millimetres; in the assessment of impacted lower third molars, contact of root apices with the superior wall of the canal, cortical integrity, and canal deflection should each be addressed separately (Robbins et al., 2022; Peña-Cardelles et al., 2025).

"The distal root apex of the impacted tooth #48 is in direct contact with the superior wall of the mandibular canal. The cortex of the canal cannot be identified in this region. The findings indicate a high risk for inferior alveolar nerve injury and must be taken into account in surgical planning."

Osseous Lesions and Fractures

In osseous lesions, odontogenic keratocyst, ameloblastoma, and giant cell granuloma should be kept in mind in the differential diagnosis; for suspicious lesions, a biopsy recommendation should be included in the recommendations section of the report (Bornstein et al., 2024). For fractures, the localization, direction of the fracture line, and presence of displacement should be systematically reported.

4.3. Temporomandibular Joint

4.3.1. Normal Anatomy and Radiological Appearance

In the normal condyle, the surface should appear smooth, the cortex thin and continuous, and the subchondral bone of homogeneous density (Sadat Mansouri et al., 2024). A round, oval, or mildly flattened condylar morphology does not in itself signify pathology; these variations may reflect physiological remodelling (Sadat Mansouri et al., 2024; Semerci & Günen Yılmaz, 2023).

4.3.2. Anatomical Variants

Condylar asymmetry alone should not be interpreted as pathology. Bifid condyle is a rare but reportable variation. Pneumatised articular eminence, while of limited clinical significance, should be reported and followed up when appropriate.

4.3.3. Pathological Findings

Degenerative Changes

TMJ degenerative joint disease findings on CBCT should be reported systematically under the headings of osteophyte formation, condylar surface erosion, subchondral sclerosis, surface flattening, and subchondral cyst (Sadat Mansouri et al., 2024; Semerci & Günen Yılmaz, 2023). The report should emphasize that CBCT findings must be interpreted in conjunction with clinical symptoms and the diagnostic criteria for temporomandibular disorders.

"Irregularity of the condylar surface, osteophyte formation on the anterior aspect, and subchondral sclerosis are observed in the left TMJ. The osseous structures of the right TMJ are assessed as within normal limits. The findings are consistent with degenerative joint disease; clinical correlation is recommended."

CBCT visualises osseous structures only and cannot provide information on disc pathology or synovial changes. In every case where disc pathology is suspected, this limitation must be explicitly stated in the report and an MRI referral made (Sadat Mansouri et al., 2024; Semerci & Günen Yılmaz, 2023).

4.4. Dental Structures

4.4.1. Dentition Assessment

Systematic recording of present, missing, supernumerary, and impacted teeth constitutes the first step of dental assessment. For impacted teeth, the eruption path, distance to adjacent root apices, and the presence of external resorption of neighbouring teeth must be reported in detail (Wong et al., 2025; Patel & Harvey, 2021).

4.4.2. Root and Canal Morphology

Root number, degree of curvature, and canal configuration should be described according to the Vertucci classification (Patel & Harvey, 2021). Variations such as the mesiobuccal 2 canal, C-shaped canal, and radix entomolaris are findings that directly guide endodontic treatment planning.

4.4.3. Endodontic Assessment

In teeth with prior endodontic treatment, filling homogeneity, apical extent, presence of overfill, suspected perforation, and fractured instruments should be assessed jointly alongside the periapical status in terms of size, margin characteristics, and cortical plate relationship (Wong et al., 2025; Patel & Harvey, 2021).

"Previous endodontic treatment is observed in tooth 36. Filling material extending 2 mm beyond the apical terminus is noted in the distal canal, and a 4×5 mm well-defined periapical radiolucent lesion is present at the mesial root."

4.4.4. Resorption Findings

Internal resorption appears as well-defined widening originating from the canal wall, while external resorption presents as irregular bone loss starting from the root surface. In both types, the localization, size, depth of involvement, and whether perforation has occurred must be reported (Wong et al., 2025; Patel & Harvey, 2021).

4.5. Airway

4.5.1. Pharyngeal Airway Assessment

Values of <10 mm for the retropalatal distance, <5 mm for the retroglossal distance, and <52 mm^2 for the minimum cross-sectional area (mCSA) are recognised as clinically critical narrowing thresholds (Pinheiro et al., 2023).

4.5.2. Association with Obstructive Sleep Apnoea

Although reductions in airway volume and cross-sectional area have been shown to correlate with the severity of obstructive sleep apnoea (OSA), CBCT cannot be used as a standalone diagnostic tool for OSA; polysomnography remains the gold standard (El-Solh et al., 2025; Khasawneh et al., 2024). Significant airway narrowing detected on CBCT provides an objective and documented indication for a sleep medicine consultation in the presence of suspected OSA (El-Solh et al., 2025).

"The mCSA at the retropalatal level is measured as 38 mm². This value falls below the clinical threshold (<52 mm²); a sleep medicine evaluation is recommended with respect to OSA risk."

4.6. Cervical Vertebrae

4.6.1. Routine Assessment

In large FOV acquisitions, the field of view frequently extends to the C1–C4 level. These structures must be assessed and reported whenever they enter the image (Heller et al., 2024; Patel & Harvey, 2021). Prominent osteophytes, compression, or deformity should be documented with a recommendation for referral to the relevant specialty.

4.6.2. Carotid Calcifications

Atherosclerotic carotid calcifications appear as bilateral irregular radiopaque foci at the C3–C4 level. Given the documented association with stroke and cardiovascular event risk, this finding must be clearly stated in the report and a cardiology consultation recommended (Oenning et al., 2018; Da Silveira et al., 2021).

"Irregular radiopaque calcifications are observed at the bilateral carotid bifurcation projection at the C3–C4 level. Given the consistency of this finding with atherosclerotic plaque calcification, referral to the relevant specialty is recommended for cardiovascular risk assessment."

4.6.3. Styloid Process Elongation

Styloid process elongation above 30 mm is considered abnormal, and above 40 mm it is regarded as a finding with a strong clinical association with Eagle syndrome (Semerci & Günen Yılmaz, 2023; Khalifa & Felemban, 2021). The length should be reported bilaterally in millimetres; symptomatic patients should be referred to an otorhinolaryngology specialist.

"The right styloid process measures approximately 48 mm in length, consistent with pathological elongation. The left styloid process measures 32 mm. ENT consultation is recommended in the presence of symptomatology."

5. Incıdental Fındıngs And Theır Management

5.1. Definition and Clinical Significance

An incidental finding is defined as any pathological or clinically significant change detected unexpectedly in structures entering the field of view that is not directly related to the primary indication of the CBCT examination (Abesi et al., 2024; Khalifa & Felemban, 2021). The unexpected nature of a finding does not exempt the clinician from the obligation to report it (Heller et al., 2024).

A comprehensive systematic review and meta-analysis encompassing 9,788 patients demonstrated that at least one incidental finding was detected in 69.1% of CBCT scans, with an average of 1.48 incidental findings per scan (Abesi et al., 2024). In a consecutive series of 374 CBCT examinations, this rate reached 78.6%, with 38.6% of findings requiring treatment and 25.2% requiring follow-up (Braun et al., 2022). Failure to detect a pathology within the field of view is regarded as negligence and deemed indefensible from a medicolegal standpoint (Heller et al., 2024).

5.2. Commonly Encountered Incidental Findings

5.2.1. Vascular Calcifications

Carotid atherosclerotic calcifications were reported in 2.7% of cases as the finding most frequently necessitating external referral in a study covering 1,260 CBCT reports (Kadkhodayan et al., 2024). Given the documented association with stroke and cardiovascular event risk, it is mandatory that this finding be recorded in the report and that a cardiology or internal medicine consultation be recommended (Kadkhodayan et al., 2024; Da Silveira et al., 2021).

5.2.2. Styloid and Ligament Ossifications

Stylohyoid calcifications were reported to account for 80.8% of incidental calcifications in an orthodontic patient series (Sunny et al., 2023). Vascular imaging should be recommended for cases exceeding 40 mm in length and in close proximity to the carotid region (Semerci & Günen Yılmaz, 2023).

5.2.3. Intracranial Calcifications

In a CBCT series of 996 patients, the prevalence of physiological intracranial calcification was found to be 49.4%, with pineal gland calcification being the most common type (47.6%) (Kırtay et al., 2022). The great majority of these calcifications are physiological in nature and do not require clinical intervention. A neurology consultation may be warranted in the presence of diffuse, irregular, or asymmetric calcification (Kırtay et al., 2022).

5.2.4. Other Common Incidental Findings

In a study encompassing 404 CBCT scans performed for implant planning, the rate of at least one incidental finding was 82%; this rate was significantly higher in large FOV acquisitions compared to small FOV acquisitions (Biel et al., 2024). Osseous variants should be reported as anatomical variants, while findings containing cortical destruction or a soft tissue component should be flagged as red flags (Kadkhodayan et al., 2024; Khalifa & Felemban, 2021).

5.3. Reporting and Referral Algorithm

Findings should be managed in three categories according to clinical significance and urgency (Kadkhodayan et al., 2024; Khalifa & Felemban, 2021):

Urgent referral: suspected significant carotid stenosis, aggressive osseous lesions suspicious for malignancy, and severe airway obstruction. The patient should be referred to the relevant specialty on the same day or the next working day (Kadkhodayan et al., 2024).

Short-term referral (4–8 weeks): symptomatic styloid elongation, marked TMJ degeneration, significant airway narrowing, and osseous lesions of uncertain clinical significance (Kadkhodayan et al., 2024; Khalifa & Felemban, 2021).

Routine referral or observation: asymptomatic mucous retention cysts, physiological intracranial calcifications, and minor osseous variants (Abesi et al., 2024; Kırtay et al., 2022).

5.4. Medicolegal Responsibility

The 2018 statement of the Royal College of Radiologists sets out the shared position on this matter with clarity: failure to detect a finding within the field of view that would reasonably be expected to be identified by a competent clinician constitutes negligence and is considered indefensible from a medicolegal standpoint (Heller et al., 2024).

The clinician's responsibility takes shape along three axes: (1) detection responsibility — systematic review of the entire FOV volume; (2) information responsibility — verbal and written communication to the patient and documentation of this in the patient file; (3) referral responsibility — making a referral to the appropriate specialty and documenting this recommendation (Heller et al., 2024; Kadkhodayan et al., 2024).

6. Reportıng Language And Standards

6.1. Descriptive and Interpretive Language

A CBCT report carries two distinct responsibilities: seeing and interpreting. Descriptive language conveys objectively observed findings in the image; interpretive language assigns clinical meaning to those findings. A blurring of the boundary between the two weakens both the clinical value and the medicolegal credibility of the report (Patel & Harvey, 2021; Schnitzer et al., 2026).

To be avoıded: *"Poor-quality root filling present, periapical infection noted."*

Correct approach: *"The filling material terminates 4 mm short of the working length; no filling is observed in the apical canal. A 5×4 mm well-defined radiolucent area is present at the mesial root."*

6.2. Confidence Level Expressions

Consistent use of standardised expressions reflecting confidence level in reporting is recommended (Patel & Harvey, 2021; Schnitzer et al., 2026):

"Consistent with the appearance of" / "Consistent with typical features of" — used when the existing radiological findings support a particular diagnosis without proving it independently.

"Suggestive of" / "Suspicious appearance" — preferred when findings point towards a particular diagnosis but the differential has not yet been closed.

"Cannot be excluded" / "Cannot be disregarded" — reserved for situations where the findings do not support a definitive diagnosis but a clinically important possibility cannot be ruled out. This expression should be used selectively (Patel & Harvey, 2021).

6.3. Writing the Differential Diagnosis

A differential diagnosis list should be the product of systematic elimination and a prioritisation that guides the clinician (Patel & Harvey, 2021; Schnitzer et al., 2026). Possibilities should be ranked from most to least likely; the list should be limited to 3–4 meaningful options, and a concrete next step should be specified after each recommendation.

"The unilocular, well-defined radiolucent lesion detected is most consistent with an odontogenic cyst; given its pericoronal location, a dentigerous cyst is placed first in the ranking. Odontogenic keratocyst cannot be excluded, and histopathological evaluation is recommended."

6.4. Structured Reporting

Studies comparing free-text and structured reports have demonstrated that structured reports score significantly higher in terms of contribution to treatment decisions, completeness of information, logical sequencing, and overall assessment (Schnitzer et al., 2026; Vosshenrich et al., 2023). The ideal approach is to preserve the framework of the structured format while keeping free-text sections active as the designated space for unusual findings and interpretive commentary (Patel & Harvey, 2021; Vosshenrich et al., 2023).

6.5. International Guidelines and Standards

The 2014 EADMFR position paper defined the Level 1 and Level 2 competency boundaries; a recent survey revealed that significant heterogeneity in dose optimisation still exists in clinical practice (Brown et al., 2014; Oenning et al., 2025). The SEDENTEXCT guidelines constitute the primary reference document interpreting the ALARA principle as specific to CBCT (European Commission, 2012). The 2026 ADA/AAOMR guidelines recommended that CBCT be used selectively based on clinical indication rather than as a routine procedure (American Dental Association & AAOMR Expert Panel, 2026). The 2025 AAE/AAOMR joint position statement updated the framework for CBCT use in endodontics with 12 clinical recommendations (American Association of Endodontists & AAOMR, 2025). ESE guidelines diverge from AAE/AAOMR on some indications and have yet to provide clear recommendations on topics such as the detection of fractured instruments (Chan et al., 2023).

6.6. The Future of AI-Assisted Reporting

Existing deep learning models are achieving accuracy levels approaching clinician-level performance in areas such as dental and jaw segmentation, periapical lesion detection, and periodontal bone loss assessment (Mureșanu et al., 2023; Fan et al., 2023). However, the majority of models have been trained on limited and homogeneous datasets, and their generalisability across different devices and patient populations has not been sufficiently tested (Mureșanu et al., 2023). Ethical and regulatory frameworks have yet to be clarified. There are compelling reasons to anticipate that the most productive approach in the future will be an "AI-assisted clinician" model (Mureșanu et al., 2023; Fan et al., 2023; Orhan et al., 2025).

7. Sample Reportıng

The sample report format recommended by the Turkish Association of Oral Diagnosis and Maxillofacial Radiology (ODMFR) is presented below. (Oral Diagnoz ve Maksillofasiyal Radyoloji Derneği, 2025)

Cone-Beam Computed Tomography Report Format

1. Patient Information:

- Full Name:
- Date of Birth:
- Sex:
- Protocol No. / File No.:

- Imaging Date:
- Reporting Date:
- Referring Clinician's Full Name:
- Clinical Information: – Diagnosis / Provisional Diagnosis:
- Reason for Referral:

2. Technical Information:

- Imaging Device: [Model and Brand]
- Voxel Size: [e.g. 0.2 mm]
- Scan Field (FOV): [e.g. 16×13 cm]
- Scan Duration:
- Radiation Dose (DAP):
- Region Examined:
- Reconstructions: Sagittal / Coronal / Axial / 3D

3. General Findings (Anatomical and Pathological)

The following structures should be assessed systematically in the order listed.

A. Maxilla:

A. Cortical structures and trabeculation
B. Sinuses (maxillary sinus, septa, mucosal thickness, opacity)
C. Alveolar bone level and density
D. Tooth-related lesions (periapical, periodontal, cystic formations, etc.)

B. Mandible:

- Cortex and trabecular structure
- Mandibular canal: localization, cortication, variation
- Lingual foramen, mental foramen and variations
- Additional lesions or pathology

C. Temporomandibular Joint (TMJ):

- Condylar shape and symmetry
- Glenoid fossa

- Joint space
- Degenerative changes (osteophyte, erosion, sclerosis, etc.)

D. Dental Structures *(Detailed in cases of pathological findings):*

- Tooth numbers (missing, supernumerary, impacted)
- Endodontic treatments (filling, perforation, pathology)
- Resorption findings (internal/external)
- Root form and number, canal morphology
- Dental attachment level (periodontal findings if present)

E. Airway:

- Nasal cavity
- Nasopharynx / Oropharynx
- Airway patency

F. Other Findings:

- Pathological formations (cyst, tumour, etc.)
- Calcifications
- Soft tissue observations (if any)
- Anatomical variations (torus, septa, etc.)

4. Conclusion and Recommendations

A summary of the diagnostic assessment, existing pathologies, anatomical variations, and recommendations is provided.

- Key Findings:
- Clinical correlation:
- Recommendation / Follow-up / Consultation:

5. Reporting Clinician Information

- Full Name:
- Specialty:
- Signature:
- Date:

8. Conclusıon

CBCT has now entered its maturity phase as a technology in dental radiology. The question under discussion is no longer "should we use this technology?" but has shifted to "are we truly using it well?" This chapter was written as an endeavour to provide a systematic and evidence-based answer to the second question.

The picture that has emerged throughout this chapter is clear: the clinical value of CBCT is proportional not to the technical quality of the image but to the competence of the clinician interpreting it. An image acquired with the most advanced device loses its clinical integrity without a systematic reading practice — without a clinician who covers the entire FOV volume, does not overlook incidental findings, distinguishes descriptive from interpretive language, and signs the report (Heller et al., 2024; Patel & Harvey, 2021).

The contribution of reporting to patient safety is concrete and measurable. It has been shown that previously unknown findings are detected in more than one-third of CBCT scans, and that the treatment plan changes in a significant proportion of these cases (Braun et al., 2022). Incidental findings outside the primary indication — such as carotid calcification, airway obstruction, or cervical vertebra pathology — can lay the groundwork for life-saving outcomes when reported and referred to in a timely manner (Kadkhodayan et al., 2024; Da Silveira et al., 2021).

Looking ahead, AI-assisted image analysis holds the potential to transform CBCT reporting (Mureșanu et al., 2023; Fan et al., 2023; Orhan et al., 2025). This transformation, however, will take the form of supporting the clinician's diagnostic process rather than replacing the clinician. A systematic, standards-compliant, and carefully prepared CBCT report protects the patient, safeguards the clinician, and constitutes the shared language of interdisciplinary communication.

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