

Guidelines and template for reporting on CBCT scans

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Key points

Provides guidelines on how to report a small volume cone beam computed tomography (CBCT) scan.

Discusses what should be included in an actionable radiographic report and why.

Provides guidelines on how to optimise how images are viewed – from monitor quality to image manipulation.

Abstract

The aim of this paper is to provide guidelines on how to report a small volume cone beam computed tomography (CBCT) scan.

Viewing conditions

Ideally, CBCT scans should be viewed and reported in a dimly lit, quiet room, using a medical grade diagnostic display device (monitor).¹ Most 'off the shelf' monitors have a lower diagnostic performance compared to well-calibrated medical monitors.²

Typically, surgery environments are too bright and ambient light may have a deleterious impact on the viewing of radiographic images.² In-surgery monitors may be useful as a secondary monitor; for demonstration to a patient or to refer to during the course of treatment.

Viewing CBCT scans in a dedicated reporting room (or in surgery before or after clinic) allows the lighting and viewing conditions to be appropriately adjusted (Fig. 1). This gives the clinician sufficient time to systematically assess the entire volume of data and consider provisional radiographic diagnoses without being potentially distracted by an understandably inquisitive or concerned patient. Complex

and time-consuming manipulations are often needed to comprehensively assess the dataset – for example, adjusting slice thickness and/or intervals between slices, or drawing a curved multiplanar reconstruction (curved MPR) (Fig. 2). If the CBCT scan is being briefly surveyed in the surgery in the presence of the patient, they must be made aware that this is only a brief assessment and that only after a thorough assessment can a diagnosis and treatment plan be devised.

Preliminary information

Patient details

This is essential information to ensure that the correct scan is assigned to the correct patient. In addition to full name, at least one other unique identifier (eg, date of birth, address, hospital number) should be used, preferably more. This is in case there are typographic errors when entered onto a computer system, or differences in spelling of names (eg, Chris, Cris, Kris).

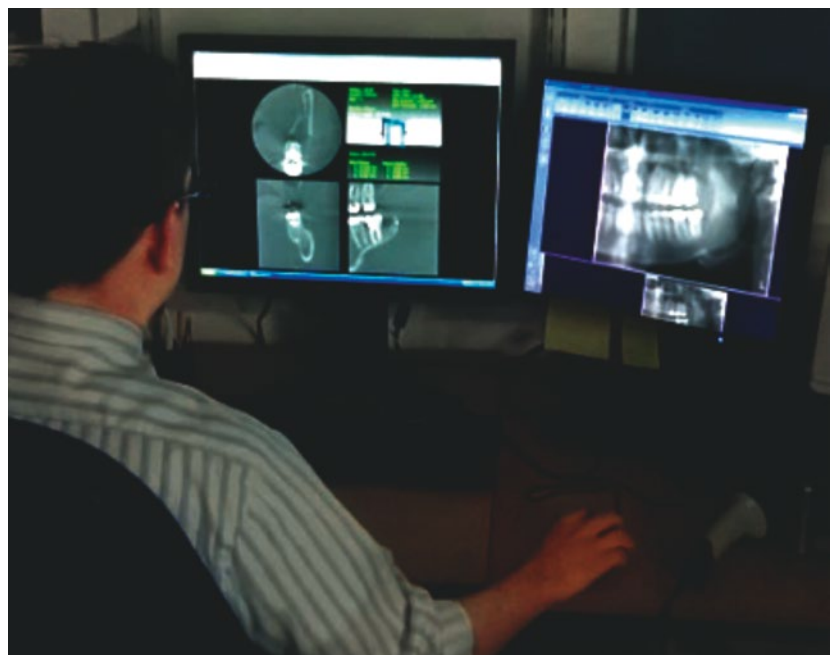


Fig. 1 Suggested viewing environment: quiet, dimly lit room, calibrated medical grade viewing monitor(s), ergonomic position

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Table 1 Aide memoire of key features to report with common indications

Key features

Referrer:

Name, Job title, Address for report to be sent

Patient details:

Name, DOB, Additional identifier (eg, address)

Clinical details:

History, Relevant medical history, Relevant dental history, previous imaging, reason for scan, Specific questions the referrer wants answered (if any)

Radiography log:

kV, mA, exposure time, scan protocol, operator, grade, comments

Report:

Anatomical region of the scan, Teeth erupted and visible in the scan volume, teeth unerupted

Endodontic	Implant	Periodontology	Lower third molars	Orthodontics
Coronal status (if possible) and presence/position of posts	Teeth present/missing/retained	Root form & relationship	Impaction and crown and follicle status (if possible)	Position/impaction of canines or other ectopic teeth
Number of root canals & nature curvatures	Radiographic stent present?	Furcations, craters and bony defects	Root number, shape, position, curvature etc.	Follicle status of ectopic teeth
Root canal configuration, presence of invaginations.	Height & width (volume) of bone	Relationship and effects on anatomical structures	Relationship and effects on anatomical structures (especially ID canal)	Resorption of adjacent teeth
Presence and quality of existing root filling, perforations	Quality of bone (if possible/ appropriate)		Caries/resorption in the distal aspect of the second molar	Angulation and root position of unerupted teeth
Periapical/periradicular bone status (trabecular bone pattern)	Relationship and effects on anatomical structures		Surrounding trabecular bone pattern	Apical status of unerupted teeth (mature / immature)
Root resorption – location, nature	Any adjacent dentoalveolar pathology			Supernumery & odontoma assessment
Relationship and effects on anatomical structures				Relationship and effects on anatomical structures

Radiological description: of any pathology followed by diagnosis/differentials

Peripheral findings: particularly if relevant to treatment or matters which need further management

Conclusion/Impression: concise summary and answer to any questions asked

Sign off: name, job title, GDC number and perhaps contact info

The age, sex and ethnicity of a patient should also be noted as this may be relevant for the differential diagnoses (for example, solitary bone cysts are rarely seen above age 20, fibro-cemento-osseous dysplasia is commonly associated with 40+ year old females of African/ Afro-Caribbean ethnicity).

Clinical details

Clinically relevant details should also be included in the referral if a CBCT scan is being referred for reporting. This allows the reporter a ‘window’ into the treatment strategy and to understand the rationale for the CBCT scan.

This should also include any relevant medical and dental history – for example, a previous history of radiotherapy to the head and neck which may have irradiated the jaws, the timing of a previous extraction where the site is healing very slowly, dental trauma or a symptomatic endodontically treated tooth.

The justification of using CBCT over alternative imaging methods should also be included with the scan.

This information allows the radiologist to tailor the report to the clinician’s needs. For example, if the scan is for implant planning the report is likely to include details of the proximity of vital anatomical structures and anatomical variants.

The authors suggest that the referrer should consider asking specific radiographically relevant questions which they would like answered to aid the diagnosis/management of the patient. For example, a referrer who has requested a CBCT scan to be taken before potential extraction of a wisdom tooth would want to know the location and distance of the inferior dental nerve from the apices of the wisdom tooth. Remember: ‘*The better the request, the better the report.*’

Radiography log

The following details should be recorded:

- The name of the operator
- Exposure parameters (eg 180/360° rotation, mA, kV, resolution)
- The anatomical region (eg left posterior mandible, anterior maxilla etc)

- Grade of scan and any comments (eg ‘First scan grade 2 – patient moved during scan, scan aborted and retaken. Second scan grade 1’)

It should be noted that CBCT scans are graded differently to other dental radiographic imaging – for CBCT grade 1 means ‘acceptable’ and grade 2 means ‘unacceptable’.

Including the exposure parameter details may help in the investigation of a poor quality scan. Furthermore, if future (follow-up) scans are required these exposure parameters may be modified to potentially improve image quality, or for comparison.

Report on the CBCT data

The entire volume of CBCT dataset must be assessed systematically and reported upon. The authors suggest sequentially assessing the scan fully in all three orthogonal planes (axial, sagittal and coronal). Only assessing a specific area of interest, eg a tooth which is treatment

planned for endodontic treatment, is poor practice. Incidental findings are common;³ missing a significant incidental finding is indefensible.

The report should include the following information:

Which teeth are present and erupted

Care should be taken when reporting on teeth which cannot be completely seen; if a molar root tip is missing from the scan then one cannot confidently say the entire tooth is sound.

Which teeth are unerupted

The presence and orientation/impaction to adjacent teeth and anatomical structures should be noted.

Systematic assessment of each tooth

Using the native CBCT or third party software, each tooth should be 'uprighted' to give the clearest view of the anatomy before assessment. Each root of a multi-rooted tooth should be uprighted and individually assessed (Fig. 3).

A tailored approach depending on the clinical situation

- Coronal status: CBCT should not be used as a primary method for diagnosis of caries.⁴ Assessment of the crowns is frequently difficult if there is beam hardening artefact, in these situations a caveat should be added to the radiographic report 'crown evaluation is not possible due to beam hardening artefact' (Fig. 4)
- Number of roots, their curvature and canal configuration
- Periapical/periradicular status of the teeth
- Location and relationship of anatomical structures such as the ID canal or sinus floor to those roots, or any relevant anatomical variants, for example, retromolar branch of the ID canal.

The condition of the other teeth in the field

- Assess the periapical and periradicular region of each root. CBCT is very accurate at detecting periapical pathology⁵
- Caries or anomalies in any other crowns; also remember to check the opposing dentition. Again, this may be compromised by beam hardening artefact.

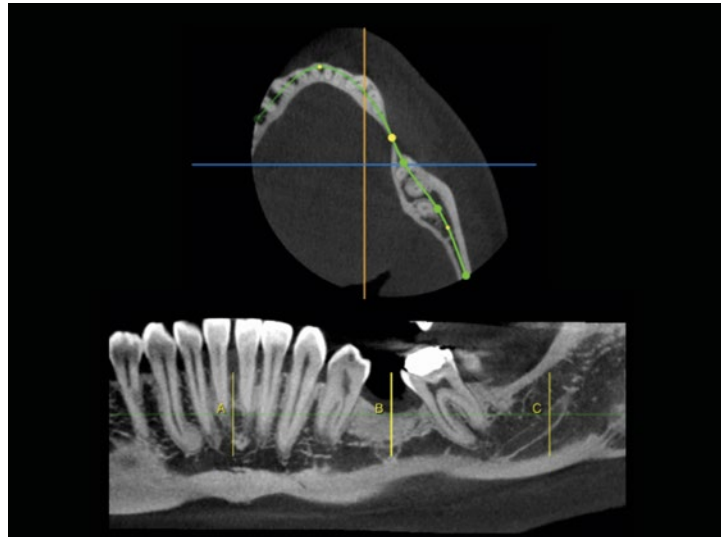


Fig. 2 Top image – small volume CBCT axial slice. Bottom view – curved MPR view of the arch (plotted by the green line on the axial slice)

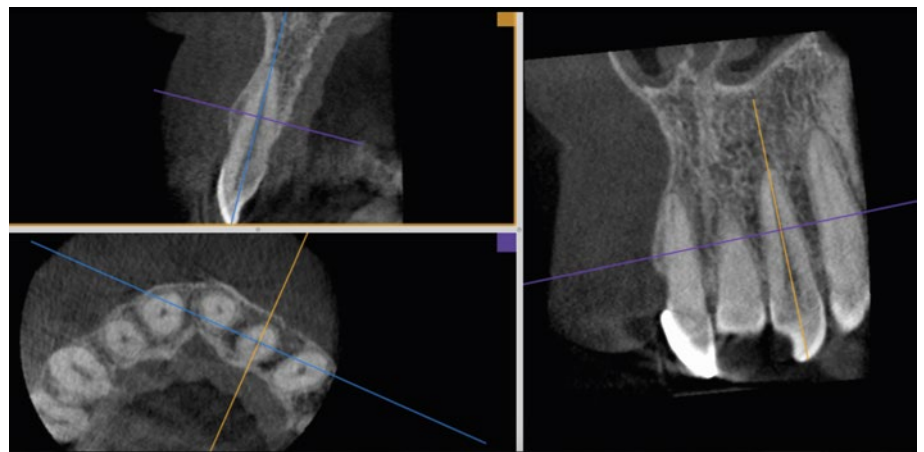


Fig. 3 The upper left lateral incisor (22) has been 'uprighted' in 3 planes to give the best view of the tooth

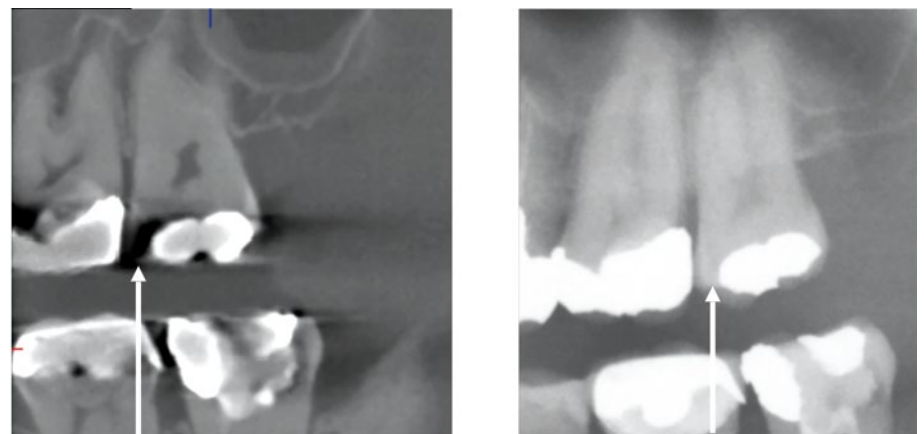


Fig. 4 Left image – parasagittal CBCT slice of 26 and 27 showing lucency (secondary caries?) at the mesial aspect of 27. Right image – DPT from the same day showing 27 mesial aspect is sound

A radiological description of any pathology followed by diagnosis

- The site, size, shape, relationships, outline, internal structure and effects on other structures should all be mentioned in a radiographic report. These are factual statements/radiographic descriptions which lead to the (differential) diagnosis
- When formulating a diagnosis, a measure of the reporter's confidence is helpful, for example: 'This is typical of' demonstrates a high level of confidence in a single diagnosis; conversely, 'this may be X, Y or Z' indicates that several lesions may be considered. Typically, the differential diagnoses are in order of likelihood from most to least common. In some cases it may not be possible to come to a definitive diagnosis for a lesion, however, it may be helpful if the lesion/anomaly can be placed in a 'category', for example 'The diagnosis is equivocal however this is likely a calcifying benign odontogenic tumour'. One may also consider the opinion from a second reporter to ascertain if a definitive diagnosis is possible.
- It is good practice to have a final look through all three planes again for anything outside the focus of your examination. 'Incidentalomas' are common – for example, aberrant calcifications are often seen during small volume scans of the posterior mandible; most frequently they represent tonsilloliths, however sialoliths, antroliths, phleboliths, lymph node calcifications and dermal acne scar calcifications are also seen. While these are unlikely to be clinically relevant to the dental problem in hand it demonstrates a thorough approach to examining the volume of the scan
- There may be anatomical variants of other teeth in the field of view which could change the treatment plan – for example, a dens-in-dente malformation of an upper lateral incisor may change how an unerupted canine is managed.

It is desirable to make recommendations if necessary, particularly if you think further imaging could be beneficial – for example 'the distal aspect of 37 is difficult to assess given the beam hardening artefact; I would recommend parallax periapical radiographs if clinical suspicion of caries remains'.

Impression/conclusion

The final impression/conclusion should be concise and ideally answer the clinical question: for example, 'mesially impacted lower left third molar, two curved roots with "pincer like" morphology and with apices immediately adjacent to the lingual ID canal with no obvious cortical separation. Caries present on distal aspect of lower left second molar.'

It may also include significant incidental findings which need to be acted upon. Tonsilloliths may be an incidental finding but are unlikely to be significant and do not need to be included. However, a suspicious incidental lesion should be, for example, a significant soft tissue mass in the pharynx which cannot be characterised on CBCT but the clinician should be alerted as it may need investigation with other methods.

The clinician should be contacted as soon as possible if a suspected malignancy, or any other suspect anomaly is detected which requires urgent attention.

Finally, the reporter's name, job title, GDC number and signature is required. Consider adding your contact details should the referrer wish to discuss the report.

Additional notes

- Do not 'crop' scans to remove the cervical spine when taking large volume scans; the entire volume must be reported. Whenever possible the smallest possible field of view CBCT scan should be considered

- It is unlikely anyone apart from a consultant radiologist has sufficient training to report on the skull base foramina, temporal bone, orbits and paranasal sinuses. Consider a supplemental report on these areas from a consultant radiologist, such as a specialist, if these are included in the CBCT volume
- The report is interpreted along with the other 'special tests', clinical examination and history by the clinician who sets the whole assessment in context. For this reason, radiological reports are not usually sent to patients; they do however form part of the permanent patient record which is accessible to the patient on request. As such the report should be written professionally.

Conclusion

After completion of a suitable postgraduate training course, practitioners should be confident in their ability to write a high quality report for CBCT. This paper provides a framework for a systemic, comprehensive and personalised CBCT radiographic report (also see Table 1 for *aide memoire*).

An opinion from a consultant dental and maxillofacial radiologist should be sought if there is anything unusual and/or the referrer or reporter feels they are out of their comfort zone.

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