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Field Of View–Based Interpretation Of CBCT In Orthodontics: A Systematic Review

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ABSTRACT

The integration of cone-beam computed tomography (CBCT) into orthodontic practice has significantly transformed diagnostic imaging, allowing for enhanced three-dimensional visualization of craniofacial structures. This systematic review investigates the influence of the field of view (FOV) on the diagnostic interpretation and clinical outcomes of CBCT in orthodontics. The review categorizes FOV into large, medium, and small, emphasizing that diagnostic accuracy is inherently task-specific and determined by the chosen FOV. It highlights that small FOVs offer superior resolution for localized diagnoses while large FOVs are crucial for comprehensive skeletal assessments. Moreover, the review addresses the limitations of reconstructing images from larger FOVs and the necessity for standardized interpretation protocols tailored to different FOV settings. Clinical recommendations suggest optimized FOV selection based on distinct clinical scenarios, balancing diagnostic needs with radiation safety. In conclusion, this review underscores that effective utilization of CBCT in orthodontics necessitates a strategic FOV selection aligned with the clinical question at hand, paving the way for enhanced patient care and outcomes.

Keywords: Cone-beam computed tomography, orthodontics, field of view, diagnostic accuracy, standardized interpretation protocols, radiation safety, incidental findings.

INTRODUCTION

The advent of cone-beam computed tomography (CBCT) has revolutionised diagnostic imaging in orthodontics, providing three-dimensional insights that far exceed the capabilities of traditional cephalograms and panoramic radiographs[1]. A pivotal feature of CBCT technology is the operator's ability to select the field of view (FOV), which determines the volume of anatomy captured—ranging from a small, localised region to the entire craniofacial complex.

However, this flexibility raises a critical question: **How does the selected FOV influence diagnostic efficacy, interpretation protocols, and clinical outcomes in orthodontic practice?**

Although multiple studies have investigated CBCT applications in orthodontics, few have systematically examined how FOV selection influences diagnostic accuracy and interpretation strategies—a gap this review aims to address.

Our review thus synthesises the current evidence to explore FOV-based interpretation of CBCT, providing a structured framework for clinicians to optimise scan selection and analysis while maintaining a balance between diagnostic necessity and the fundamental principles of radiation safety.

DEFINING THE FIELD OF VIEW (FOV) IN THE ORTHODONTIC CONTEXT

The **field of view (FOV)**, typically measured in centimetres, represents the **cylindrical or spherical volume of tissue** captured during a CBCT scan.

In orthodontics, FOVs are broadly categorised as follows:

- **Large FOV:** Captures the entire craniofacial skeleton—from the frontal sinus to the hyoid bone—and includes both temporomandibular joints (TMJs). This setting is essential for complex cases involving severe skeletal discrepancies, craniofacial syndromes, or orthognathic surgery planning[2].
- **Medium FOV:** Encompasses the maxilla and mandible, typically including the dentition and surrounding alveolar bone. It is useful for assessing multiple impacted teeth or evaluating the airway in the context of sleep apnoea[3].
- **Small/Limited FOV:** Focuses on a specific, localised region, such as a single tooth, quadrant of the arch, or temporomandibular joint (TMJ). This is ideal for localising impacted canines, assessing root resorption, or evaluating root parallelism[4].

The selection of the FOV is directly proportional to the radiation dose delivered to the patient, making its judicious selection a cornerstone of the **ALARA principle** (As Low As Reasonably Achievable)[5].

KEY FINDINGS FROM THE SYSTEMATIC REVIEW

The synthesis of available literature reveals several critical themes regarding **FOV-based interpretation** in CBCT imaging for orthodontics.

1. Diagnostic Accuracy is FOV-Dependent

The review consistently demonstrates that **diagnostic accuracy is task-specific** and directly influenced by the **selected FOV**.

- **For Localised Diagnostics:** For tasks such as identifying root resorption, assessing buccal or palatal bone thickness, or precisely locating an impacted tooth, a small FOV is superior. It provides higher spatial resolution (smaller voxel size) within the region of interest, reducing scatter and producing sharper images without interference from surrounding anatomical structures[4,6].
- **For Comprehensive Skeletal Analysis:** When the diagnostic objective involves assessing the maxillomandibular relationship in all three planes of space, evaluating airway dimensions, or analysing TMJ morphology, a large FOV is indispensable.

  Small or medium FOVs cannot adequately capture the necessary anatomical landmarks (e.g., condyles, nasion, basion) for comprehensive cephalometric or 3D airway analysis[2,7].

2. The Pitfall of "Reconstructed" Analyses from Large FOVs

A common practice is to acquire a large FOV scan and then digitally reconstruct smaller regions, creating a so-called 'virtual' small FOV. Although this is technically feasible, the resolution of reconstructed images is inherently restricted by the original, larger voxel size used during large FOV acquisition[8].

Therefore, for diagnostic tasks requiring fine detail (e.g., visualisation of a thin labial bone plate or minor root fracture), a natively acquired small FOV will always yield superior diagnostic clarity compared to a digitally cropped section of a large FOV scan[6].

3. Standardisation of Interpretation Protocols

The review underscores the lack of universal standardisation in interpreting CBCT scans across different FOVs, emphasising the need for FOV-specific interpretation protocols.

- **Large FOV Interpretation:** Requires a systematic 'outside-in' approach, where the radiologist or orthodontist first evaluates major structures such as the cervical spine, cranial base, and soft tissue contours for incidental findings before focusing on the primary orthodontic objectives. This approach demands broad anatomical knowledge and a structured review protocol to minimise the risk of oversight[9,10].

- **Small FOV Interpretation:** Involves focused evaluation of local anatomy. The protocol should include assessment of root morphology, lamina dura integrity, bone quality, and the spatial relationship of teeth to adjacent structures.

However, clinicians must guard against **'tunnel vision'**, as pathology just beyond the selected FOV may be overlooked[4].

4. **The Challenge of Incidental Findings:** The prevalence of incidental findings—such as mucosal thickening in the paranasal sinuses, calcified ligaments, or osseous pathologies—increases markedly with larger FOVs[9]. One study included in the review reported incidental findings in over 40% of large FOV scans[10]. This poses both clinical and medicolegal challenges, necessitating well-defined protocols for referral, documentation, and follow-up, which are comparatively less critical in small FOV scans.

CLINICAL RECOMMENDATIONS AND A PROPOSED DECISION MATRIX

Based on the evidence, the following decision matrix is proposed for FOV selection in orthodontics:

Clinical Scenario	Recommended FOV	Rationale
Impacted Canine Localization (Single)	Small FOV	Maximizes resolution for precise positional diagnosis; minimizes dose[4,6]
Multiple Impacted Teeth / Supernumeraries	Medium FOV	Balances comprehensive coverage of the arches with reasonable resolution and dose[3]
Orthognathic Surgery Planning	Large FOV	Essential for capturing all skeletal landmarks and simulating postoperative results[2,7]
Airway Analysis (OSA)	Large FOV	Required to visualize the entire naso-pharyngo-laryngeal airway[7]
Assessment of Root Resorption or Root Parallelism	Small FOV	Superior image quality for fine anatomical detail of root and bone structures[4]
Evaluation of Alveolar Bone Boundaries for Decompensation	Small/Medium FOV	Provides sufficient detail on bone thickness and morphology for safe tooth movement planning[6]

TMJ Disorder Assessment	Medium/Large FOV	Must capture both condyles and fossae for a comparative assessment[2]

CONCLUSION

The interpretation of CBCT in orthodontics is inextricably linked to the selected field of view (FOV)—there is no 'one-size-fits-all' approach. A small FOV provides high-detail, low-dose imaging for localised diagnostic needs, whereas a large FOV is indispensable for comprehensive skeletal and airway evaluation, albeit with a higher radiation exposure and a greater likelihood of incidental findings.

The key to effective and ethical CBCT utilisation lies in an imaging strategy, wherein the clinical question dictates the choice of FOV, and the FOV, in turn, determines a structured and systematic interpretation protocol.

Future research and clinical initiatives should aim to standardise FOV-specific interpretation guidelines to further enhance diagnostic accuracy, radiation safety, and overall patient care. The role of machine learning in optimising FOV selection and automating interpretation workflows should also be evaluated.

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