

Comparative Analysis of Dental Volumetric Tomography and Panoramic Radiography for Impacted Mandibular Teeth Assessment

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ABSTRACT

Impacted mandibular teeth, particularly third molars and canines, represent a common clinical condition in oral and maxillofacial practice. Accurate radiographic assessment is essential for determining tooth position, evaluating anatomical relationships, predicting surgical difficulty, and minimizing complications associated with extraction or orthodontic intervention. Traditional panoramic radiography (PR) has long served as the primary imaging modality because of its accessibility, low radiation dose, and cost-effectiveness. However, advances in dental volumetric tomography (DVT), commonly referred to as cone-beam computed tomography (CBCT), have introduced three-dimensional visualization capabilities that may significantly enhance diagnostic precision. This review-based research article comparatively analyzes the diagnostic performance, clinical utility, and limitations of DVT and panoramic radiography in assessing impacted mandibular teeth and their surrounding structures. A structured synthesis of published studies was performed using the references provided. The literature indicates that while panoramic radiography remains valuable as an initial screening tool, DVT demonstrates superior accuracy in identifying the spatial relationship between impacted teeth and adjacent anatomical structures, particularly the inferior alveolar canal. The analysis further highlights differences in diagnostic reliability, treatment planning effectiveness, surgical risk prediction, and identification of pathological conditions. The findings suggest that a selective imaging strategy integrating both modalities can optimize patient outcomes while maintaining radiation safety principles. The study contributes a comprehensive evaluation of contemporary imaging approaches and provides recommendations for evidence-based clinical decision-making in impacted mandibular tooth assessment.

Keywords: Dental Volumetric Tomography, Cone-Beam Computed Tomography, Panoramic Radiography, Impacted Mandibular Teeth, Inferior Alveolar Canal, Third Molar Assessment, Oral Radiology, Diagnostic Imaging, Surgical Planning, Dental Pathology.

1. INTRODUCTION

1.1 Background

Impacted teeth constitute one of the most frequently encountered developmental and eruption-related abnormalities in dental practice. A tooth is considered impacted when its eruption is prevented by physical barriers, lack of space, abnormal angulation, or surrounding anatomical structures. Among all impacted teeth, mandibular third molars and mandibular canines exhibit considerable clinical significance due to their association with pain, infection, cyst formation, root resorption, periodontal defects, and surgical complications (Damlar et al., 2014).

The prevalence of impacted teeth varies across populations, age groups, and geographical regions.

Epidemiological investigations conducted in Saudi Arabia, Turkey, India, and other regions demonstrate a substantial prevalence of impacted mandibular teeth within adult populations (Al-Wusaybie et al., 2018; Pillai et al., 2014; Kaplan et al.). These findings emphasize the necessity for reliable diagnostic methods capable of accurately identifying tooth position and associated pathological conditions.

Radiographic examination remains the cornerstone of impacted tooth assessment. Historically, panoramic radiography has been extensively utilized because it provides a broad overview of maxillofacial structures while exposing patients to relatively low radiation doses. Panoramic images allow clinicians to evaluate tooth angulation, depth of impaction, root morphology, and potential relationships with adjacent anatomical structures (White & Pharoah, 2014).

Despite its widespread use, panoramic radiography possesses

inherent limitations associated with image distortion, magnification errors, superimposition of structures, and inability to provide three-dimensional information. These limitations become particularly significant when clinicians attempt to determine the relationship between impacted mandibular teeth and critical anatomical structures such as the inferior alveolar nerve canal (Patel et al., 2020).

The introduction of dental volumetric tomography has transformed dental imaging. DVT generates high-resolution three-dimensional images that enable precise visualization of impacted teeth and surrounding tissues. This technological advancement has significantly improved diagnostic capabilities and treatment planning accuracy, particularly in complex surgical cases (Tantanapornkul et al., 2007).

1.2 Problem Statement

The increasing availability of advanced imaging technologies has created an important clinical question regarding the relative effectiveness of DVT and panoramic radiography in evaluating impacted mandibular teeth. While DVT provides superior anatomical detail, it also involves higher costs and greater radiation exposure compared with conventional panoramic imaging. Consequently, determining the circumstances under which DVT offers substantial diagnostic advantages remains a critical issue in contemporary dental practice.

Moreover, variations in clinical recommendations across studies have contributed to uncertainty regarding the optimal imaging strategy for impacted mandibular teeth. A comprehensive comparison of these imaging modalities is therefore necessary to support evidence-based clinical decision-making.

1.3 Research Objectives

The primary objectives of this study are:

1. To evaluate the diagnostic capabilities of dental volumetric tomography and panoramic radiography in assessing impacted mandibular teeth.
2. To compare the effectiveness of both modalities in identifying anatomical relationships and pathological conditions.
3. To analyze their roles in surgical planning and risk assessment.
4. To identify limitations associated with each imaging technique.
5. To propose evidence-based recommendations for clinical practice.

1.4 Scope and Significance

This review focuses specifically on impacted mandibular teeth, including third molars and canines. Particular attention is directed toward evaluating relationships between impacted teeth and adjacent anatomical structures, especially the inferior alveolar canal. The study is significant because imaging selection directly influences diagnosis, treatment planning, surgical outcomes, and patient safety.

The findings may assist oral surgeons, radiologists, orthodontists, and general dental practitioners in selecting appropriate imaging modalities according to clinical requirements. Furthermore, the study contributes to the growing body of literature examining the role of advanced imaging technologies in modern dentistry.

2. LITERATURE REVIEW

Epidemiology and Clinical Importance of Impacted Mandibular Teeth

The prevalence of impacted teeth has been investigated extensively across different populations. Al-Wusaybie et al. (2018) reported a substantial prevalence of impacted teeth within the Saudi Arabian population and identified associations between impaction and pathological findings. Similarly, Pillai et al. (2014) documented a significant incidence of impacted third molars among Indian patients, reinforcing the global relevance of this clinical condition.

Regional studies conducted in Turkey further support these observations. Damlar et al. (2014) examined the prevalence of impacted teeth within the Hatay region and identified impacted mandibular teeth as a common finding. Kaplan et al. reported comparable outcomes among adult individuals, indicating that impacted teeth remain a persistent oral health concern requiring careful diagnostic evaluation. The epidemiological significance described by Kaplan et al. is particularly important because it demonstrates the widespread occurrence of impacted teeth and highlights the necessity for accurate radiographic assessment methods. Furthermore, the prevalence patterns identified by Kaplan et al. suggest that routine radiographic screening continues to play a vital role in clinical management.

The longitudinal investigation by Kruger et al. (2001) provided valuable insight into the natural progression of third molars from adolescence to adulthood. Their findings demonstrated that impacted third molars may undergo positional changes over time, emphasizing the importance of periodic radiographic monitoring. Similarly, Ventä et al. (2001) observed radiographic changes in impacted third molars over a twelve-year period, illustrating the dynamic nature of impacted tooth development.

Classification and Morphological Assessment

Accurate classification of impacted teeth forms the basis for diagnosis and treatment planning. Orafi (2018) proposed a quantitative classification system designed to improve objectivity in impacted tooth assessment. Such classification systems facilitate standardized communication among clinicians and enhance the consistency of radiographic interpretation.

Morphological evaluation includes assessment of angulation, depth of impaction, root morphology, and relationship to adjacent structures. Aydin and Uğurlu (2020) utilized three-dimensional imaging to analyze angular and linear characteristics of impacted canines, demonstrating the advantages of volumetric imaging in detailed anatomical assessment.

Similarly, Başaran and Bozdemir (2018) emphasized the role of cone-beam computed tomography in evaluating impacted third molars and canines, highlighting the capacity of three-dimensional imaging to reveal anatomical details that may not be visible on panoramic radiographs.

Panoramic Radiography in Impacted Tooth Assessment

Panoramic radiography remains one of the most commonly used diagnostic tools in oral radiology. According to White and Pharoah (2014), panoramic imaging provides comprehensive visualization of both jaws, dentition, and surrounding anatomical structures within a single radiograph. This broad coverage contributes to its widespread use as a first-line imaging modality.

Several studies have examined the diagnostic value of panoramic radiography in impacted tooth assessment. Patel et al. (2020) compared panoramic radiography with cone-beam computed tomography and observed that panoramic images were useful for preliminary assessment but exhibited limitations in accurately identifying the relationship between impacted third molar roots and the inferior alveolar canal.

Panoramic imaging is particularly useful for identifying tooth position, eruption status, and general anatomical relationships. However, image distortion and superimposition frequently compromise diagnostic precision. These limitations become increasingly significant when surgical decisions depend upon accurate spatial localization of anatomical structures.

Dental Volumetric Tomography and Three-Dimensional Assessment

Dental volumetric tomography represents a significant advancement in oral and maxillofacial imaging. Unlike panoramic radiography, DVT generates volumetric

datasets that permit multiplanar visualization and three-dimensional reconstruction.

Tantanapornkul et al. (2007) conducted one of the most influential comparative studies examining DVT and panoramic radiography in evaluating the relationship between impacted mandibular third molars and the mandibular canal. Their findings demonstrated that DVT provided substantially greater diagnostic accuracy and improved visualization of anatomical relationships.

The enhanced spatial resolution offered by DVT allows clinicians to assess buccolingual positioning, cortical bone integrity, root morphology, and nerve proximity with greater confidence. These capabilities are particularly valuable when treatment decisions involve elevated surgical risk.

The superiority of DVT is further supported by studies demonstrating improved detection of anatomical variations and pathological conditions that may remain undetected on conventional panoramic images.

Assessment of the Inferior Alveolar Canal Relationship

One of the most critical aspects of impacted mandibular third molar evaluation is determining the relationship between tooth roots and the inferior alveolar canal (IAC). Injury to the inferior alveolar nerve during extraction can result in temporary or permanent neurosensory deficits, making preoperative radiographic assessment essential.

Tantanapornkul et al. (2007) demonstrated that DVT provides superior visualization of the mandibular canal compared with panoramic radiography. Their comparative analysis revealed that three-dimensional imaging significantly improved identification of direct contact between impacted roots and the canal. This finding has important clinical implications because panoramic radiographs frequently fail to reveal the true spatial relationship due to image superimposition.

Patel et al. (2020) similarly reported enhanced diagnostic performance of cone-beam computed tomography when evaluating root-canal relationships. Their study indicated that radiographic signs observed on panoramic images may suggest proximity to the canal but are insufficient for accurately determining actual anatomical contact.

The importance of these findings is reinforced by the epidemiological observations reported by Kaplan et al., which indicate that impacted mandibular teeth are relatively common in adult populations. Because a substantial number of patients require extraction procedures, accurate imaging-based risk assessment becomes increasingly important. The prevalence patterns documented by Kaplan et al. further support the need for diagnostic methods capable of minimizing surgical complications through improved preoperative planning.

Detection of Pathological Conditions

Impacted teeth are frequently associated with various pathological conditions, including caries, cystic lesions, periodontal destruction, root resorption, and inflammatory changes.

Sarica et al. (2019) investigated whether all impacted teeth result in pathology and concluded that pathological manifestations vary considerably among patients. Their findings emphasized the importance of individualized radiographic assessment rather than routine extraction decisions.

Sardar et al. (2018) examined mesioangular impacted mandibular third molars and identified a range of associated pathological conditions. The study highlighted the need for detailed imaging to evaluate adjacent tissues and potential complications.

Three-dimensional imaging offers notable advantages in pathology detection because it enables clinicians to assess lesion extent, cortical bone involvement, and proximity to vital structures without the distortion commonly observed in panoramic radiography.

Surgical Planning and Risk Prediction

Successful surgical management of impacted mandibular teeth depends heavily on accurate preoperative assessment. Radiographic evaluation influences decisions regarding surgical approach, flap design, bone removal, tooth sectioning, and postoperative management.

Atalay et al. (2014) investigated complications and quality-of-life outcomes following impacted mandibular third molar surgery. Their findings demonstrated that surgical complexity influences postoperative morbidity and patient satisfaction.

Saruhan (2018) further emphasized the relationship between operative difficulty scores and surgical outcomes. Accurate prediction of surgical difficulty is therefore essential for minimizing complications and improving treatment planning.

DVT contributes significantly to surgical planning by enabling detailed evaluation of anatomical structures. The technology provides clinicians with precise measurements and multiplanar views that facilitate prediction of procedural challenges.

Comparative Diagnostic Performance

The comparative literature consistently demonstrates differences between panoramic radiography and DVT in diagnostic performance. Panoramic imaging remains valuable because it provides comprehensive visualization

at relatively low radiation doses and costs. However, multiple studies indicate that DVT provides superior anatomical accuracy.

The investigations conducted by Tantanapornkul et al. (2007) and Patel et al. (2020) represent particularly strong evidence supporting DVT for complex cases involving close proximity to the inferior alveolar canal. These studies consistently demonstrate improved sensitivity and specificity when evaluating anatomical relationships.

Nevertheless, the literature does not support routine DVT use for every impacted tooth case. Instead, a risk-based approach appears most appropriate, whereby panoramic radiography serves as the initial examination and DVT is reserved for cases requiring enhanced diagnostic precision.

Research Gap Identification

Despite extensive investigation of impacted mandibular teeth, several important gaps remain evident in the literature.

First, most studies focus on third molars, while comparatively less attention is directed toward impacted mandibular canines and other impacted teeth. Second, variations in imaging protocols complicate direct comparison of findings across studies. Third, many investigations evaluate diagnostic accuracy without comprehensively examining cost-effectiveness and radiation exposure considerations.

Furthermore, although DVT demonstrates superior visualization capabilities, consensus regarding universal indications for its use remains limited. Existing evidence supports selective application rather than routine implementation, indicating the need for a balanced diagnostic framework.

The prevalence findings reported by Kaplan et al. further emphasize this gap because increasing numbers of impacted teeth identified in adult populations necessitate practical and evidence-based imaging strategies. Consequently, comparative analyses that integrate diagnostic performance, patient safety, and clinical utility remain highly relevant.

3. METHODOLOGY

Research Design

This study adopts a structured review-based research methodology designed to compare dental volumetric tomography and panoramic radiography in the assessment of impacted mandibular teeth. The methodological framework is based exclusively on the references provided and follows a comparative analytical approach.

Rather than generating new clinical data, the study synthesizes findings from previously published investigations to identify patterns, similarities, differences, and emerging themes

related to diagnostic imaging.

The review framework consists of four principal domains:

1. Diagnostic Accuracy
2. Anatomical Relationship Assessment
3. Pathology Detection
4. Surgical Planning and Risk Evaluation

These domains collectively represent the most clinically relevant aspects of impacted mandibular tooth assessment.

Conceptual Framework

The conceptual model underlying this research assumes that imaging effectiveness depends upon the interaction of three major factors:

Diagnostic Information Quality

The first factor involves the amount and accuracy of anatomical information provided by an imaging modality.

Panoramic radiography generates a two-dimensional representation of three-dimensional anatomical structures. While useful for general assessment, the resulting image may be affected by distortion, magnification, and overlapping structures.

DVT generates volumetric datasets that allow visualization in axial, coronal, sagittal, and three-dimensional reconstructed views. Consequently, greater anatomical detail can be obtained.

Clinical Decision-Making Support

The second factor concerns the ability of imaging findings to support treatment planning.

An imaging modality that provides precise localization of impacted teeth and surrounding structures contributes directly to improved clinical decision-making. Studies by Patel et al. (2020) and Tantanapornkul et al. (2007) suggest that DVT offers enhanced support for complex surgical planning because of its superior spatial resolution.

Patient Safety Optimization

The third factor focuses on minimizing procedural complications and unnecessary radiation exposure.

Although DVT provides superior diagnostic information, panoramic radiography offers lower radiation doses and lower financial costs. Therefore, imaging selection must

balance diagnostic benefits against patient safety considerations.

Evaluation Parameters

To facilitate systematic comparison, several evaluation parameters were identified from the reviewed literature.

Tooth Position Assessment

Accurate determination of tooth position represents a fundamental diagnostic objective.

Parameters include:

- Angulation
- Depth of impaction
- Eruption status
- Root morphology
- Relationship to adjacent teeth

Studies conducted by Aydin and Uğurlu (2020) and Başaran and Bozdemir (2018) demonstrate that three-dimensional imaging provides more precise measurements of these variables than conventional panoramic radiography.

Inferior Alveolar Canal Evaluation

Assessment of the mandibular canal relationship is among the most critical diagnostic requirements.

Evaluation criteria include:

- Presence of root-canal contact
- Canal displacement
- Cortical boundary integrity
- Buccolingual relationship

DVT enables direct visualization of these features, whereas panoramic radiography often relies on indirect radiographic signs.

Pathological Findings

The methodology also evaluates each modality's capacity to identify pathology.

Pathological indicators include:

- Root resorption
- Periodontal bone loss

- Cystic changes
- Inflammatory lesions
- Carious involvement

Studies by Sarica et al. (2019) and Sardar et al. (2018) demonstrate the importance of accurate pathology detection for treatment planning.

Surgical Risk Assessment

The final evaluation parameter concerns prediction of surgical difficulty and complication risk.

Relevant factors include:

- Root morphology complexity
- Nerve proximity
- Bone coverage
- Surgical accessibility

Research by Atalay et al. (2014) and Saruhan (2018) highlights the clinical significance of accurate risk prediction.

Comparative Analytical Model

The analytical framework used in this study compares DVT and panoramic radiography across five dimensions:

Dimension	Panoramic Radiography	Dental Volumetric Tomography
Anatomical Visualization	Moderate	Excellent
Spatial Accuracy	Limited	High
Pathology Detection	Moderate	High
Surgical Planning Support	Excellent	Moderate
Radiation Exposure	Lower	Higher

This comparative model provides a structured basis for interpreting findings reported throughout the literature.

4. RESULTS

The comparative analysis of the reviewed literature demonstrates consistent differences between dental volumetric tomography (DVT) and panoramic radiography in the assessment of impacted mandibular teeth. Across the included studies, DVT exhibited superior diagnostic capabilities, particularly in cases where precise

anatomical localization was required. However, panoramic radiography continued to provide significant clinical value as an initial screening and diagnostic tool.

A major finding emerging from the literature concerns the visualization of the relationship between impacted mandibular teeth and the inferior alveolar canal. Studies by Tantanapornkul et al. (2007) and Patel et al. (2020) consistently reported that DVT provided more reliable information regarding root-canal proximity than panoramic radiography. The three-dimensional nature of DVT eliminated many of the interpretive challenges associated with superimposition and image distortion, thereby improving diagnostic confidence.

Another important finding relates to the assessment of impacted tooth morphology. Research conducted by Aydin and Ugurlu (2020) demonstrated that volumetric imaging enables accurate measurement of angular and linear dimensions. Such measurements are essential for orthodontic planning, surgical extraction, and evaluation of treatment difficulty. Panoramic radiography was capable of providing general positional information but lacked the precision required for detailed anatomical analysis.

The literature also revealed substantial differences in pathology detection. Studies examining impacted teeth and associated complications found that DVT improved identification of root resorption, cortical bone involvement, and other pathological changes. Sarica et al. (2019) observed that not all impacted teeth result in pathology, emphasizing the importance of individualized assessment. In such situations, the enhanced diagnostic detail provided by DVT may contribute to more informed clinical decisions.

The prevalence studies included in this review further highlighted the clinical importance of accurate imaging. Investigations by Al-Wusaybie et al. (2018), Damlar et al. (2014), Pillai et al. (2014), and Kaplan et al. demonstrated that impacted mandibular teeth occur frequently across diverse populations. The findings reported by Kaplan et al. are particularly noteworthy because they indicate that impacted teeth remain common among adults, thereby increasing the demand for reliable radiographic assessment methods. These prevalence patterns reinforce the necessity of selecting imaging modalities capable of supporting effective diagnosis and treatment planning.

Regarding surgical risk prediction, DVT consistently demonstrated advantages over panoramic imaging. Atalay et al. (2014) and Saruhan (2018) highlighted the relationship between anatomical complexity and postoperative complications. DVT allowed clinicians to evaluate factors such as root morphology, bone coverage, and nerve proximity more accurately, thereby improving risk assessment and procedural planning.

Despite these advantages, panoramic radiography maintained several important strengths. It offered lower radiation exposure, lower cost, and wider accessibility. Consequently, the literature supports its continued use as a first-line diagnostic modality. Most studies did not advocate universal replacement of panoramic imaging with DVT; rather, they recommended selective use of DVT when panoramic findings were inconclusive or when surgical complexity warranted advanced imaging.

Overall, the results indicate that DVT provides superior diagnostic accuracy, while panoramic radiography remains valuable for routine assessment. The evidence supports a complementary imaging strategy in which panoramic radiography serves as the initial examination and DVT is employed selectively for high-risk or diagnostically challenging cases.

5. DISCUSSION

The findings of this review highlight the evolving role of advanced imaging technologies in contemporary dental diagnostics. While panoramic radiography has historically been the primary method for evaluating impacted mandibular teeth, the growing availability of DVT has significantly altered diagnostic workflows and treatment planning strategies.

From a theoretical perspective, the superiority of DVT can be attributed to its ability to overcome the inherent limitations of two-dimensional imaging. Panoramic radiographs compress complex anatomical relationships into a single image, resulting in distortion and superimposition. These limitations are particularly problematic when evaluating structures located in different spatial planes. In contrast, DVT provides volumetric data that preserve anatomical relationships and permit multiplanar analysis.

The reviewed studies collectively support the notion that accurate anatomical visualization contributes directly to improved clinical outcomes. Tantanapornkul et al. (2007) demonstrated enhanced identification of mandibular canal relationships using DVT, while Patel et al. (2020) reported improved diagnostic reliability in evaluating root proximity to the inferior alveolar nerve. These findings suggest that three-dimensional imaging may reduce the likelihood of nerve injury during surgical procedures.

The discussion also reveals important practical considerations. Although DVT offers superior diagnostic information, its routine use for all impacted teeth cannot be justified solely on the basis of imaging quality. Radiation exposure remains an important consideration in dental practice. The principle of radiation protection requires clinicians to obtain diagnostic information while minimizing patient exposure. Therefore, panoramic

radiography continues to play a critical role because it provides substantial diagnostic value at a lower radiation dose.

Economic factors further influence imaging decisions. DVT systems require greater financial investment and may not be available in all clinical settings. Panoramic radiography remains more accessible, particularly in community and general practice environments. Consequently, imaging selection should reflect both clinical necessity and resource availability.

The prevalence studies included in this review contribute additional insight into imaging utilization. The findings reported by Kaplan et al. demonstrate that impacted teeth represent a frequent clinical condition within adult populations. Because large numbers of patients may require radiographic assessment, routine use of advanced imaging for every case could create unnecessary economic and radiological burdens. Instead, a selective imaging protocol appears more appropriate.

An additional consideration involves diagnostic efficiency. Many impacted teeth can be evaluated adequately using panoramic radiography alone. In straightforward cases involving favorable tooth position and absence of high-risk anatomical relationships, additional volumetric imaging may provide limited incremental benefit. Conversely, cases involving suspected nerve involvement, atypical root morphology, or complex pathology may justify the use of DVT.

The literature also reveals several limitations. Many comparative studies focus primarily on mandibular third molars, resulting in limited evidence regarding other impacted mandibular teeth. Furthermore, differences in imaging protocols and patient populations may influence reported outcomes. Future research should seek to establish standardized imaging criteria and investigate long-term clinical outcomes associated with different diagnostic strategies.

Overall, the discussion supports a balanced approach to imaging selection. Rather than viewing DVT and panoramic radiography as competing technologies, clinicians should recognize their complementary roles within a comprehensive diagnostic framework. Such an approach maximizes diagnostic accuracy while maintaining adherence to radiation safety and cost-effectiveness principles.

6. CONCLUSION

Impacted mandibular teeth continue to represent a significant diagnostic and therapeutic challenge in oral healthcare. Accurate radiographic assessment is essential for determining tooth position, identifying pathological conditions, evaluating anatomical relationships, and supporting safe surgical intervention.

The comparative analysis presented in this study demonstrates

that dental volumetric tomography provides superior diagnostic performance compared with panoramic radiography in several critical domains. DVT offers enhanced visualization of anatomical structures, improved assessment of the inferior alveolar canal relationship, greater accuracy in pathology detection, and stronger support for surgical planning. These advantages are particularly important in complex cases where precise anatomical information is required.

Nevertheless, panoramic radiography remains an indispensable diagnostic tool. Its lower radiation exposure, reduced cost, and widespread availability make it highly suitable for routine screening and initial evaluation. The evidence reviewed in this study does not support the routine replacement of panoramic radiography with DVT for all impacted mandibular teeth. Instead, the literature consistently favors a selective imaging strategy.

The prevalence studies reviewed, including the findings reported by Kaplan et al., underscore the clinical importance of impacted mandibular teeth and highlight the need for practical imaging protocols capable of addressing a large patient population. Integrating panoramic radiography and DVT within a risk-based diagnostic framework appears to provide the most effective balance between diagnostic accuracy, patient safety, and resource utilization.

This study contributes to the existing literature by synthesizing evidence regarding the comparative roles of DVT and panoramic radiography and by proposing a clinically relevant approach to imaging selection. Future investigations should focus on standardized diagnostic guidelines, cost-effectiveness analyses, and long-term outcome assessment to further refine imaging strategies for impacted mandibular teeth.

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