

# DIFFERENTIAL DIAGNOSIS BETWEEN RADICULAR CYST AND GRANULOMA USING CONE-BEAM COMPUTED TOMOGRAPHY AND ULTRASONOGRAPHY: A SYSTEMATIC REVIEW

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## ABSTRACT

Pulp tissue necrosis followed by colonization and infection of the root canal are determining events in the development of apical periodontitis. Radicular cysts and granulomas represent the most prevalent inflammatory periapical pathologies. This systematic review was conducted to analyze the possibility of performing a differential diagnosis between radicular cysts and granulomas using cone-beam computed tomography (CBCT) and ultrasonography (US). Searches were conducted in six electronic databases and three additional platforms for gray literature. All searches were performed up to May 15, 2021. A total of 1,111 studies were identified after duplicate removal. In phase 1, 35 studies were selected for full-text reading. In phase 2, 30 articles met the eligibility criteria and were included in this review, comprising 23 observational clinical studies and 7 case reports. There was significant variability in the methodological designs of the studies: various devices, protocols, and studied variables. The CBCT's ability to establish a differential diagnosis for radicular cysts ranged from 60% to 80%, and for granulomas from 44% to 63%, while ultrasonography demonstrated 77% to 100% concordance for cyst diagnosis and 50% to 77% for granuloma diagnosis. The risk of bias in the studies was classified as low to moderate. CBCT and ultrasonography examinations enable the differential diagnosis between inflammatory periapical pathologies.

**KEYWORDS:** endodontics; differential diagnosis; apical periodontitis; systematic review.

## INTRODUCTION

Pulp tissue necrosis and root canal infection often result in apical periodontitis (AP), which can manifest as periapical granulomas or radicular cysts. Accurate

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diagnosis is essential, as each of these conditions requires different therapeutic approaches.

- **Periapical granuloma:** Inflammatory tissue with immune cell infiltration.
- **Radicular cyst:** Epithelial-lined cavity, which can be true or pocketed, depending on its communication with the root canal.

Imaging methods assist in diagnosis:

- **Periapical Radiography:** A two-dimensional exam, limited in precise visualization.
- **CBCT:** Produces high-resolution three-dimensional images, effective in distinguishing granulomas from cysts, though costly and involving radiation.
- **Ultrasonography (US):** More accessible and radiation-free but limited in penetrating bone structures.

Choosing the method should balance lesion complexity, exam availability, and the need to minimize radiation exposure. Systematic reviews are recommended to optimize the use of these techniques in diagnosing and treating periapical lesions.

## **MATERIALS AND METHODS**

This systematic review, conducted following the PRISMA Statement and registered in PROSPERO (CRD42021273284), aimed to evaluate the efficacy of CBCT and US in distinguishing radicular cysts from periapical granulomas.

Research Question and PICOS Methodology

- **P (Population):** Permanent teeth with apical periodontitis.
- **I (Intervention):** Use of CBCT or US for differential diagnosis.
- **C (Comparison):** Histopathological diagnosis as the gold standard.
- **O (Outcome):** Ability to differentiate radicular cysts from granulomas.
- **S (Studies Included):** Observational studies, case series, and case reports.

## **Inclusion and Exclusion Criteria**

Observational studies that used CBCT or US for differential diagnosis with histopathology as the reference were included. Excluded studies included animal research, ex vivo models, primary teeth, other imaging methods, and articles unrelated to endodontic periapical lesions, as well as non-primary documents such as letters and reviews.

## **Search Strategy**

The search was conducted up to May 15, 2021, in databases such as PubMed, EMBASE, LILACS, Web of Science, Scopus, and Livivo, along with gray literature searches via Google Scholar and ProQuest. The search utilized specific term combinations and was managed using EndNote Web and Rayyan to remove duplicates.

## **Study Selection and Data Collection**

Study selection followed two phases: title and abstract review by two independent reviewers, and full-text analysis and reference review by the same reviewers, with a third reviewer resolving disagreements. Extracted information included study characteristics, sample details, examination parameters, and results. Missing data were requested from the authors when necessary.

## **Risk of Bias Assessment**

Methodological quality was assessed using the Joanna Briggs Institute checklist. The risk of bias was classified as high, moderate, or low depending on the percentage of positive responses to evaluation criteria. Disagreements were resolved through discussion or by a third reviewer.

This systematic review aims to provide a solid foundation for choosing between CBCT and US in the differential diagnosis of periapical lesions, focusing on the accuracy and efficacy of these methods in clinical practice.

## RESULTS

### Objective and Methodology

This systematic review, registered in PROSPERO under number CRD42021273284, evaluated the efficacy of Cone-Beam Computed Tomography (CBCT) and ultrasonography for the differential diagnosis between radicular cysts and granulomas in permanent teeth with apical periodontitis. The PICOS acronym guided the research, including observational studies that used histopathological diagnosis as the reference standard.

### Study Selection Process

A total of 1,386 articles were identified in major databases, with 1,111 remaining after duplicate removal. In the first phase, 35 studies were selected for full-text reading, and 30 met the inclusion criteria for qualitative analysis. Reasons for exclusion are detailed in Figure 1 and Appendix 2.

### Study Characteristics

Of the 30 included articles, 23 were observational studies and 7 case reports, published between 2003 and 2020. The studies covered samples from several countries: Asia (China, India, Turkey), Europe (England, Switzerland, Italy), and the Americas (USA, Honduras, Brazil). Sample sizes ranged from 1 to 113 participants, aged 8 to 75 years.

### Equipment and Parameters

- **CBCT:** The primary devices used were NewTom 3G and Planmeca ProMax 3D Max, with parameters varying from 70 to 120 kVp and voxel sizes from 0.076 to 0.3 mm.
- **Ultrasonography:** The Logic 500 Pro was the most frequent device, followed by Volusion 730 Expert and Logic 500 MD MRS. US parameters also showed significant variation.

**Results:**

- **CBCT:** Differential diagnosis capability for radicular cysts ranged from 60% to 80% and for granulomas from 44% to 63%.
- **Ultrasonography:** Demonstrated 77% to 100% concordance for cysts and 50% to 77% for granulomas.

**Risk of Bias**

Included studies showed a moderate risk of bias. Due to the high heterogeneity between studies, a meta-analysis was not possible. The risk of bias is detailed in Table 2.

**CONCLUSION**

CBCT and ultrasonography are effective tools in determining the pathological nature of periapical lesions.

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