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

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ABSTRACT

Pulp tissue necrosis followed by colonization and infection of the root canal are decisive events in the onset of apical periodontitis. Root cysts and granulomas are the most prevalent inflammatory periapical pathologies. This systematic review was developed to analyze the possibility of differential diagnosis between root cysts and granulomas using cone-beam computed tomography (CBCT) and ultrasonography. Searches were performed in six electronic databases and three additional platforms to search for gray literature. All searches were performed by May 15, 2021. After excluding duplicate articles, 1,111 articles were identified. In phase 1, 35 studies were selected for full reading. In phase 2, 30 articles met the eligibility criteria and were included in this review, comprising 23 observational clinical studies and seven case reports. There was considerable variability in the methodological designs of the studies: different devices, protocols, and variables were studied. The ability of CBCT to establish the differential diagnosis of radicular cysts ranged from 60% to 80% and granulomas from 44% to 63%, while ultrasound showed 77% to 100% accuracy.

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agreement 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 ultrasound examinations allow differential diagnosis between inflammatory periapical pathologies.

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

INTRODUCTION

Pulp tissue necrosis and root canal infection are determining factors in the development of apical periodontitis (AP), which occurs due to the interaction between irritants and the host's immune system (Nair, 2004). AP can manifest as a periapical granuloma or root cyst (Nair et al., 1996; Love & Firth, 2009). The prevalence of these lesions varies significantly between studies, which can cause uncertainty for clinicians when choosing the appropriate treatment (Bacaltchuk et al., 2005; Lalon

The definitive diagnosis of inflammatory periapical lesions is obtained through histopathological examination (Peters & Lau, 2003). Granulomas are composed of fibrovascular tissue infiltrated by inflammatory cells, while root cysts are lined by epithelium and have a distinct cavity (Nair, 1996; Simon, 1980; Neville et al., 2009). Differentiating between granulomas and cysts through clinical and imaging examinations, such as radiographs, can be challenging due to their limitations in representing two-dimensional images (Estrela et al., 2008).

Cone-beam computed tomography (CBCT) has been a useful tool for more accurate diagnoses, eliminating image overlaps and offering better resolution (Mozzo et al., 1998; Estrela et al., 2008). Despite its benefits, it has drawbacks such as high cost and variation in radiation dose (van der Borden

Another recent technology is ultrasonography (US), which does not use ionizing radiation and is more affordable (Cotti et al., 2003; Sönmez et al., 2019). However, its application is limited by its difficulty in penetrating bone structures, restricting its use in some dental specialties (Manfredini et al., 2003). Studies indicate that US can differentiate between solid and cystic lesions (Chandak et al., 2011).

Systematic reviews and meta-analyses are important tools for establishing evidence-based guidelines, which are essential for differential diagnosis and clinical decision-making (Sacks et al., 1987; Marinho, 2006; Estrela et al., 2007). However, the

ability of CT and US to differentiate root cysts from granulomas is still a topic that requires further investigation and scientific support to improve diagnostic accuracy and treatment.

MATERIALS AND METHODS

This systematic review, conducted in accordance with the PRISMA Statement and registered in PROSPERO (CRD42021273284), aimed to evaluate the effectiveness of cone beam computed tomography (CBCT) and ultrasonography (US) in differentiating between radicular cysts and periapical granulomas.

Research Question and PICOS Method: P (Population): Permanent teeth with apical periodontitis; I (Intervention): Use of CBCT or US for differential diagnosis; C (Comparison): Histopathological diagnosis as the reference standard; O (Outcome): Ability to differentiate between radicular cysts and 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 and had histopathology as a reference were included. Studies in animals, ex vivo models, deciduous teeth, other imaging methods, and articles not focused on endodontic periapical lesions were excluded, as well as non-primary documents such as letters and reviews.

Search strategy: The search was conducted until May 15, 2021, in databases such as PubMed, EMBASE, LILACS, Web of Science, Scopus, and Livivo, as well as gray literature via Google Scholar and ProQuest. The search used combinations of specific terms and was managed with EndNote Web and Rayyan to remove duplicates.

Data Selection and Collection The selection of studies followed two phases: review of titles and abstracts by two independent reviewers, and analysis of full texts and references by the same reviewers, with a third reviewer to resolve disagreements. The information extracted included study characteristics, sample, test parameters, and results. Missing data were requested to the authors when necessary.

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

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

RESULTS

Objective and methodology: This systematic review, registered in PROSPERO under number CRD42021273284, evaluated the effectiveness 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 included the following procedures where 1,386 articles were identified in the main databases, with 1,111 articles remaining after exclusion of duplicates. In the first phase, 35 studies were selected for full reading, and 30 met the inclusion criteria for qualitative analysis. The reasons for exclusion are detailed in Figure 1 and Appendix 2.

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

Equipment and Parameters

CT: The main equipment used was the NewTom 3G and Planmeca ProMax 3D Max, with varying parameters, including tube voltage from 70 to 120 kVp and voxel from 0.076 to 0.3 mm.

Ultrasonography: Logic 500 Pro was the most frequently used device, followed by Volusion 730 Expert and Logic 500 MD MRS. Ultrasonography parameters also varied widely.

Results: CTFC showed a differential diagnostic capability for radicular cysts ranging from 60% to 80% and for granulomas from 44% to 63%. Ultrasonography showed a concordance of 77% to 100% for radicular cysts and 50% to 77% for

granulomas.

Risk of Bias: The included studies showed a moderate risk of bias. Due to the high heterogeneity between studies, a meta-analysis was not possible.

CONCLUSION

CT and ultrasound examinations are effective tools in determining the pathological nature of periapical lesions.

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