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To cite:

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J Contemp Orthod 2021;5(1): 13-19.

Received on: 19-01-2020

Accepted on: 21-02-2020

Source of Support: Nil

Conflict of Interest: None

A Content analysis of Orthodontic perspective of Accuracy and Reliability of CBCT for Localizing and Grading of Root Resorption Related to Impacted Maxillary Canines.

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ABSTRACT

INTRODUCTION:

This paper is a research done to determine the accuracy and reliability of CBCT for localizing and grading of root resorption related to Impacted Maxillary Canines through a new research methodology of **CONTENT ANALYSIS.**It conveys preliminary quantitative and qualitative data from a content analysis of how CBCT has the potential in providing improved diagnosis and treatment plan than that of conventional radiographs.CBCT when used to supplement clinical examination provides more accurate and larger information about the location ,root resorption of adjacent teeth, ankylosis of impacted maxillary canine, cystic degeneration etc and this information helps in an accurate orthodontic diagnosis to plan its exposure and various alignment methods.

Therefore, the researches on this topic carried out by various researchers during the period of 12 years is done to sum up the favourable and less favourable results through content analysis. The results indicate that articles largely portrayed favourable discourses about the use of CBCT for determining the root resorption associated with maxillary canine impaction.

OBJECTIVES:

1. Content is intended to educate more about the accuracy and reliability of CBCT in determining the root resorption associated with maxillary canine impaction through content analysis.
2. Comparing the radiographic diagnostic accuracy between conventional radiographs and CBCT system in detecting severity of root resorption associated with impacted maxillary canines.

MATERIALS AND METHOD

1. A comprehensive search of articles related to this study was collected from year 2008-2020.
2. A conceptual type of content analysis of all the articles is done as a research methodology in which the texts are reduced to categories consisting of a word, set of words or phrases
3. A coding method was used to categorise favourable and less favourable results of the chosen previously documented research.
4. Inferences obtained through the analysis of the documented research data were then summed up in tabular form.

RESULTS

While comparing the volumetric 3D method of CBCT and traditional 2D radiographs, various favourable and less favourable concepts were listed,this showed that a favourable content towards CBCT outweighed the unfavourable.

CONCLUSION

- This study, found an in-sight about CBCT, when used to supplement clinical examination and conventional radiographic imaging, provides accurate and reliable information about location of impacted canine and root resorption of adjacent tooth associated with it which is mandatory in order for surgeons and orthodontists to be able to make an accurate diagnosis and interdisciplinary treatment plan.

- Further studies are needed to evaluate if and how the diagnostic parameters of CBCT can be refined to determine Bucco-palatal position of impacted canine and also its clinical relevance and clinical threshold of symptomatic resorption.

KEYWORDS:*Content analysis, Canine Impaction, Root resorption, CBCT, Accuracy*

INTRODUCTION

- Impaction is defined as the lack of eruption of a tooth in the dental arch within the time and physiological limits of the normal eruption process.[1]After the third molars, Maxillary permanent canines are the most frequently impacted teeth .The etiology has said to be controversial, possibly due to a multifactorial pre-dispositions such as either due to insufficient space in the dental arch, ectopic position of the tooth, or the presence of an obstruction such as a retained tooth, supernumerary or scar tissue.[2]
- There is also a significant consequence related to an impacted tooth resulting in the occurrence of pressure resorption of adjacent teeth. It often remains asymptomatic, limiting its diagnosis. However, early diagnosis of such a condition is important in order to determine a proper treatment strategy.
- The orthodontic-surgical management of impacted canines requires accurate diagnosis and precise location of the impacted canine and the surrounding structures.[3]This helps in following preventive measures that can reduce the severity of the impaction and, thus avoiding possible detrimental effects.
- Various radiographic methods for localization of Impacted canine have been described vividly either in single or in combinations.
- Diagnosisand treatment planning can be difficult with conventionalradiographic methods, due to various factors which leads todifficulty in distinguishing the details.Distortion and projectioneffects are few of the difficulties encountered with conventionalradiographs.[3]
- However,the diagnostic information obtained from conventional radiography is valuable for the overall prediction of tooth eruption and treatment results.[4]But, it has its limitations as well in assessing the position of Maxillary Impacted Permanent Canine and root resorption of adjacent tooth.[5]
- The introduction of cone-beam computed tomography (CBCT) has created opportunities to overcome the drawbacks of conventional radiography, including some potential opportunities for evaluating impacted teeth.[6-9]When used to supplement clinical examination,CBCT provides more accurate and larger information about the location,root resorption of adjacent teeth, ankylosis of impacted maxillary canine, cystic degeneration etc.
- CBCT also shows high sensitivity for detection of small cavities and shows resorption in 3 dimensions. These findings are likely to justify CBCT as a routine diagnostic tool for detection of canine impaction and root resorption. This technology could be useful in orthodontic practices as well.[4]
- This diagnostic accuracy helps in Orthodontic diagnosis to overcome various complications associated with ectopically erupting teeth and to plan its exposure and various alignment methods.
- The purpose of this study was to determine the accuracy and reliability of CBCT for localizing and grading of root resorption related to Impacted Maxillary Canines through a new research methodology of content analysis.It conveys preliminary quantitative and qualitative data from a content analysis about how CBCT has the potential in providing improved diagnosis and treatment plan than that of conventional radiographs.[10,11]

MATERIALS AND METHOD

1. A comprehensive search of articles related to this study was collected for a period of 12 years and the sampling frame allowed inclusion of only content specific articles.

2. A conceptual type of content analysis of all the articles is done as a research methodology in which the texts are reduced to categories consisting of a word, set of words or phrases.

3. The set of keywords **(Table1)**were then categorised in a favourable, Neutral and less favourable coding theme.

4. Inferences obtained through the analysis of the documented research data were then summed up in tabular form**. (Table 1)**

Inclusion criteria

1. Inclusion of only content specific articles.[1-5,12-21]
2. Original research articles on localizing and grading of root resorption related to impacted maxillary canines.

Exclusion criteria

1. Review Articles and case reports on the similar subject were excluded
2. Non content specific articles

Table1, word(s)of identification used through-out search to provide comparative evidence and categorise results into favourable, neutral and less favourable.

FAVOURABLE	NEUTRAL	LESS FAVOURABLE
❋ MORE RELIABLE DIAGNOSTIC TOOL ❋ HIGH DETECTION RATE OF MINUTE LESIONS ❋ IMPROVES DIAGNOSIS AND TREATMENT PLAN ❋ DETECTING ANY DEGREE OF RESORPTION OF ADJACENT TOOTH ❋ BETTER EVALUATION OF APICAL REGION OF CANINES ❋ ASSESSING MESIO-DISTAL POSITION OF THE APEX OF CANINE ❋ ASSESSING THE BUCCO-PALATAL POSITION OF APEX ❋ LOW RADIATION DOSE	❋ EVALUATION IN ROUTINE ORTHODONTIC DIAGNOSIS WITH CBCT	❋ PHENOMENON OF SYMPTOMATIC RESORPTION

RESULTS

While comparing the volumetric 3D method of CBCT and traditional 2D radiographs, a conceptual type of content analysis indicates that the favourablecontent towards CBCT outweighedthe less favourable content. **(fig 1)**

- Categorised favourable concept of this study evidently sequeled the potential of CBCT in providing improved diagnosis and treatment plan than that of conventional radiographs. It showed that CBCT can provide accurate,reliable information and better evaluation of and for the following:-
  - ❋ Detection rate of minute lesions [2,4,12,13]
  - ❋ Improvement in diagnosis and treatment plan [1-3,12-17]
  - ❋ More reliable diagnostic tool [2,4,13,16]
  - ❋ Assessment of mesio-distal position of the apex of canine [13,14]
  - ❋ Evaluation of apical region of canines [12,13,17]
  - ❋ Detection of any degree of resorption of adjacent tooth [2,4,5,14-21]
  - ❋ Assessment of the bucco-palatal position of apex [14-17,19,20]
  - ❋ Low radiation dose [1,4,13,14,16,17]
- There was also a neutral outcome towards the fact that there is a need in further research to support the fact that CBCT can be used in routine orthodontic diagnosis.[4]
- The less favourable concept resulted in showing that more studies and research with prospective studies are recommended to support complete analysis of phenomenon of symptomatic resorption.[4] **(Table 1)**
- As explained graphically in Figure 1, the following features showed maximum accordance amongst all researchers to be more favourable discourses in support of CBCT in Orthodontics:-

1. Detection of any degree of resorption of adjacent tooth,
2. Improves diagnosis and treatment plan
3. Low radiation dose
4. Assessing the bucco-palatal position of apex

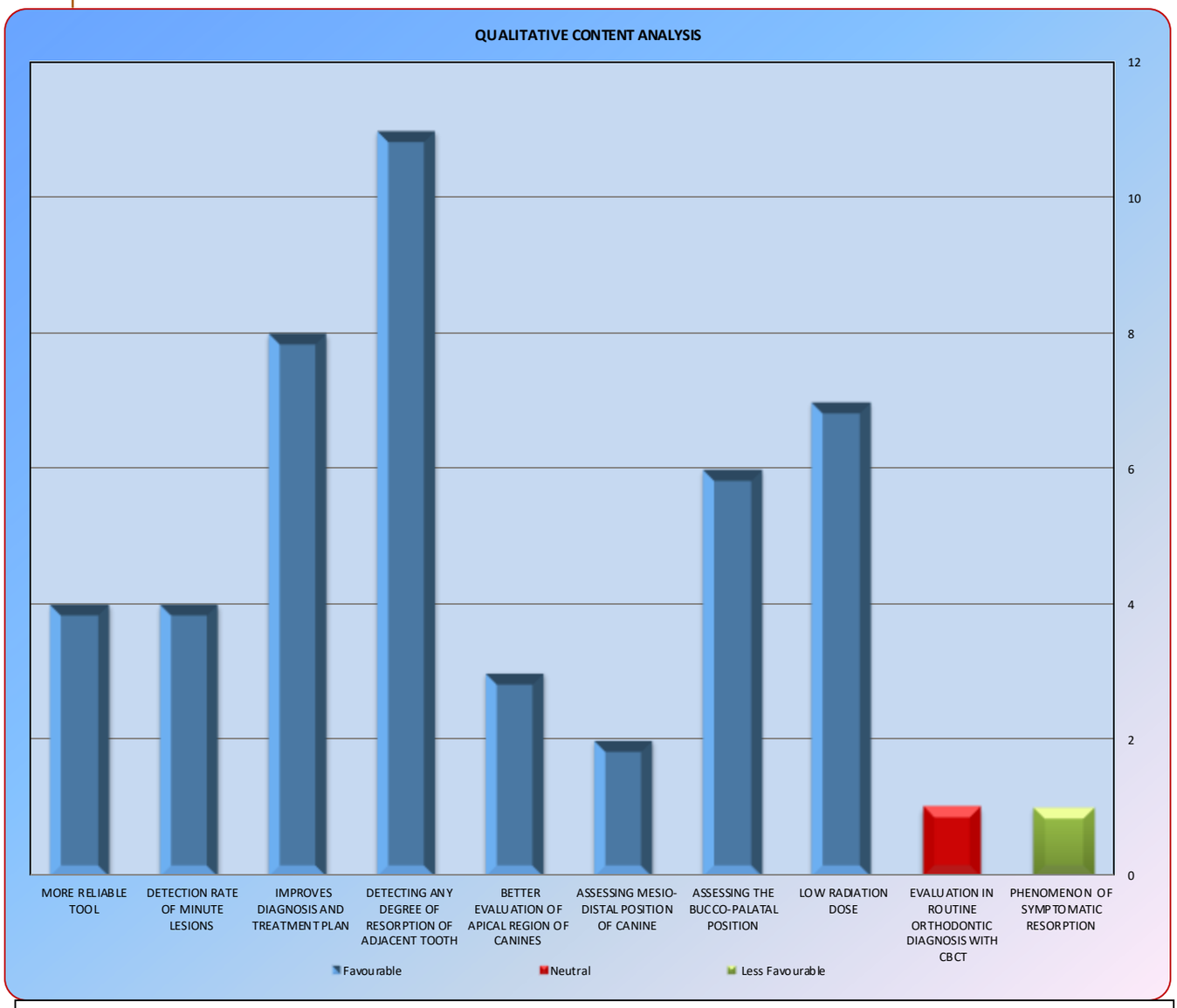

Figure 1: A Bar graph showing the outcome of comparative evidence of categorised keywords into favourable,neutral and less favourable.

DISCUSSION

- Radiographic investigation is the most important tool in the assessment of impacted canines as well as root resorption of adjacent tooth associated with it.[1]
- Root resorption is the most common sequelea of canine impaction and also the most difficult one to treat. The diagnosis of root resorption might help in reducing thesubsequent complications.
- For many years, conventional radiography was regarded as the standard technique for the diagnosis and treatment planning for impacted canines.But this technique provides inadequate accuracy or interpreted representations of all canine aspects and associated structures.[14]
- With this in mind, a conceptual type of content analysis is carried out to compare the radiographic diagnostic accuracy between conventional radiography and CBCT systems in detecting different depths and locations of root resorption of adjacent tooth associated with impacted maxillary canines.
- This study lends acomparative evidence that an increased precision in the localization of the canines and the improved estimation of the space conditions in the arch were obtained with CBCT.
- As depicted favourably in an articleand extant research,it tells that CBCT provides a precise localization of an impacted canine in the sagittal plane.It also helps in better assessment of the presence and degree of root resorption of neighbouring teeth.[1] **(fig 2)**

Figure 2: A schematic diagram, Location of the root resorption in relation to the long axis of the involved tooth.

- It also provides a significant correlation between vertical localization of the impacted canine and the long axis of the neighbouring incisor.[1] **(fig 3)**

Figure 3: A schematic diagram, Vertical location of the cusp tip in relation to the long axis of the neighbouring lateral incisor on axial CBCT plane.

- Regarding factors affecting the conventional 2D radiographs such as distortion, magnification, and superimposition of anatomic structures situated in different planes, articles were in a favourable tone towards 3D radiographs being able to overcome these drawbacks.[14]
- Articles also showed a favourable perspective towards CBCT able to determine the severity of the overlap of impacted canine with the lateral incisor and determining its intra-osseous position as well.[14] **(fig 4).**

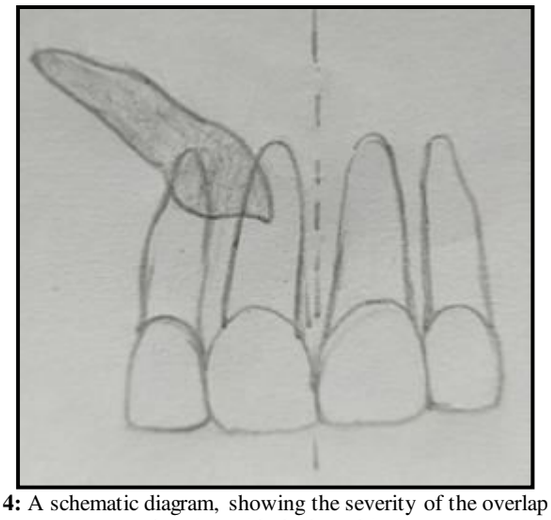

Figure 4: A schematic diagram, showing the severity of the overlap of impacted canine with the lateral incisor

- In few articles, CBCT determining the mesio-distal position of the apex of the impacted canine was mentioned favourably and further stated the fact the level of uncertainty in assessing bucco-palatal position of apex of canine is lesser with CBCT than with the routine radiographs.[14,19,20]
- The radiation dose is always a topic of discussion while using CT. However, articles have mentioned clearly about advantages of CBCT over CT and favourably highlighted the fact that less radiation is administered to the patient through CBCT.[1,16]
- The high detection rate of minute lesions is also a favourable concept observed in articles, suggesting that CBCT as a reliable diagnostic tool[2,4,12]
- Article also mentioned that, CBCT provides a better evaluation for any degree of resorption associated with adjacent tooth.[2,17,19,20]
- Thus, this studyfound an in-sight about CBCT providing accurate information about location of impacted canine and root resorption of adjacent tooth associated with it,which is mandatory in order for surgeons and orthodontists to be able to make an accurate diagnosis and interdisciplinary treatment plan.[1,3]
- In an article it was mentioned in a neutral notion that there is a need in further research to support the fact that CBCT can be used in routine orthodontic diagnosis.[4]
- It is less favourably stated that more studies and research with retrospective studies are recommended to support complete analysis of phenomenon of symptomatic resorption.[4]

CONCLUSION

- Hence it has been concluded that different diagnosis and treatment plans are obtained with 2D and 3D images of impacted maxillary canines .In addition to the clinical examination and conventional radiographic imaging, CBCT provides more accurate information about location of the impacted canine and prevalence and degree of root resorption associated with neighbouring teeth.
- This study, found an in-sight about CBCT providing accurate and reliable information about thehigh detection rate of minute lesions, better interpretation of treatment outcome and its progress, ability to detect any degree of resorption of adjacent tooth, assessing the bucco-palatal or mesio-distal position of the apex of canine and also better evaluation of apical region of canines.
- This isanimportant information for surgeons and orthodontists to be able to make an accurate diagnosis and interdisciplinary treatment plan.
- Further studies are needed tosupport the fact that CBCT can be used in routine orthodontic diagnosis.
- Also,more studies and research with retrospective studies are recommended to support complete analysis of phenomenon of symptomatic resorption.
- Three-dimensional imaging ultimately results in more successful treatment outcomes and better care for patients.Thus,concluding that CBCT is a more reliable diagnostic tool.

ACKNOWLEDGMENT

The authors would like to express great appreciation for the authors of the content specific articles included in this study.

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