



**ORIGINAL RESEARCH PAPER**

**Orthodontics**

**ROOT RESORPTION ON ADJACENT TEETH ASSOCIATED WITH INCLUDED PERMANENT CANINES: A STUDY WITH COMPUTERIZED TOMOGRAPHY**

**KEY WORDS:** Root resorption; Tooth; Impacted Canine; Cone-Beam Computed Tomography

**Valentina Araneda Villalobos**

Argomedo 320 Depto. 412B, Santiago de Chile, Universidad del Desarrollo, Chile

**Vinka Matulic Jimenez**

Nueva los Alerces 3072-B, Ñuñoa, Santiago de Chile, Universidad del Desarrollo, Chile.

**Nicolás Valenzuela Átala**

Manuel Montt 1453, Depto. 208, Providencia, Santiago Chile, Universidad del Desarrollo, Chile.

**Ximena Noelia Toledo Pinto**

Cristobal colon 5800, Dpto 2003, Las Condes, Santiago de Chile, Universidad de Concepción.

**ABSTRACT**

**Introduction:** The most common complication that an impacted canine can generate is root resorption in neighboring pieces. The objective of this study is to describe the prevalence and location of root resorption in teeth adjacent, diagnosed with computed tomography. **Method:** The database of the diagnoses of all the patients evaluated during the years 2020 and 2021 between 15 and 22 years of age was reviewed. All the pieces with the diagnosis of included canine were included in the study. Those pieces with incorrect diagnosis and those that did not have an image or its report were excluded. The variables: affected teeth, damaged root third and compromised root canal were analyzed. **Results:** Of the total of 62 patients, 14 presented root resorption associated with included canines. Of these 14 patients, all were female. The frequency of root resorption generated in neighboring teeth was 25.37%. The most affected pieces were lateral incisors (58.82%). **Conclusion:** Our results reported a similar frequency of root resorption compared to international studies on the subject, following a similar pattern in terms of their affected surface in the root thirds.

**INTRODUCTION**

Canines are the second most frequently impacted teeth after third molars, with a prevalence that varies between 1 - 3%<sup>1</sup>. They are located in a functionally and aesthetically complex area, compared to third molars.

The most common complication that can be caused by an impacted canine on a neighboring tooth is root resorption, which is defined as the progressive loss of cementum and dentin of the affected tooth<sup>2</sup>. Root resorption (RR) is a relatively common phenomenon and an underestimated problem<sup>3</sup>. The incidence of this complication is variable and depends on the radiographic method used for its diagnosis. Many methods have been used: occlusal, periapical, panoramic projections, postero-anterior or lateral radiography, however, computerized tomography (CBCT) stands out, since it has allowed us to observe features not identified with a 2D image and earlier, contributing to the diagnosis and treatment plan<sup>4</sup>.

The incidence of RR found in the literature varies between 40.5% - 52% severity in at least one auxiliary tooth<sup>2,6</sup>. Among the conditions, the most associated with RR we found the female sex, patients who will have a complete development of the canine root, with an overprojected crown in the axis of the lateral incisor and with a mesial angle of eruption to the midline greater than 25°<sup>3</sup>. The tooth with the highest rate of RR was the lateral incisor, followed by the central incisor and premolars, generally starting in the apical or middle third<sup>2,6</sup>.

The objective of this study is to describe the prevalence and location of root resorption in teeth adjacent to impacted permanent canines, diagnosed with computed tomography, in subjects who have not undergone orthodontic treatment.

**METHODS**

A descriptive study was carried out to determine the frequency of impacted definitive canines in patients aged from 15 to 22 years, in Santiago, Chile, based on the clinical

records of all patients evaluated during the years 2020 and 2021 in the Clinical Center "Instituto Nacional de Ortodoncia". The study was conducted following the principles of the Declaration of Helsinki and was approved by the Scientific Ethics Committee of the Oriental Metropolitan Health Service of Chile.

To find all the patients with the diagnosis of included canines, a search was carried out in the database of the years 2020 and 2021 with the term "included". All patients with diagnosis of included canine through CBCT were included. Patients with semi-included canines, without CBCT or its report, and those with previous orthodontic treatment were excluded.

After finding all the patients with a diagnosis of an included canine, the sex of the patient and local conditions were recorded. Patients with root resorption were studied according to the following variables: affected teeth, damaged root third, and compromised root canal. These were evaluated by three examiners through the CBCT, with the Ondemand 3D Dental program. Additionally, the information obtained with the radiological reports was corroborated.

**RESULTS**

A total of 67 pieces that classify as included canines were obtained in 62 patients. The local intraoral conditions associated with the included canines were studied, finding first the presence of the temporary canine (50.74%), followed by the inclination in the neighboring pieces (31.34%) and root resorption (25.37%). In the imaging reports, imprinting (20.9%), gyroversions (6.7%), included adjacent pieces, agenesis, odontomas, transigrations and cysts were also described less frequently (Figure 1).

Of the 62 patients, 14 presented root resorption associated with included canines. Of these 14 patients, all were female. Of the 67 canines included, 17 (25.37%) generated root resorption in neighboring teeth. In relation to the affected pieces, 10 lateral incisors (58.82%), 3 premolars (17.64%), 3

central incisors (17.64%) and 1 canine (5.88%) were evidenced (Figure 2).

The root third in which the highest prevalence of resorption was observed was the middle third in 6 teeth (35.29%) and the apical third in 6 teeth (35.29%), followed by compromise of the union of the middle third -apical in 4 dental pieces (23.52%) and compromise of the union of the middle-cervical third of 1 piece (5.8%).

Regarding the depth of root resorption, superficial dentin compromise was observed in 7 pieces (41.17%), followed by deep dentin compromise in 6 pieces (35.29%) and an average dentin compromise of 4 pieces (23.52%). Of the 17 pieces that presented root resorption, 2 were found with pulp involvement (11.76%) (Figure 3).

**DISCUSSION**

The results of our study showed a root resorption frequency of 25.37%. In comparison, it can be seen that Oberoi and Kim using computed tomography obtained a higher percentage with 37.5% and 49.5%, respectively <sup>7-8</sup>. Ericson, for his part, found 48% in the study conducted in 2000 and 49% in the 2006 study <sup>4,6</sup>.

In relation to the distribution by sex, 100% of the RRs were in women, which is related to what has been mentioned in various studies with a figure close to 90% <sup>9,11</sup>.

The most prevalent affected teeth were lateral incisors with 58.82%, followed by central incisors and premolars (17.64%), a figure higher than that reported by Simic, where 27.2% corresponded to upper lateral incisors and 23.4% of maxillary central incisors <sup>2</sup>. In contrast, Walker et al. mentions that 67% of the lateral incisors were affected and 11% of the central incisors <sup>12</sup>. Ericson, for his part, reported 38% in the lateral incisors and 9% in the central incisor <sup>4</sup>. Variations in the results can be observed from various studies.

The most affected root thirds were the middle third and the apical third, both with 35.29%, followed by the mid-apical 23.62% and finally the mid-cervical with 5.8%. Ericson and Kuroi carried out an investigation with CBCT where they report 43% affection in the apical third and 21% in the middle third, values consistent with the figures obtained <sup>4</sup>. R. Rimes, performs a classification similar to that of this research, obtaining close figures, the most affected third was the mid-apical with 60%, followed by the apical with 31.42% and mid-cervical with 5.71% <sup>13</sup>.

In relation to the depth of involvement, superficial damage was the most frequent (41.17%), followed by deep dentin involvement (35.29%). These values differ from those found by Erickson and Kuroi, where severe damage is more prevalent (56.25%), followed by moderate with 25% and 18.75% of mild cases <sup>4</sup>. In relation to pulp involvement, 2 teeth were affected (11.76%), a figure that again differs from that of Erickson and Kuroi, where 56.25% presented pulp involvement <sup>4</sup>. This is because the study carried out by these authors considers the extraction of the piece and the evaluation directly, finding cases of deep RR that were indeed reported.

As strengths of the study, the use of CBCT and the radiological report stand out, which allowed each patient to be evaluated in detail and three-dimensionally. Within the limitations of the study, the size of the sample and the use of its own severity classification due to the lack of consensus in the literature are considered. It is expected in the future to expand the age range of the sample and increase the age range.

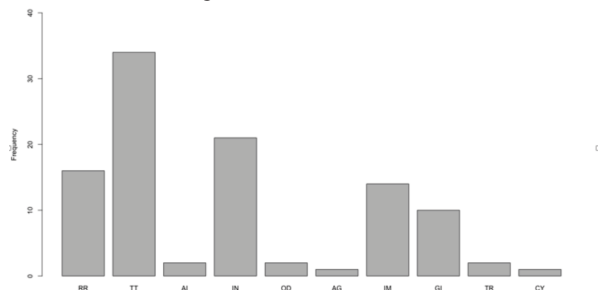
**CONCLUSION**

Root resorption is a relevant pathology in patients with included permanent canines. Our results report similar

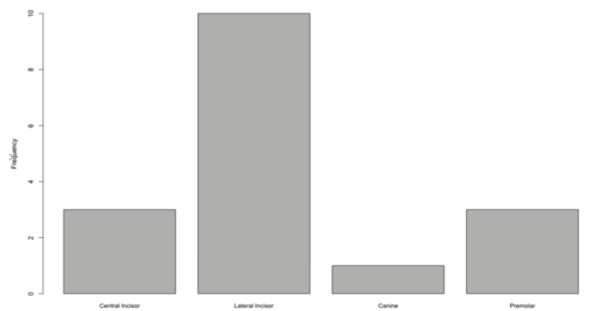
frequencies of root resorption compared to international studies, following similar patterns in terms of affected teeth and surfaces.

**Conflicts Of Interest**

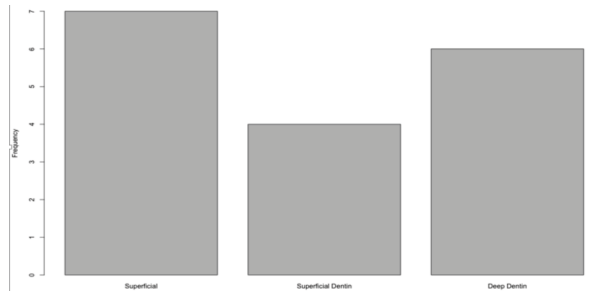
The participants declare that they have no conflicts of interest or source of financing.



**Figure 1:** Local conditions associated with canines included. Root resorption (RR), Temporary tooth (TT), Adjacent piece included (AI), Inclination (IN), Odontoma (OD), Agenesis (AG), Imprint adjacent (IM), Giroversion (GI), Transmigrant (TR), Cyst (CY).



**Figure 2:** Piece with root resorption



**Figure 3:** Depth of root resorption

**REFERENCES**

- Bishara SE. Clinical management of impacted maxillary canines. *Semin Orthod.* 1998;4(2):87-98.
- Simić S, Nikolić P, Stanišić Zindović J, Jovanović R, Stošović Kalezić I, Djordjević A, et al. Root Resorptions on Adjacent Teeth Associated with Impacted Maxillary Canines. *Diagnostics.* 2022;12(2).
- Ericson S, Kuroi J. Resorption of maxillary lateral incisors caused by ectopic eruption of the canines. *Am J Orthod Dentofac Orthop.* 1988;94(6):503-13.
- Ericson S, Kuroi J. Incisor Root Resorptions Due to Ectopic Maxillary Canines Imaged by Computerized Tomography: A Comparative Study in Extracted Teeth. *Angle Orthod.* 2000;70(4):276-83.
- Liu D gao, Zhang W lin, Zhang Z yan, Wu Y tang, Ma X chen. Localization of impacted maxillary canines and observation of adjacent incisor resorption with cone-beam computed tomography. *Oral Surgery, Oral Med Oral Pathol Oral Radiol Endodontology.* 2008;105(1):91-8.
- Bjerklín K, Ericson S. How a computerized tomography examination changed the treatment plans of 80 children with retained and ectopically positioned maxillary canines. *Angle Orthod.* 2006;76(1):43-51.
- Oberoi S, Knuettel S. Three-dimensional assessment of impacted canines and root resorption using cone beam computed tomography. *Oral Surg Oral Med Oral Pathol Oral Radiol [Internet].* 2012;113(2):260-7.
- Kim Y, Hyun HK, Jang KT. The position of maxillary canine impactions and the influenced factors to adjacent root resorption in the Korean population. *Eur J Orthod.* 2012;34(3):302-6.
- Ericson S, Kuroi J. Radiographic examination of ectopically erupting maxillary canines. *Am J Orthod Dentofac Orthop.* 1987;91(6):483-92.
- Arens DE. An alternative treatment for the severely resorbed maxillary lateral incisor: A sequela of ectopic eruption. *J Endod.* 1995;21(2):95-100.
- Nakajima T. Root resorption of upper permanent incisor caused by impacted

- canine: An analysis of 23 cases. *Int J Oral Surg*. 1984;13(4):299-306.
12. Walker L, Enciso R, Mah J. Three-dimensional localization of maxillary canines with cone-beam computed tomography. *Am J Orthod Dentofac Orthop*. 2005;128(4):418-23.
  13. Rimes RJ, Mitchell CNT, Willmot DR. Maxillary incisor root resorption in relation to the ectopic canine: A review of 26 patients. *Eur J Orthod*. 1997;19(1):79-84.
  14. Algerban, A., Jacobs, R., Lambrechts, P., Loozen, G., & Willems, G. (2009). Root resorption of the maxillary lateral incisor caused by impacted canine: a literature review. *Clinical oral investigations*, 13(3), 247-255.