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Morphologic evaluation of maxillary premolar canals in a subpopulation from southern Brazil: a cone beam computed tomography study

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Abstract

AIM. To evaluate the anatomic variations of both maxillary premolars by cone beam computed tomography (CBCT) images.

MATERIALS AND METHODS**.** Data were evaluated from 599 exams (313 women and 286 men), scanned by 300 Maxio CT, Instrumentarium®/Kavo Dental Excellence, FOV 5x5 and voxel 0.085 mm. The images were evaluated by two endodontists using Vertucci's classification.

RESULTS. The prevalence of maxillary premolars with more than one root was higher in men (48.3%) than in women (29.7%) ($p < 0.05$). A higher percentage of type I and type III canals (53.1% and 20.2%, respectively) was observed in the second premolar (15.0%) with only one root than in the first premolars (14.3%). The percentage of IV, V, VI, and VII type canals was higher in the first premolars. Most teeth with two roots had a root canal of the type IV, both in the first premolar (97.9%) and in the second premolar (93.5%). When all teeth were considered, regardless of the number of roots, the first maxillary premolar showed a higher prevalence of type IV root canals (68.0%) and the second maxillary premolar showed a higher prevalence of type I root canals (46.4%) ($p < 0.05$). There was a significant association between gender and the number of maxillary premolar roots in a southern Brazilian subpopulation. Most maxillary first premolars had two roots with a type IV configuration and this configuration was common in males, while second premolars tended to be single-rooted and with a type I configuration and were common in women.

Keywords: cone beam computed tomography, endodontics, root canal anatomy

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Морфологическая оценка корневых каналов премоляров верхней челюсти у субпопуляции с юга Бразилии: исследование с применением конусно-лучевой компьютерной томографии

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Резюме

ЦЕЛЬ ИССЛЕДОВАНИЯ. Оценить анатомические вариации корневой системы премоляров верхней челюсти с использованием конусно-лучевой компьютерной томографии (КЛКТ).

МАТЕРИАЛЫ И МЕТОДЫ. В исследование были включены данные 599 КЛКТ-обследований (313 женщин и 286 мужчин), выполненных на томографе 300 Maxio CT, Instrumentarium®/Kavo Dental Excellence, с полем обзора 5×5 мм и вокселем 0,085 мм. Изображения анализировались двумя врачами-эндодонтистами в соответствии с классификацией Вертуччи.

РЕЗУЛЬТАТЫ. Частота обнаружения премоляров верхней челюсти с более чем одним корнем была выше у мужчин (48,3%), чем у женщин (29,7%) ($p < 0,05$). Во-вторых, премолярах с одним корнем наблюдался более высокий процент каналов типов I и III (53,1 и 20,2% соответственно), чем у первых премоляров (15,0 и 14,3% соответственно). Каналы типов IV, V, VI и VII чаще встречались в первых премолярах. Большинство зубов с двумя корнями имели каналы типа IV – как в первых (97,9%), так и, во-вторых, премолярах (93,5%). При учете всех зубов независимо от количества корней установлено, что для первых премоляров верхней челюсти наиболее характерна конфигурация канала типа IV (68,0%), тогда как для вторых премоляров преобладающей была конфигурация типа I (46,4%) ($p < 0,05$). Установлена значимая зависимость между полом и числом корней премоляров верхней челюсти у обследованной субпопуляции юга Бразилии. У большинства первых премоляров верхней челюсти было два корня с каналами типа IV, что чаще встречалось у мужчин, тогда как вторые премоляры в основном имели один корень и конфигурацию канала типа I, что было характерно для женщин.

Ключевые слова: конусно-лучевая компьютерная томография, эндодонтия, анатомия корневого канала

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INTRODUCTION

Knowledge of the morphology and anatomic variability of the root canal system is important to perform successful endodontic treatment [1]. It is critical that the clinician be aware of these internal and external variations and their relationships to adjacent anatomic structures to improve the outcome of endodontic treatment [2].

Periapical radiography is the most used method for examining root canal morphology during endodontic therapy [3]. Anatomical overlap and image distortion can be potential drawbacks of this technique [4]. To capture these anatomical variations, such as additional canals, it is necessary to perform root dissociation techniques and change the horizontal angle of the radiograph [5]. CBCT provides a three-dimensional assessment of the tooth and anatomical structures [5], eliminates overlap, and allows viewing in the axial, coronal, and sagittal planes [6].

Root canal morphology may vary in the same individual [7]. Factors that may contribute to these variations in root canal anatomic complexity include age, gender, and the type of study performed [8]. The Brazilian population is heterogeneous and has genetic contributions from other continents: Europe, Africa, America, and Asia [9].

Maxillary premolars are frequent candidates for endodontic treatment, accounting for 15.8% to 21.5% of all treated teeth [10; 11]. Many studies have already reported that maxillary premolars exhibit high variability in internal root anatomy. In maxillary first premolars, the number of single-rooted teeth varies from 22% to 66%, the number of double-rooted teeth varies from 33% to 84%, and the number of triple-rooted teeth varies from 0% to 6%. [12–15]. This study aimed to evaluate the anatomical variability of maxillary premolars in terms of the number of roots and the configuration of root canals in a subpopulation in southern Brazil using CBCT.

MATERIALS AND METHODS

This study was approved by the local ethics committee with protocol no. 5.062.770. It was an observational, cross-sectional, and retrospective study evaluating maxillary premolar morphology using CBCT images acquired from January 2018 to July 2020. A total of 599 images of maxillary premolars (338 first and 262 second premolars) from 341 patients of both sexes, aged between 16 and 87 years, were analyzed. Images were selected according to the following criteria: Presence of first and/or second maxillary premolars regardless of semiarch, complete root formation, no resorptions and calcifications, no endodontic treatments, and crowns. The sample was selected using the G*power program. The sample size of 599 images provided a minimum test power (1-β) of 80% with an α-significance level of 5% for small effects in the analyzes of association with sex ($w = 0.13$) and age. Canal configuration ($w = 0.15$).

The CBCT images used in this study were obtained with the scanner OP 300 Maxio CT, Instrumentarium®/Kavo Dental Excellence, using the following acquisition protocol: Voltage of 90 kV and 12.5 mA, FOV 5x5, voxel 0.085 mm and minimum exposure time of 6.1 seconds. The images were evaluated by two trained endodontists. Inter-examiner agreement was evaluated using the Kappa test. For the evaluation, On Demand software was used in a low-light environment: first in the axial, sagittal and coronal planes. The following information was recorded and evaluated: Number of canals, number of roots, sex of the patient, and root canal configuration according to the Vertucci classification [1] (Fig. 1):

Type I: A single canal exits the pulp chamber and extends to the apex;

Type II: Two separate canals emerge from the pulp chamber and join to form a single canal anterior to the apex;

Type III: A single canal emerges from the pulp chamber, divides into two canals in the middle third of the root, and then unites into a single canal;

Type IV: Two separate canals from the pulp chamber to the apex;

Type V: A single canal exits the pulp chamber and divides into two separate canals with two separate foramina before the apex;

Type VII: Two separate canals leave the pulp chamber, unite in the root body to the apex, and divide again into two separate canals before the apex;

Type VIII: A single canal exits the pulp chamber, divides, and then reunites in the canal body, ending in two separate canals anterior to the apex.

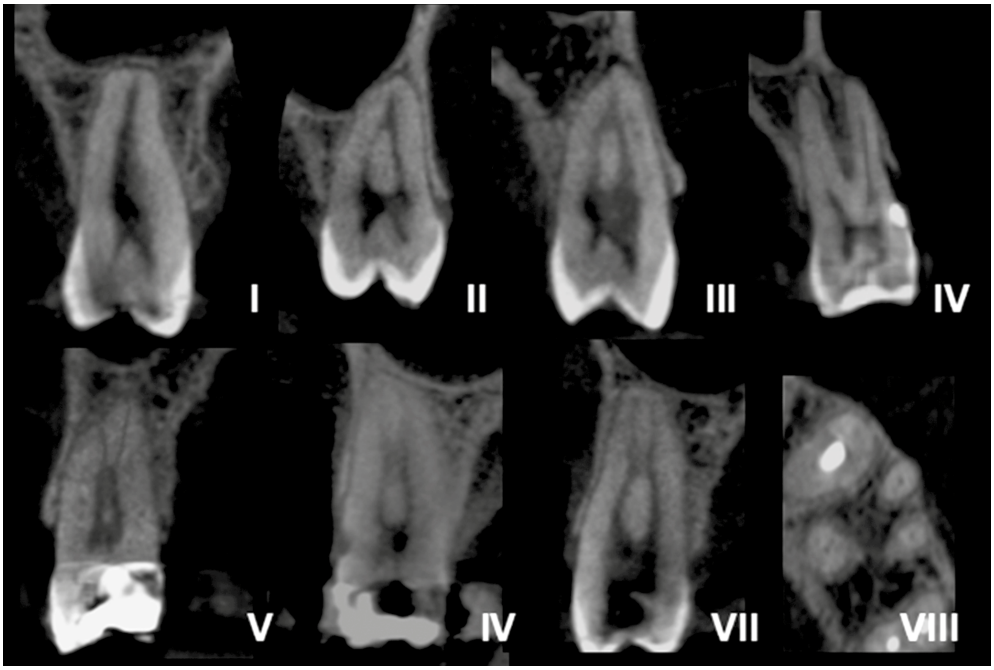

Fig. 1. Vertucci classification types found in the present studies among the maxillary premolars assessed by CBCT. CBCT coronal sections showing Vertucci Classification from type I to VII and sagittal section showing type VIII classification

Рис. 1. Типы классификации Вертуччи, выявленные в настоящих исследованиях среди премоляров верхней челюсти, оцененных с помощью КЛКТ. Коронарные срезы на КЛКТ, демонстрирующие классификацию Вертуччи от типа I до VII, и сагиттальный срез, показывающий тип VIII

Chi-square and Fisher exact tests were used to analyze associations between sex and number of roots and between tooth position and Vertucci root canal configuration. All analyzes were performed using the R program with a significance level of 5%.

The number of roots detected in the axial plane was classified according to Pécora et al. [16]: Single-rooted: teeth with a single root and teeth with two independent canals that appeared to have two interconnected roots.

Multi-rooted: teeth with two roots that have partially or completely branched roots; teeth with three roots, where three roots are independent of the pulp chamber floor or branch at some point along the buccal or palatal roots.

RESULTS

There was perfect agreement between the two investigators regarding the number of roots in the PMS (kappa = 1.00; 95%CI: 1.00–1.00). There was also near perfect agreement between the two investigators regarding the configuration of root canals in the PMS (kappa = 0.90; 95%CI: 0.76–1.00).

Table 1 shows that there is a significant relationship between gender and the number of roots ($p < 0.05$). Note that 50.9% of females and 31.7% of males had a root in the maxillary first premolar. Similarly, 48.0% of females and 64.7% of males had two roots in the maxillary premolar ($p < 0.05$). For the maxillary second premolar, 93.7% of females had only one root and no females had

Table 1. Analyzes of association between the number of roots and gender for the first PMS, second PMS and the total

Таблица 1. Анализ взаимосвязи между количеством корней и полом для первых премоляров, вторых премоляров и в совокупности для всех премоляров

Tooth	Gender	Number of roots				*p*-value
		One	Two	Three	Total	
		Frequency ([1]%)			Frequency ([2]%)	
1º PMS	Female	87 (50.9)	82 (48.0)	2 (1.2)	171 (50.6)	0.0006[3]
	Male	53 (31.7)	108 (64.7)	6 (3.6)	167 (49.4)	
	Total	140 (41.4)	190 (56.2)	8 (2.4)	338 (56.4)	
2º PMS	Female	133 (93.7)	9 (6.3)	0 (0.0)	142 (54.4)	0.0017[3]
	Male	95 (79.8)	22 (18.5)	2 (1.7)	119 (45.6)	
	Total	228 (87.4)	31 (11.9)	2 (0.8)	261 (43.6)	
Geral	Female	220 (70.3)	91 (29.1)	2 (0.6)	313 (52.3)	<0.0001[4]
	Male	148 (51.7)	130 (45.5)	8 (2.8)	286 (47.7)	
	Total	368 (61.4)	221 (36.9)	10 (1.7)	599 (100.0)	

Note. [1] percentages in rows; [2] percentages in column; [3] fisher's Exact Test; [4] chi-square test.

Примечание. [1] проценты в строках; [2] проценты в столбцах; [3] точный тест Фишера; [4] тест хи-квадрат.

Table 2. Analyzes of association between root canal configurations (Vertucci Classification) and tooth position for cases with one, two, three roots

Таблица 2. Анализ взаимосвязи между конфигурациями корневых каналов (по классификации Вертуччи) и положением зуба для случаев с одним, двумя и тремя корнями

Number of Roots	Tooth position	Root canal configuration								Total	*p*-value
		I	II	III	IV	V	VI	VII	VIII		
		Frequency ([1]%)								Frequency ([2]%)	
One	1º PMS	21(15.0)	34(24.3)	20(14.3)	44(31.4)	3(2.1%)	8(5.7)	10(7.1)	0(0.0%)	140 (38.0%)	<0.0001[3]
	2º PMS	121(53.1)	24(10.5)	46(20.2)	20 (8.8)	4(1.8)	4(1.8)	9 (3.9)	0 (0.0)	228 (62.0)	
	Total	142(38.6)	58(15.8)	66(17.9)	64(17.4)	7(1.9)	12(3.3)	19(5.2)	0 (0.0)	368 (61.4)	
Two	1º PMS	0 (0.0)	0 (0.0)	0 (0.0)	186(97.9)	1(0.5)	0 (0.0)	0 (0.0)	3 (1.6)	190 (86.0)	0.1345[3]
	2º PMS	0 (0.0)	1 (3.2)	0 (0.0)	29 (93.5)	0(0.0)	0 (0.0)	0 (0.0)	1 (3.2)	31 (14.0)	
	Total	0 (0.0)	1 (0.5)	0 (0.0)	215(97.3)	1(0.5)	0 (0.0)	0 (0.0)	4 (1.8)	221 (36.9)	
Three	1º PMS	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0(0.0)	0(0.0)	0(0.0)	8(100.0)	8 (80.0)	–
	2º PMS	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0(0.0)	0 (0.0)	0 (0.0)	2 (100.0)	2 (20.0)	
	Total	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0(0.0)	0(0.0)	0 (0.0)	10(100.0)	10 (1.7)	
General	1º PMS	21 (6.2)	34(10.1)	20 (5.9)	230(68.0)	4(1.2)	8 (2.4)	10(3.0)	11 (3.3)	338 (56.4)	<0.0001[3]
	2º PMS	121(46.4)	25 (9.6)	46(17.6)	49 (18.8)	4(1.5)	4 (1.5)	9 (3.4)	3 (1.1)	261 (43.6)	
	Total	142(23.7)	59(9.8)	66(11.0)	279(46.6)	8(1.3)	12(2.0)	19(3.2)	14(2.3)	599 (100.0)	

Note. [1] percentages in the lines; [2] percentages in the column; [3] Fisher Exact Test.

Примечание. [1] процент в строках; [2] процент в столбце; [3] точный критерий Фишера.

three roots. For males, 18.5% had two roots and 1.7% had three roots ($p < 0.05$). Considering the two positions of teeth, the prevalence of teeth with more than one root was also higher in men (48.3%) than in women (29.7%), $p < 0.05$. There was a significant relationship between tooth position and root canal configuration only in teeth with one root and in the total number of teeth ($p < 0.05$) (Table 2). A higher percentage of type I and type III canals (53.1% and 20.2%, respectively) was observed in the second maxillary premolar with only one root than in the first premolars with one root (15.0% and 14.3%, respectively). The percentages of type IV, V, VI, and VII canals were higher in first maxillary premolar than in second maxillary premolar. Most teeth with two roots had a root canal of the type IV, both in the first maxillary premolar (97.9%) and in the second maxillary premolar (93.5%). All teeth with three roots had a root canal of the type VIII. When all teeth were considered, regardless of the number of roots, the maxillary first premolar showed a higher prevalence of type IV root canals (68.0%) and the second maxillary premolar showed a higher prevalence of type I root canals (46.4%), $p < 0.05$.

DISCUSSION

The study of root canal anatomy is important to achieve a favorable outcome in endodontics [15]. Therefore, morphologic variations should be evaluated when planning and performing endodontic treatment [17].

CBCT provides a good way to assess root canal morphology without overlaying anatomical structures [13]. In addition, studies indicate the advantage of being a rapid, inexpensive, and nondestructive method with low radiation that allows images to be obtained in both oblique planes and orthogonal planes and analyzed in vivo [18].

In the present study, most maxillary premolars had two roots (56.2%), whereas 41.4% had only one root, followed by 2.4% who had three roots. These results are consistent with the studies of Abella et al. [13] and Martins et al. [7].

As for the upper second premolar, the present study showed that 87.4% had one root and 11.9% had two. For one root, the prevalence was lower (71.2%) in the study by Lima et al. [15] and higher (94.4%) in the study by Martins et al. [7]. In 3 roots, the present study agreed with Lima et al. [15], with a very low percentage. Martins et al. [7] did not detect any upper second premolar with three roots in their specimens.

The complexity of internal root canals is determined by genetics, age, and sex. The Brazilian population is one of the most heterogeneous populations in the world, with a significant genetic contribution from other continents [19]. Sex and number of maxillary premolar roots showed a significant association in this study ($p < 0.05$), which contradicts the results of the study by Abella et al. [13]. The prevalence of maxillary premolars with more than one root was higher in men (48.3%) than in women (29.7%). These results are consistent with the study of Lima et al. [15], which also used a Brazilian subpopulation, and with Ok et al. [12] (Turkish population). These results are useful for the dental surgeon in preoperative planning and evaluation and may contribute to the success of endodontic treatment.

Regarding the configuration of the root canals [1], most of the teeth with two roots [97.3%] was of the IV types as in the study by Lima et al [15]. From all the samples, 29.7% of the teeth studied had a complex canal system, which is difficult to detect only with a periapical radiograph. In maxillary first premolars, type I was the most common (53.1%), which agrees with Abella et al. [13] and Lima et al [15], followed by type III (20.2%).

In maxillary second premolars, 31.4% of the teeth examined were of the type IV, followed by 24.3% of the II types. Lima et al. [15] found (32.6%), of type IV and type I was much higher (49.9%). The present study agrees with the studies of Martins et al. [7] and Abella et al. [13]. The prevalence of the type VIII configuration is critical for a correct diagnosis, and therefore these studies of anatomic variability are important. Thus, if an abnormality with enlargement is noted or suggested on periapical radiography, requesting a CBCT scan is indicated for a better anatomical assessment prior to endodontic treatment. In this way, the predictability of the case becomes much better and so do the chances of success.

CONCLUSION

The morphology of maxillary premolars was very different in this subpopulation, especially in the second maxillary premolars. These differences must be considered before and during endodontic treatment. CBCT is an important tool that can be used to analyze the morphological variations of root canals.

REFERENCES / СПИСОК ЛИТЕРАТУРЫ

1. Vertucci F.J. Root canal anatomy of the human permanent teeth. *Oral Surg Oral Med Oral Pathol*. 1984;58(5):589–599. https://doi.org/10.1016/0030-4220(84)90085-9
2. Ahmad I.A., Alenezi M.A. Root and root canal morphology of maxillary first premolars: a literature review and clinical considerations. *J Endod*. 2016;42(6):861–872. https://doi.org/10.1016/j.joen.2016.02.017
3. Baratto Filho F., Zaitter S., Haragushiku G.A., de Campos E.A., Abuabara A., Correr G.M. Analysis of the internal anatomy of maxillary first molars by using different methods. *J Endod*. 2009;35(3):337–342. https://doi.org/10.1016/j.joen.2008.11.022
4. Celikten B., Tufenkci P., Aksoy U., Kalender A., Kermeoglu F., Dabaj P., Orhan K. Cone beam CT evaluation of mandibular molar root canal morphology in a Turkish Cypriot population. *Clin Oral Investig*. 2016;20(8):2221–2226. https://doi.org/10.1007/s00784-016-1742-2
5. Patel S., Dawood A., Whaites E., Pitt Ford T. New dimensions in endodontic imaging: part 1. Conventional and alternative radiographic systems. *Int Endod J*. 2009;42(6):447–462. https://doi.org/10.1111/j.1365-2591.2008.01530.x
6. Koivisto T., Chiona D., Milroy L.L., McClanahan S.B., Ahmad M., Bowles W.R. Mandibular canal location:

Cone-beam computed tomography examination. *J Endod*. 2016;42(7):1018–1021. https://doi.org/10.1016/j.joen.2016.03.004

7. Martins J.N.R., Gu Y., Marques D., Francisco H., Caramês J. Differences on the root and root canal morphologies between Asian and white ethnic groups analyzed by cone-beam computed tomography. *J Endod*. 2018;44(7):1096–1104. https://doi.org/10.1016/j.joen.2018.04.001
8. Awawdeh L., Abdullah H., Al-Qudah A. Root form and canal morphology of Jordanian maxillary first premolars. *J Endod*. 2008;34(8):956–961. https://doi.org/10.1016/j.joen.2008.04.013
9. Silva E.J., Nejaim Y., Silva A.I., Haiter-Neto F., Zaia A.A., Cohenca N. Evaluation of root canal configuration of maxillary molars in a Brazilian population using cone-beam computed tomographic imaging: an in vivo study. *J Endod*. 2014;40(2):173–176. https://doi.org/10.1016/j.joen.2013.10.002
10. Wayman B.E., Patten J.A., Dazey S.E. Relative frequency of teeth needing endodontic treatment in 3350 consecutive endodontic patients. *J Endod.* 1994;20(8):399–401. https://doi.org/10.1016/S0099-2399(06)80299-2
11. Zaatar E.I., al-Kandari A.M., Alhomaidah S., al-Yasin I.M. Frequency of endodontic treatment in Kuwait: radiographic evaluation of 846 endodontically treated teeth. *J Endod*. 1997;23(7):453–456. https://doi.org/10.1016/s0099-2399(97)80302-0
12. Ok E., Altunsoy M., Nur B.G., Aglarci O.S., Çolak M., Güngör E. A cone-beam computed tomography study of root canal morphology of maxillary and mandibular premolars in a Turkish population. *Acta Odontol Scand*. 2014;72(8):701–706. https://doi.org/10.3109/00016357.2014.898091
13. Abella F., Teixidó L.M., Patel S., Sosa F., Duran-Sindreu F., Roig M. Cone-beam computed tomography analysis of the root canal morphology of maxillary first and second premolars in a Spanish population. *J Endod*. 2015;41(8):1241–1247. https://doi.org/10.1016/j.joen.2015.03.026
14. Estrela C., Bueno M.R., Couto G.S., Rabelo L.E., Alencar A.H., Silva R.G. et al. Study of root canal anatomy in human permanent teeth in a subpopulation of Brazil's center region using cone-beam computed tomography – Part 1. *Braz Dent J*. 2015;26(5):530–536. https://doi.org/10.1590/0103-6440201302448
15. de Lima C.O., de Souza L.C., Devito K.L., do Prado M., Campos C.N. Evaluation of root canal morphology of maxillary premolars: a cone-beam computed tomography study. *Aust Endod J*. 2019;45(2):196–201. https://doi.org/10.1111/aej.12308
16. Pécora J.D., Saquy P.C., Sousa Neto M.D., Woelfel J.B. Root form and canal anatomy of maxillary first premolars. *Braz Dent J*. 1992;2(2):87–94.
17. Estrela C., Holland R., Estrela C.R., Alencar A.H., Sousa-Neto M.D., Pécora J.D. Characterization of successful root canal treatment. *Braz Dent J*. 2014;25(1):3–11. https://doi.org/10.1590/0103-6440201302356
18. Neelakantan P., Subbarao C., Ahuja R., Subbarao C.V., Gutmann J.L. Cone-beam computed tomography study of root and canal morphology of maxillary first and second molars in an Indian population. *J Endod.* 2010;36(10):1622–1627. https://doi.org/10.1016/j.joen.2010.07.006
19. Silva D., Gomes A.C., Silva J.M. da, Neves A. de A., Zaia A.A., Silva E.J.N.L. da. Evaluation of foraminal transportation during foraminal enlargement with different instrumentation systems. *Braz J Oral Sci.* 2014;13(4):246–250. https://doi.org/10.1590/1677-3225v13n4a01

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