

Root Canal Morphology of Maxillary Premolars among the Elderly

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Reportedly, maxillary premolars are the most complex teeth for performing endodontic treatment,^[1] with root canals varying based on race, genetic predisposition, diet, region, gender,^[2] and perhaps age. To date, few detailed studies have been conducted to assess number of roots and root canal morphology of maxillary premolars in the elderly. The present study analyzed root canal morphology of maxillary premolars in elderly individuals using cone-beam computed tomography (CBCT), which has substantial clinical value in guiding endodontic treatment.^[3]

CBCT images of maxillary premolars were obtained from 267 elderly (aged ≥ 60 years) patients (202 men and 65 women) who had received treatment at the People's Liberation Army Stomatological Hospital between September 2015 and September 2016. All patients provided written informed consent. In total, 1038 CBCT images of maxillary premolars (521 of maxillary first premolars and 517 of maxillary second premolars), recorded using Promax 3D Max (Planmeca Oy, Helsinki, Finland) were selected based on the following criteria: (i) complete root structure, no fracture; (ii) clear root canal morphology without absorption, calcification, and root filling material; (iii) no posts, crowns, or artificial crowns; and (iv) clear and complete image of the tooth.

All CBCT images were evaluated by two clinicians who recorded tooth position, patient gender, number of roots, and root canal morphology (Vertucci's classification). The Chi-square test was used to analyze the association between root canal morphology and tooth position. We defined teeth that were bifurcated or trifurcated around one-third (or higher) of the root apex as two- or three-rooted teeth.

Overall, 57.9% of maxillary first premolars from male patients were single rooted, and the remaining were two rooted (40.3%) or three rooted (1.8%); on the other

hand, 70.2% of female patients presented single-rooted teeth, whereas the remaining presented two-rooted teeth. Moreover, 90.6% and 9.4% of maxillary second premolars from male patients were single rooted and two rooted, respectively; on the other hand, 98.4% of female patients presented single-rooted teeth whereas the remaining presented two-rooted teeth. Marked differences in number of roots and gender were observed in both maxillary first and second premolars ($\chi^2 = 7.244, 8.350$, respectively, $P \leq 0.05$).

Moreover, among the 521 specimens of maxillary first premolars, 60.9%, 37.8%, and 1.3% were single-, two-, and three-rooted teeth, respectively, with no statistical relationship between number of roots and tooth position ($P = 0.898$). Furthermore, among the 517 specimens of maxillary second premolars, 92.5% and 7.5% were single- and two-rooted teeth, respectively (no three-rooted teeth), with no statistical relationship between number of roots and tooth position ($P = 0.398$).

Table 1 shows the prevalence of various root canal morphologies identified in maxillary premolars based on the number of roots. In addition, some special morphologies, 2-1-2-1, 4-4, 1-3, and 2-1-2-1-2, were noted in maxillary first premolars.

From collected samples, bilateral maxillary premolars without defects were selected in accordance with the standards of image analysis; among these, 60.8% and

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Table 1: Root canal morphology of maxillary premolars according to Vertucci's classification among the enrolled elderly individuals

Items	Vertucci's classification									Total
	I	II	III	IV	V	VI	VII	VIII	Others	
Maxillary first premolars										
Single-rooted teeth	21 (6.6)	150 (47.3)	–	78 (24.6)	7 (2.2)	47 (14.8)	1 (0.3)	–	13 (4.1)	317
Two-rooted teeth	–	–	–	193 (98.0)	–	–	–	4 (0.03)	–	197
Three-rooted teeth	–	–	–	–	–	–	–	6 (85.7)	1 (14.3)	7
Total	21	150	–	271	7	47	1	10	14	521
Maxillary second premolars										
Single-rooted teeth	157 (32.8)	207 (43.3)	3 (0.6)	31 (6.5)	16 (3.4)	47 (29.8)	3 (0.6)	–	14 (2.9)	478
Two-rooted teeth	–	–	–	38 (97.4)	–	–	–	1 (2.6)	–	39
Total	157	207	3	69	16	47	3	1	14	517

Values were shown as *n* or *n* (%). –: Not applicable.

52.4% of elderly patients presented identical root canal morphology of both maxillary first and second premolars, respectively. The Chi-square test revealed no relationship between bilateral symmetry in root canal morphology and tooth position ($\chi^2 = 3.613$, $P = 0.057$).

Overall, 61.0% of men and 57.5% of women presented bilateral symmetry in root canal morphology of maxillary premolars. The Chi-square test revealed no relationship between bilateral symmetry in root canal morphology and gender ($\chi^2 = 0.478$, $P = 0.489$).

As such, the success of root canal therapy depends on the comprehensive understanding of root canal morphology and its variations. However, treatment becomes more challenging because of aging of the root canal system, particularly among elderly patients. A previous study of maxillary first premolars reported that as aging progressed, the proportion of Type I and Type III canals decreased while that of Type II canals increased, with no remarkable changes in the proportion of Type IV canals.^[4] The incidence of single-, two-, and three-rooted maxillary first premolars in the Chinese population ranges 31.5–79.0%, 21.0–68.5%, and 0–6%, respectively.^[5]

In the present study that evaluated maxillary premolars among the elderly in China, 60.9% of first premolars were single rooted, most of which revealed Type IV canals. On the other hand, 92.5% of maxillary second premolars were single rooted, and a large proportion of these were Type II canals. These differences clarified the particularity of the elderly, which are consistent with the diversity of root canal morphology observed among various racial groups.

Imaging technology plays an important role in clinical diagnosis and treatment by proving an accurate and reliable basis for treatment planning and success. Reportedly, CBCT can accurately evaluate root canal systems, which helps improve the root canal cleaning technique.^[3] A previous study^[3] demonstrated the quality of CBCT images and its clinical application in evaluating root canal morphology before endodontic treatment. Thus, CBCT could be extremely valuable in detecting root canal morphology

among elderly patients. As root canal morphology of maxillary premolars varies largely in the elderly, providing optimal root canal therapy in such patients can be challenging. Moreover, the complexity of accessory canals impedes achievement of appropriate/ideal canal preparation and obturation. Perhaps, CBCT scanning before endodontic treatment can help distinguish the morphology of root canals and provide the clinician with guidance.

Declaration of patient consent

We certify that we have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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