

**Endodontic treatment of maxillary first premolar with three root canals – A Case Report**

<sup>1</sup>Dr. Abhishek Guria, Associate Professor Dept. of Conservative Dentistry & Endodontics, Haldia Institute of Dental Sciences & Research, Banbishnupur, Balughata, Haldia, West Bengal 721645.

<sup>2</sup>Dr. Anirban Bhattacharyya, Professor and Head of Department Dept. of Conservative Dentistry & Endodontics, Haldia Institute of Dental Sciences & Research, Banbishnupur, Balughata, Haldia, West Bengal 721645.

<sup>3</sup>Dr. Asim Bikash Maity, Professor Dept. of Conservative Dentistry & Endodontics, Haldia Institute of Dental Sciences & Research, Banbishnupur, Balughata, Haldia, West Bengal 721645

<sup>4</sup>Dr. Ahana Chakraborty, Second Year Post Graduate Trainee Dept. of Conservative Dentistry & Endodontics, Haldia Institute of Dental Sciences & Research, Banbishnupur, Balughata, Haldia, West Bengal 721645.

**Corresponding Author:** Dr. Ahana Chakraborty, Second Year Post Graduate Trainee Dept. of Conservative Dentistry & Endodontics, Haldia Institute of Dental Sciences & Research, Banbishnupur, Balughata, Haldia, West Bengal 721645.

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**Abstract**

The numerous difficulties found during root canal treatments are due to anatomical variations in the radicular morphology. Maxillary second premolars generally have a single root and one or two canals. Patients presenting with three canals in maxillary second premolar is a rare phenomenon. In these patients, accurate preoperative radiographs with multiple angulations are useful in diagnosis. This article describes the diagnosis and endodontic management of maxillary second premolar with three canals.

**Keywords:** Anatomical variations, maxillary second premolar, root canal treatment, three root canals, two roots.

**Introduction**

The success of a root canal therapy depends upon a thorough chemo-mechanical cleansing and shaping of the entire root canal system and its three-dimensional filling with a hermetic seal <sup>[1]</sup>. Therefore, it is imperative that professionals have a thorough knowledge of the internal anatomy of the pulp chamber and the entire root canal system, including the knowledge of possible anomalies or less common configurations of the root canal system in order to increase efficiency and consequently, the rate of clinical success of endodontic treatment <sup>[2]</sup>.

Morphological variations in maxillary premolars have been reported and these pose a challenge for

endodontists. One of the most anatomically diverse tooth groups are the upper second premolars showing a wide range of variations in the number of roots, direction of the roots, number of root canals and configuration of the pulp chamber making the maxillary second premolar one of the most difficult teeth to treat endodontically [3]. Most common form is single rooted with 90.7% of incidence. The incidence of two rooted form ranges from 5.5% to 20.4% [4,5] and the three-rooted form showed an incidence of 0% to 1% [6,7].

Like the root form, the canal system can also vary. In an in vitro study by Raj and Sumitha (2010), out of two hundred extracted maxillary second premolars from an Indian population, 64.1% samples had one root canal at the apex, 35.4 % had two root canals at the apex and 0% samples with three canals at the apex. Root canal configuration wise Vertucci's Type II was most prevalent (33.6%) while Type VII (1%) was least [8]. Vertucci (2005) reported an incidence of 1% of maxillary second premolars having 3 canals at apex [9] while Kartal et al. (1998) reported an incidence of 0.6% [10].

The purpose of this case report is to describe the endodontic treatment of a two-rooted maxillary second premolar with three separate root canals.

### Case report

A 30-year-old female patient with a non-contributory medical history reported to our Out Patient Department of Conservative Dentistry and Endodontics of Haldia Institute of Dental Sciences and Research complaining of sharp and severe lingering pain on the upper left back teeth region since 1 month. The pain increased on consumption of hot and cold food. Intraoral clinical and radiographic examination revealed a deep disto-occlusal caries involving pulp in the left maxillary second premolar (Fig. 1).

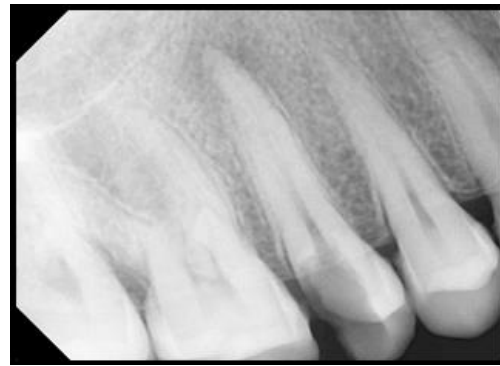


Fig 1: Pre-operative radiograph of #25

The tooth had exaggerated response to electric pulp testing and the diagnosis of symptomatic irreversible pulpitis was made. Routine non-surgical endodontic treatment was planned.

After obtaining the informed consent for the root canal treatment, the tooth was isolated with a rubber dam (Hygenic, Coltene Whale dent, Switzerland) after infiltration with local anesthesia (2% lidocaine with 1:100000 epinephrine).

A conventional endodontic access was prepared with an Endo Access Bur (Dentsply, Maillefer, Switzerland) and an Endo Z bur (Dentsply, Maillefer, Switzerland). Canal orifices were identified with a DG 16 explorer (Hu-Friedy, USA) revealing 3 canal orifices- two buccal and one palatal (Fig. 2).



Fig 2: Clinical picture showing three orifices (two buccal and one palatal) of #25

The working length of the canals were determined; MB = DB = 20 mm and P = 17.5 mm using an apex locator

(Canal Pro Coltene, Whale dent, Switzerland). Working length radiograph was taken to confirm the three separate canals (Fig. 3).



Fig 3: Working length radiograph showing three separate canals.

Protaper (Dentsply, Maillefer, Switzerland) rotary NiTi files were used to prepare the Mesio Buccal and palatal canals till F1 and size 25 Neo Endo Flex (Orikam) with a taper of 4% were used to prepare the distobuccal canal using a torque-controlled Endo motor (Canal Pro 2, Coltene Whale dent, Switzerland). Two different rotary file systems has been used with different tapers. Neo Endo Flex file of taper 4% (smaller than F1 which has a taper of 7%) has been used to prepare the distobuccal canal to preserve the dentin. Copious amount of 5% sodium hypochlorite solution (Par can, Septodont) was used for irrigation during instrumentation. and a final rinse was done using 17% ethylene diamine tetraacetic acid (Neo EDTA, Orikam). All three canals were dried with sterile paper points (Protaper, Dentsply, Maillefer, Switzerland and Orikam) and master cone was confirmed (Fig. 4a. and 4b.).



Fig 4a: Radiograph showing master cone verification.



Fig 4b: Clinical picture showing master cone selection.

Obturation was done using calcium hydroxide-based sealer (Apexit Plus, Ivoclar) (Fig. 5). The postoperative radiograph showed satisfactory obturation (Fig. 6). Post endodontic restoration tooth was done with composite (Te-Econom Plus Composite, Ivoclar) (Fig. 7)



Fig 5: Clinical picture showing obturation of #25.



Fig 6: Radiograph showing obturation of #25



Fig 7: Radiograph showing post endodontic restoration of #25

The patient was recalled after a week for follow-up and was found to be asymptomatic following which he was referred to the Department of Prosthodontics and Crown and Bridge for extra coronal restoration.

### Discussion

A major cause of poor outcome in endodontic treatment has been reported to be because of failure to identify and treat the entire root canal system [9]. A missed canal harbours microorganisms which can lead to post-treatment disease, making it necessary to reclean and reshape the entire root canal system in a tooth.

The most common type of root canal morphology of maxillary second premolars is the presence of a single canal at the apex [9]. The possibility of this tooth group having three canals is very small and only a few cases have been reported. Vertucci (1974) in his study reported 75% maxillary second premolars having only one canal at the apex, 24% samples having two canals and 1%

having three canals at the apex among two hundred maxillary second premolars [11]. Bellizzi and Hartwell (1985) reviewed clinical records covering a span of thirteen years. Among six hundred and thirty maxillary second premolars, they found that only 1.1% samples had three canals at the apex [12]. Sert and Bayirli (2004) examined two hundred maxillary second premolars from Turkish population half of which were from male patients and the other half from female patients. They found that only 1% of the samples from female patients and 3% from the male patients had three canals at the apex [13].

Various other studies have been done on the incidence of maxillary second premolars having three canals at the apex (Table 1).

The incidence of two-rooted maxillary second premolars has been reported to range from 1.6% [32] to 20.4% [5]. Ingle has reported an incidence of 8.4% of maxillary second premolars having two roots and other variations and anomalies associated with this tooth [33]. There has been very few reported cases so far about a two-rooted maxillary second premolar with three separate root canals (2 buccal and 1 palatal) ending at apex.

As conventional radiographs are twodimensional images, use of a horizontal angle variation technique may facilitate the identification of extra canals. Tube shift technique using a change in 20-40 degrees horizontal angulation is suitable for detecting number of canals in one root [34].

This radiographic examination, along with slight modification of the access cavity, is essential to locate the canal orifice in case of complex canal anatomy. Magnification, dyes, piezoelectric ultrasonic handpieces with abrasive surfaces and 'champagne bubbling test' also help in locating additional canals [35].



In vital teeth, red line test can visually aid in the identification of canals since blood (much like a dye), emanating from an orifice, fin or an isthmus area, serves to map of the underlying anatomy below the pulpal floor. White line test is when in necrotic teeth, the dentinal dust frequently moves into any anatomical space (orifice, fin or isthmus), when performing ultrasonic procedures without water and forms a white

dot or line providing a visual map for the identification of an extra canal [36].

Advanced diagnostic imaging modalities like cone-beam computed tomography (CBCT) can provide a three-dimensional image allowing better visualization of the root canal anatomy [37]. However, CBCT was not available at our institution and the use of 2D radiographic images seemed sufficient to make accurate diagnosis for this case.

Author	Year	No. of Teeth	Three Canals at Apex (%)
Pineda and Kuttler <sup>[14]</sup>	1972	282	0
Vertucci <sup>[15]</sup> (USA)	1974	200	1
Bellizzi and Hartwell <sup>[12]</sup>	1985	630	1.1
Pecora et al. <sup>[7]</sup>	1993	300	0.3
Chima <sup>[16]</sup> (Nigeria)	1994	26 females 20 males	0
Caliskan et al. <sup>[17]</sup> (Turkey)	1995	100	0
Kartal et al. <sup>[10]</sup>	1998	300	0.6
Zaatar et al. <sup>[5]</sup> (Kuwait)	1997	103	0
Sert and Bayirli <sup>[13]</sup> (Turkey)	2004	100 females 100 males	1 3
Khurram et al. <sup>[18]</sup>	2007	57 females 43 males	0 0
Sardar et al. <sup>[19]</sup> (Pakistan)	2007	100	0
Rozylo et al. <sup>[20]</sup>	2008	56	0
Peiris <sup>[21]</sup> (Sri Lanka)	2008	114	0
Peiris <sup>[21]</sup> (Japan)	2008	60	0
Weng et al. <sup>[22]</sup> (China)	2009	65	0
Raj and Sumitha <sup>[8]</sup> (India)	2010	200	0
Neelakantan et al. <sup>[23]</sup> (India)	2011	350	0
Al-Nazhan et al. <sup>[24]</sup> (Saudi Arabian)	2012	431	0.9
Elkady and Allouba <sup>[25]</sup> (Saudi Arabia)	2013	110	0
Muna et al. <sup>[26]</sup> (Jordan)	2014	217	0.46
Yang et al. <sup>[27]</sup> (China)	2014	374	1.6
Abella et al. <sup>[28]</sup> (Spanish)	2015	392	0.3

Elnour et al. <sup>[29]</sup> (Saudi Arabian sub-population)	2016	100	5
Saber et al. <sup>[30]</sup> (Egypt)	2018	382	1.2
Al-Zubaidi1 et al. <sup>[31]</sup> (Saudi Arabia)	2021	250 females 250 males	1

Table 1: Percent of maxillary second premolars having three root canals at apex in various studies.

**Conclusion**

Variations in root canal morphology should always be considered prior to any endodontic procedure. Careful clinical examination, a complete analysis of radiographs at multiple angulations, thorough exploration of the pulp floor under magnification, proper canal identification and negotiation are all necessary factors to achieve successful results in endodontic therapy.

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