Endodontic Society of the Philippines

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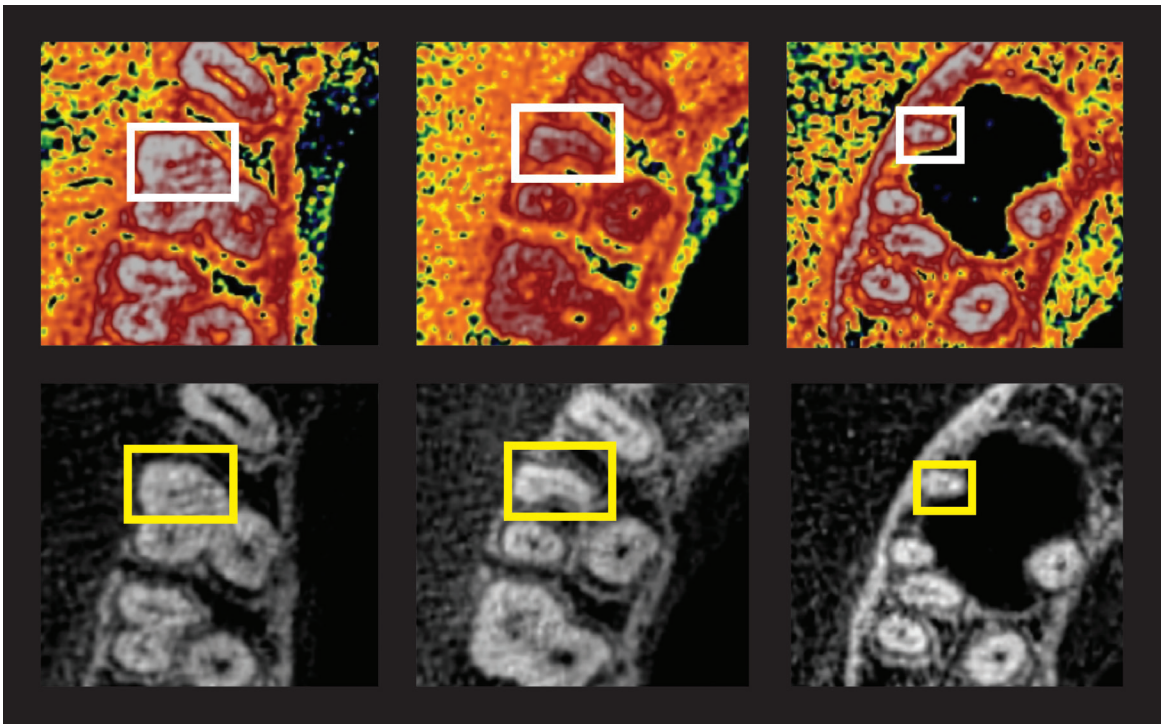

Official Journal of the Endodontic Society of the Philippines

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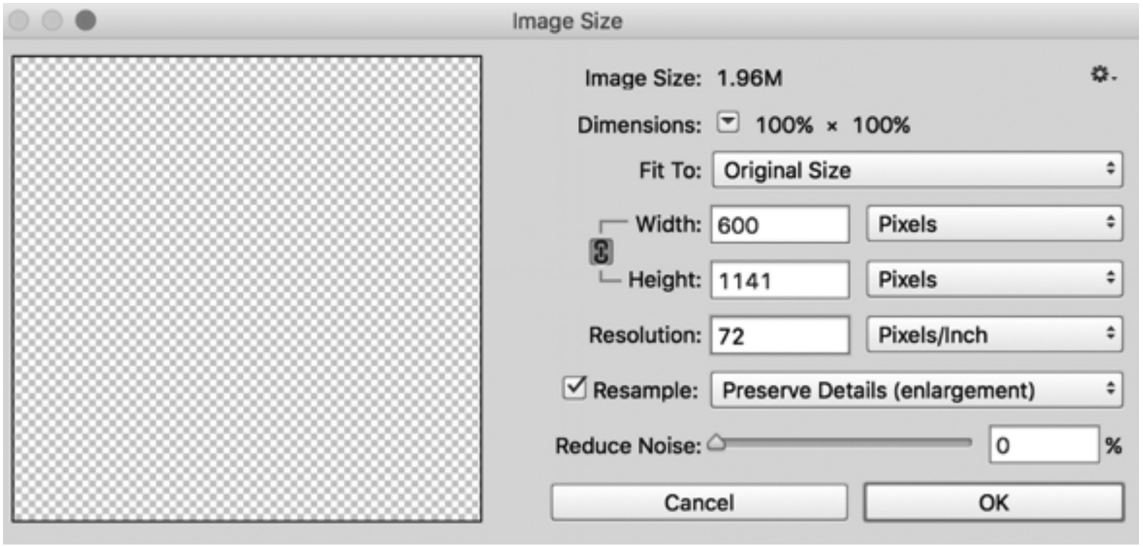


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B. Original Case Reports:

I. Title (same as in Section A)
II. Introduction
III. Case History
IV. Materials and Methods
V. Discussion
VI. Conclusion
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# Emergency Management of a 1st Maxillary Premolar with Bayonet Shaped Canals: A Case Report

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## Introduction

On a number of occasions, teeth that require endodontic treatment present with sudden change in the axial inclination or curve in the roots and root canals. (1) Canals with double curvatures are referred to as bayonet or S shaped. (2) The apical curvature is the most difficult to negotiate and may lead to strip perforation during instrumentation. (17) This type of anatomy require special attention in terms of diagnosis, treatment planning and execution. Furthermore, special instruments and instrumentation techniques ought to be employed to have successful treatment. When a patient presents with severe intractable pain, it becomes an endodontic emergency and further complicates the treatment. The clinician must therefore adequately prepared to manage the complex canal anatomy in an emergency state.

This case report presents an endodontic emergency management of maxillary first premolar with bayonet shaped canals.

## Case Report

A 17-year-old female student was referred from University of the East dental infirmary to the Postgraduate Endo-Perio clinic with severe pain that was aggravated by biting.

**Fig. 1. Pre-Operative photograph of tooth 14**

### History of Present Illness

Two years prior to consult (PTC), she noticed food impaction in between her maxillary premolars. One year PTC, she began experiencing mild sensitivity upon taking cold drinks. Three months PTC, she experienced discomfort while chewing, afterward she noticed a cavity when she checked in the mirror. One month PTC, she experienced moderate pain on taking cold drinks. She took Mefenamic acid 500mg to relieve pain on two occasions. She presented late in the afternoon with severe pain that was aggravated by biting. She had taken 500mg Mefenamic acid every six hours that day but no relief. Medical history was non-contributory.

### Diagnostic Tests

On intraoral examination, a deep carious disto-occlusal lesion was visible on tooth 14. Probing depths were within normal range. The tooth had an exaggerated painful lingering response to cold test and positive response to digital pressure. Intraoral periapical radiograph revealed a large carious lesion extending to the pulp chamber, intact lamina dura and an S-shaped root.

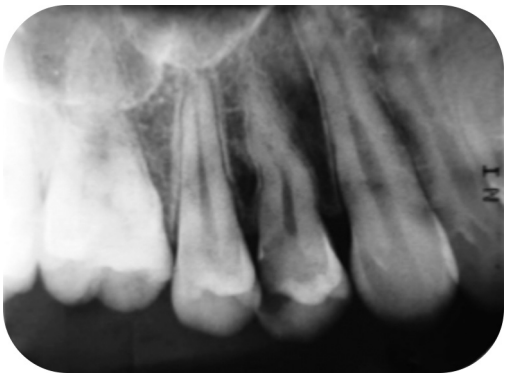

**Fig. 2. Pre-Operative radiograph of tooth 14**

### Pulpal and Periapical Diagnosis

Symptomatic Irreversible Pulpitis with Symptomatic Apical Periodontitis.

**Treatment**

Emergency treatment was done. Anaesthesia was achieved using 2% Lidocaine with 1:100,000 epinephrine. Caries was removed followed by rubber dam isolation and access cavity preparation. Patency was checked with a pre-curved size 6 M-Access (Dentsply Sirona) but stopped at the first curvature. Coronal pre flaring was done using ProTaper FHU orifice shaper (Dentsply Sirona). Size 6 M-Access file finally reached the length and canal was enlarged up to size 15 of M Access file. Root ZX Mini apex locator (J Morita Japan) was used to establish the working length (WL) and confirmed with radiograph. Size 15 M-Access files with apical binding were used for Initial Apical File radiograph. This was followed by mechanical glide path preparation using ProGlider (Dentsply Sirona). WaveOne Gold Small (20/.07) was chosen to do the final canal enlargement using the X-Smart Plus (Dentsply Sirona), irrigation with 2.5% NaOCl and lubrication with 15% EDTA Glyde™ (Dentsply Sirona). Irrigation recapitulation and irrigation was followed strictly during the entire biomechanical preparation (BMP). Apical Gauging with 0.02 taper K file Nitiflex (Dentsply Sirona) was done and Master Apical File (MAF) radiograph was taken. The access cavity preparation was sealed with Fermin.

**Fig. 3. Clinical photograph of caries removal**

**Fig. 4. IAF radiograph**

**Fig. 5. MAF radiograph**

Second visit, coronal build up with Ceram.X Universal (Dentsply Sirona) was done. Having met the criteria for obturation, obturation was started. Master cone was establish using .02 taper of gutta percha. Correct WL and tug back was achieved prior to radiograph taking. Final irrigation was done with 17% aqueous EDTA solution for one minute with manual agitation followed by 2.5% NaOCl. Obturation was done using 0.02 taper gutta percha cones, AH Plus root canal sealer (Dentsply Sirona) and 0.02 NiTi finger spreaders (Mani Japan) employing lateral compaction technique. A radiograph was taken to confirm quality of obturation. Gutta percha cones were cut 2mm below the orifices. Temporary restoration using Fermin was placed as there was no more time for treatment.

**Fig. 6. Final access cavity**

**Fig. 7. MAF radiograph**

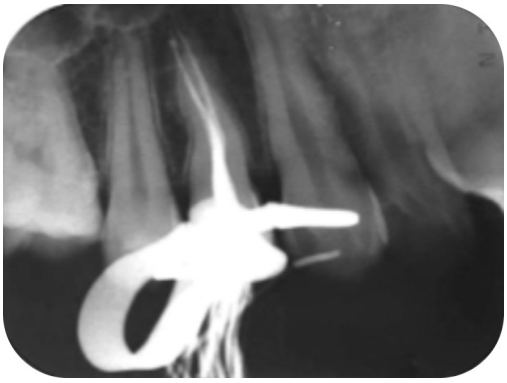

**Fig. 8. Obturation radiograph**

Third visit, Glass Ionomer cement, GIC Fuji VII (GC Dental, Japan) coronal orifice seal was placed. SDR (Dentsply Sirona) placed in bulk over GIC up to 2mm below the cavosurface margin and completed using Ceram.X Universal. A radiograph was taken to ensure good marginal adaptation.

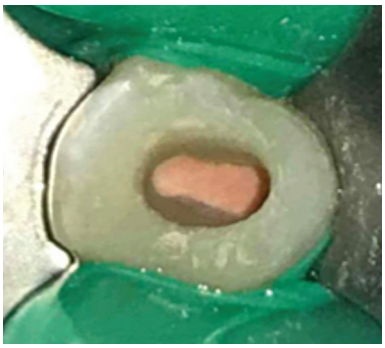

**Fig. 9. Fuji VII GIC canal orifice seal**

**Fig. 10. Direct composite onlay**

**Fig. 11. Direct composite onlay radiograph**

The patient was referred to the UE postgraduate prosthetic department for the final restoration. Final restoration was IPS e. max Lithium disilicate (Ivoclar Vivadent) indirect onlay. Fourth visit, photograph and radiograph of the final restoration were taken.

**Fig. 12. Final restoration photograph, IPS e. max Lithium disilicate indirect onlay**

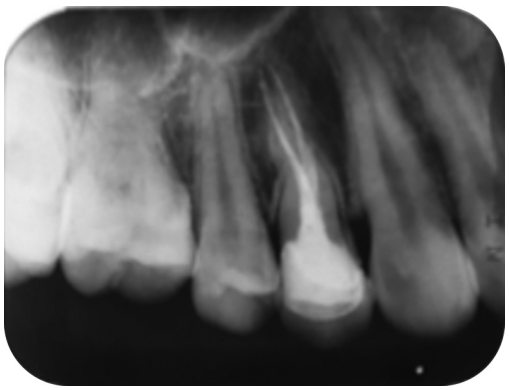

**Fig. 13. Final restoration radiograph**

## Case Discussion

Most teeth demonstrate some curvature along the root canal. In addition, most canals have several planes of curvature throughout their length (1) The incidence of bayonet shaped canals in maxillary 1st premolars is 5.5% (2). Pre-operative radiograph is useful in revealing root canal morphology and anatomy (3). In this case an intraoral periapical radiograph revealed a bayonet-shaped canals. The first curvature had an angle of 34 degrees whereas the second was 25 degress according to Schneider's classification. Severe canal curvatures present difficulties in shaping and cleaning. Without understanding the complex canal anatomy, employing proper instrument and instrumentation techniques, errors may be created further affecting the outcome of treatment. The patient in this case presented with a severe pain and with limited time of treatment. The main goal in treating a patient presenting with severe pain from a tooth with severe canal curvature, is to remove the pulp tissue to relieve the patient of pain, however proper techniques must be used to avoid errors.

Fewer anaesthetic problems develop with maxillary molars and premolars with Symptomatic Irreversible Pulpitis as in this case (4). However, supplemental anaesthesia in the form of intraligamental and intrapulpal anaesthesia is required where routine anaesthesia is not effective (5).

Successful treatment requires thorough cleaning and shaping of the root canals. However, existence of curvatures may pose difficulty in biomechanical preparation (6). Patency and coronal pre flaring is important prior to glide path preparation. A glide path is a smooth reproducible radicular tunnel extending from the root canal orifice to the radiographic canal terminus or exit as determined by an electronic apex locator (7). Currently, single-file rotary glide path preparation system like the ProGlider (Dentsply Sirona) has been invented (8). In this case report, glide path preparation was done using ProGlider (Dentsply Sirona). Glide path preparation permits for an understanding and appreciation of the original root canal anatomy, renders the canal patent to receive rotary endodontic files, and permits a more efficient and safer action during BMP (9, 10).

WaveOne Gold (WOG) (small) file 20/.07 (Dentsply Sirona) was used during BMP. This was to maintain canal anatomy, prevent strip perforation, apical transportation or instrument separation. (11) The use of rotary NiTi shaping files in a reciprocating movement has increased resistance to instrument separation (12). One such system, Wave One (WO) (Dentsply Sirona), showed increased resistance to instrument separation (13,14). The movement of the file has not been changed, but the cross section of the file has been modified to the parallelogram structure with two cutting edges making the file more flexible. Furthermore, the off-centre design seen in ProTaper Next files (Dentsply Sirona) is also used in the WOG files. The key modification is the alteration of alloy from M-Wire to GOLD alloy (15). The GOLD alloy technology involves heating the file and then slowly cooling it, rather than the M-Wire technology involving heat treatment before the manufacture. The manufacturer claims improved flexibility through this new heat treatment method (16).

In bayonet shaped canals, the apical curve is the most difficult to negotiate. The chances of strip perforation are high in these canals. Guttman recommended that pre flaring the coronal 1/3rd of the canal (at the expense of the tooth structure) to lessen the angle of curvature (17). Once this procedure is accomplished, it is easy to negotiate the remaining the root canal. It also allows irrigant to reach more deeply into the canal more quickly, and insertion of hand files into the middle and apical 3rd without restriction. (18) Removal of restrictive dentin offers better tactile sense, greater flexibility and effective use of a file (18). In this case pre-curved size 6 M-Access (Dentsply Sirona) files did not reach working length. Coronal pre flaring was done using ProTaper FHU orifice shaper (Dentsply Sirona). Thereafter, pre-curved M-Access files size 6 was introduced into the canals with a watch winding motion and was able to reach the working length determined by Root ZX mini apex locator (J Morita Japan). Canal preparation was done until file size 10 was super loose.

A frequent error that may occur during endodontic procedure in a bayonet shaped root canal is the failure to preserve root canal curvature, resulting in ledge, zipping, apical transportation, instrument separation and the most common is strip perforation (19). To evade these mishaps, the basic principles of endodontic treatment was observed, that is, analyse preoperative radiograph, straight line access to apical foramen, pre-curving of the files, recapitulation, copious irrigation, and the use of flexible NiTi instruments. The WOG reciprocating file (Dentsply Sirona) was used for the biomechanical preparation because of its flexibility. Temporary restoration using Fermin at least 4mm thickness (31) was placed since there was no time to continue with treatment. This offers a good seal over a period of three weeks.

During the second visit, the patient was free of pain and the temporary restoration was intact. Coronal build up with Ceram.X Universal (Dentsply Sirona) was done. Proper coronal build up enhances outcome of endodontic treatment by preventing marginal leakage during treatment (33). 17% EDTA solution was irrigated in the canals and agitated for one minute to chelate with Ca2+ and other divalent cations, demineralize the dentin, and remove the inorganic components of the smear layer (20, 21). A final rinse with 2.5% NaOCl was done (22). This results in thorough disinfection of root canal system and better adaptation of materials to canal walls. (23, 24)

Lateral Compaction obturation technique was used, (1, 25) and it offers a predictable length control during compaction (25). NiTi 0.02 taper finger spreaders were used because of their flexibility, reduced stress and greater penetration. (26) AH Plus root canal sealer (Dentsply Sirona) used. Its sealing ability is comparable to some calcium silicate based sealers on long-term basis (32). Temporary restoration using Fermin at least 4mm thickness (31) was placed since there was no time to continue with treatment.

Third visit, Glass Ionomer cement, GIC Fuji VII (GC Dental, Japan) was introduced into the canal orifices as a seal to prevent coronal microleakage. GIC offers a higher sealing ability compared to composite at 1mm & 2mm (27). The pink shade was used as it is easily identifiable in case of reentry. SDR, Smart Dentine Replacement (Dentsply Sirona) was placed in bulk on top of GIC up to 2mm below the cavosurface. SDR has lower polymerization shrinkage and allows bulk placement thus saving time (28). Full cuspal coverage composite restoration using Ceram.X. Universal (Dentsply Sirona) was done as interim restoration.

To protect the tooth, Indirect onlay IPS e. max Lithium disilicate (Ivoclar Vivadent) was done. Lithium disilicate coronal restorations have shown a 97.4 % Survival rate after 5 years and 94.8 % after 8 years of clinical service (29). The long term success of endodontic treatment greatly relies on the quality of final coronal restoration (30).

This case report presents the emergency management of a maxillary 1st premolar with bayonet shaped canals, in a patient who presented with severe pain and limited time for treatment.

## Conclusion

Proper history, diagnosis and correct treatment is the key to a successful endodontic treatment. Teeth with Symptomatic Irreversible Pulpitis may be difficult to achieve anaesthesia necessitating supplemental anaesthesia. Achieving adequate anesthesia is paramount in managing emergency cases. Preflaring the coronal 3rd to reduce the curvature angle is helpful in managing bayonet shaped canals.

During endodontic treatment, apex locators are valuable tools in working length determination.

Glide path preparation enables optimal use of rotary instruments for shaping and reduces chances of file separation.

Finally, use of NiTi finger spreaders during lateral compaction for curved canals enables deeper penetration thus giving optimal obturation.

Note: This case report won 1st place at the 2018 Dentsply Sirona Asia University Endodontic Case Contest country level, in the Philippines. It was also presented in the 2018 regional Asia final Endodontic case contest held in conjunction with the 2018 IFEA in Seoul, Korea.

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# Management of Curved Canals on a Mandibular Third Molar Using WaveOne Gold

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## Introduction

Third molar teeth often present challenges during dental procedures, this may be due to its most posterior location, unusual anatomy or sometimes abnormal eruption pattern (1). Which is why most clinicians tends to extract third molars without considering their strategic value in the oral cavity. Especially in the practice of endodontics, third molars present one of the toughest challenges; severe root canal curvature. Understanding the root canal anatomical variations and proper treatment planning can aid to the success of endodontic treatment.

## Case Report

The patient is a 26-year-old male, with a Bachelor of Science degree in Information Technology. He was referred to the UECD Dental Infirmary regarding pain on tooth 38. The patient's chief complaint was *"sumasakit yung bagang ko kapag umiinom ng malamig"*.

**Fig. 1. Pre-operative clinical appearance of 38 with a large carious lesion on the mesial surface of the tooth and a hyperplastic pulp**

### History of Present Illness

Three years prior to consultation (PTC) the patient had a class two mesioocclusal composite restoration on tooth 38. Four months PTC the composite restoration on 38 was dislodged while eating. Patient felt mild discomfort when drinking cold beverages. The patient did not do anything about the discomfort. One month PTC – the patient felt sharp pain when drinking cold beverages on 38. The pain lingered for about 10-15 seconds and scored 7 out of 10 on a pain scale. The patient was advised to seek dental consultation by his sister, a dental student and was referred to UECD Dental Infirmary. On the day of consultation, June 21, 2017. Oral prophylaxis and mouth examination was performed. The patient was then referred to the Oral Medicine section of UECD to address the chief complaint. The patient's Medical History was non-contributory.

### Diagnostic Tests

Clinical examination revealed a large carious lesion on the mesial surface of the tooth with a hyperplastic pulp on tooth 38. The result of Cold test lingered on the offending tooth, percussion was positive, palpation was negative, and probing

**Fig. 2. Pre-operative straight-on radiograph of tooth 38 showing curvature of mesial and distal root canals**

depth were normal. Radiographic examination revealed a deep carious lesion exposing the mesial pulp chamber. The mesial canal was curved, and there is widening of periodontal space on the mesial root, and apical curvature on the distal root was seen.

**Diagnosis**

Asymptomatic Irreversible Pulpitis with Symptomatic Apical Periodontitis

**Treatment Proper**

Inferior alveolar nerve block was administered using 2% lidocaine prior to treatment. Then caries was removed, access preparation was done, and the pulp polyp was removed using sharp spoon-shaped excavator. Coronal build-up was done using Smart Dentin Replacement (SDR) composite.

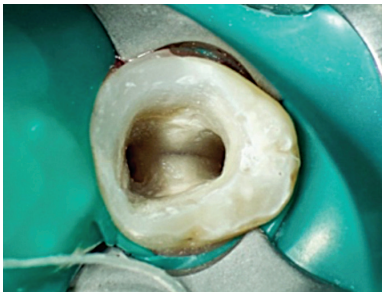

**Fig. 3. Clinical appearance of tooth 38 after Coronal Build-up, Rubber Dam Isolation and Access Preparation**

Canal patency was done using pre-curved sizes 8 and 10 stainless steel files and Tri-Auto ZX electronic apex locator (J. Morita) was used to determine the working length. Canal Preparation was done using a pre-curved size 10 stainless steel K-files, ProGlider, and WaveOne Gold. As per manufacturer's instructions, the canals were enlarged to size 10 prior to use of rotary instruments. ProGlider was used to establish the glide path in the presence of NaOCl. Once the glide path was established, canal shaping was done using WaveOne Gold with Primary File. Apical gauging was done using Dentsply M Access files.

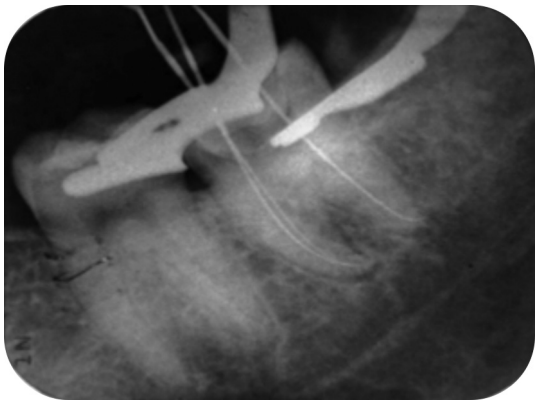

**Fig. 4. Initial Apical Files of Mesiobuccal, Mesiolingual, and Distal Canals**

Two percent tapered gutta percha was used for Master Cone selection. The technique for obturation used was cold lateral condensation, and the sealer used was slow-set ZOE. After obturation, gutta percha were cut 1mm apical to the canal orifices and protected with GC Fuji VII. Onlay restoration was done using SDR composite resin in 4mm increments and Ceram X Universal composite shade A2 was used to create occlusal detail. Radiographs were taken from pre-operative, angulated pre-operative, initial apical file, master apical file, master cone, obturation and postoperative radiograph showing the final restoration.

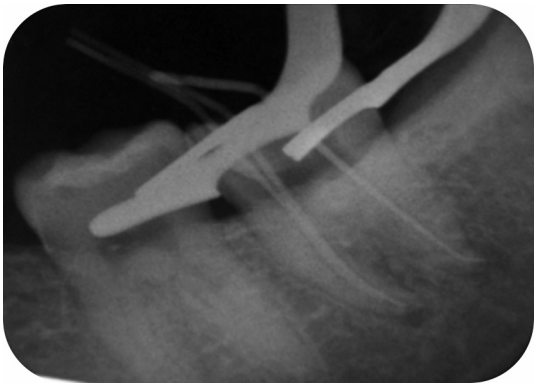

**Fig. 5. Master Cone using .02 taper of GP#30 – MB, ML and #35 Distal canal**

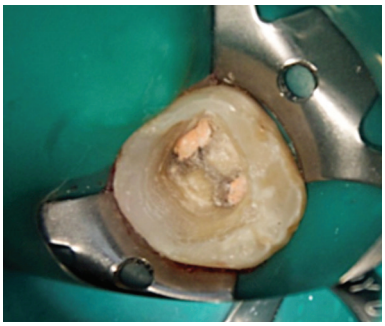

**Fig. 6. Clinical Appearance of cut Gutta Percha**

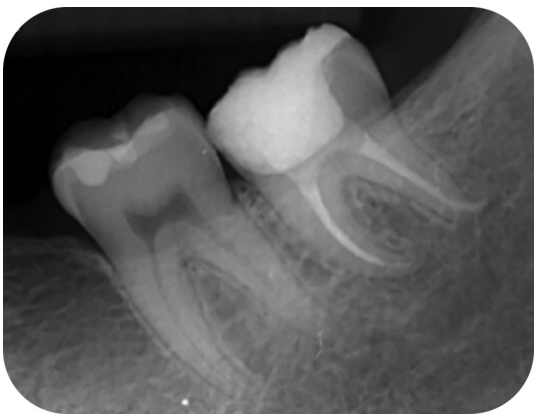

**Fig. 7. Radiographic appearance of tooth 38 after final restoration**

## Case Discussion

The patient was suffering from Asymptomatic Irreversible Pulpitis and Symptomatic Apical Periodontitis according to the AAE classification of pulpal and periapical diseases. The pulpal and periapical diagnosis were based on the patient's chief complaint, history of present illness and the different

diagnostic tests done. Tooth 38 has a large carious lesion on the mesio-occlusal surface and a hyperplastic pulp was seen on the clinical examination. Radiographic examination revealed a slight widening of the periodontal space on the mesial root. Tooth 38 exhibited lingering pain upon thermal stimulation, slight pain on percussion, no pain on palpation, and presented normal probing depth.

Minimum intervention and retaining every functional component of the dental arch, including third molars, are the principle goals of contemporary dental practice (1). In this case, the retention of tooth 38 would be essential for the maintenance of the function and occlusion. Especially in this case, tooth 38 has an opposing tooth in occlusion and the first mandibular molar on the same quadrant is lost. Removal of another molar in the same quadrant can affect function. An orthodontic translation of the second and third molars to close the edentulous area may provide a viable and more conservative treatment option than the fixed prosthodontic approach.

Prior to treatment, since the tooth was vital, inferior alveolar nerve block using 2% Lidocaine (Xylestesin 3M ESPE) was administered. Removal of carious lesion was done to prevent contamination of the canal, then access preparation was done and the pulp polyp was removed using a sharp spoon-shaped excavator. Coronal build-up was done to prevent fracture of the tooth in between visits. Tooth 38 was also removed out of contact to avoid further trauma to the tooth.

Prior to canal preparation, canal patency was first established using a size 6 stainless steel file up to the tentative working length. Working length was determined with the use of an electronic apex locator (Root ZX II J. Morita), and was verified with a radiograph.

Before commencing endodontic treatment in third molar teeth, a meticulous understanding of their root and root canal anatomical variations and their endodontic implications is of prime importance. The morphological variations of mandibular third molars may have one to four roots. In bi-rooted mandibular third molars, >90% of the root canal configurations in the mesial root are presented in four types I (1), II (2-1), IV (2-2) and V (1-2), where type I and II are the most common (1). In this case, tooth 38 is bi-rooted and the mesial root has a root canal configuration of type II (Vertucci, F., 2015).

One of the most important aspects of endodontic treatment is the cleaning and shaping of the root canals. However, the preparation of curved canals presents one of the greatest challenges in endodontics and is fraught with difficulties. Failure of root canal treatment in curved canals is mainly due to procedural errors like ledges, fractured instruments, canal blockage, zip and elbow creation (3).

The root canal angulation was determined using the Schneider's method of root canal angulation. The Schneider's method determines canal curvature based on the angle obtained by two straight lines. The first line is parallel to the long axis of the root canal, and second line passes through the apical foramen until intersecting with the first line at the point where the curvature starts. The angle formed was named according to the degree of root canal curvature: straight: 5degrees, moderate: 10-20, severe: 25-70. In this case, the mesial root canals were classified as severe with an angle of 43°, and also severe for the distal canal with an angle of 50° (4).

For the management of the canal curvatures in this case, Glide path was achieved by enlarging the canals with the use of precurved size #10 stainless steel K-files, and using ProGlider. ProGlider was used because according to (5, 6 Guiseppe Cantatore in 2014). The ProGlider has also been shown to be highly effective in preserving canal anatomy and creating no apical abnormalities and it provides elevated resistance to cyclic fatigue. Glide path creation was essential for the prevention of rotary file separation and most effective rotary use. Establishing a glide path can provide the rotary instrument a passive free fall up to the working length (7).

Once the glide path is established by ProGlider, WaveOne Gold was used because, according to a study (8) it exhibits better cyclic fatigue resistance and flexibility than other reciprocating rotary instruments. Its improved flexibility can maintain the natural shape of the root canal. In this case, ProGlider and WaveOne Gold were able to manage the curvature of the mesial root canals and apical curvature of the distal root canal while maintaining their natural shape.

Cold lateral condensation was the technique used in obturation of the canals using slow-set ZOE as a sealer. Warm gutta-percha (9) obturation demonstrated a greater incidence of overextension than cold lateral condensation, although the two obturation techniques were not significantly different in terms of post-operative pain, long term outcomes and obturation quality. It is important that the intracanal barrier (10) should provide adequate coronal seal and prevent the entry of bacterial toxins into the root canal that compromises the success of the RCT. In this case, GC Fuji VII was placed over the cut gutta-percha, to act as a barrier to coronal leakage. GIC was used as an intracanal barrier because it has chemical bonding ability to the dental structures, which provides better sealing ability than composite resins (11).

According to Dr. John Rhodes, a good root filling and good restoration provide coronal seal and achieves the best outcome. In this case, the final restoration involves direct composite onlay restoration. Direct onlay was the technique used (12) if an endodontically treated tooth does not undergo great coronal structure loss, despite access preparation, restorative treatment includes execution of direct composite resin restorations to close the endodontic access, with a very good prognosis. As part of the coronal sealing, SDR was placed in 4mm increments. SDR is a useful material for rapidly sealing the bulk of the access cavity in endodontics. Also, it was used because of its self-leveling property which provides an intimate adaptation of the resin to the prepared cavity walls. Following which, a single shade composite such as Ceram X One UNIVERSAL was used to create and refine occlusal detail. This simplified two-increment technique can produce a highly aesthetic composite restoration without encroaching heavily on surgery time (13). The occlusion was checked with an articulating paper and unnecessary contacts were removed. A radiograph was taken to evaluate the final restoration.

## Conclusion

Mandibular third molars are not always to be extracted; their strategic value should be considered. In this case, the mandibular third molar was retained for the maintenance of function.

Despite the curvature of the mesial canals and apical curvature of the distal canal, they were properly managed using ProGlider and WaveOne Gold with less difficulty. The selection of a good file system, establishment of a good glide path and maintaining a correct working length can ease the management of canal curvature even on a third molar.

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# Management of a Combined Endodontic-Periodontal Lesion: A Case Report

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## Introduction

Dental pulp and periodontal tissues originate from the ectomesenchymal cells (Mandel, Machtou, & Torabinejad, 1993). The dental papilla gives rise to the dental pulp whereas the dental follicle forms the periodontal ligament which are separated by Hertwig's epithelial root sheath. The development of the root and the periodontal supporting tissues follows that of the crown. Epithelial cells of the external and internal dental epithelium (the dental organ) proliferate in an apical direction, forming a double layer of cells called Hertwig's epithelial root sheath (RS) (Lang & Jan, 2015).

More than half of teeth mortality is associated with pulpal and periodontal complications (Bender, 1997), because of the relationship between periodontal and pulpal diseases as first described by Simring and Goldberg in 1964 (Simring & Goldberg, 1964). Majority of pulpal and periodontal diseases are caused by bacterial infection. It has reported that the cross-infection between the periodontal ligament and root canal can occur through the anatomical pathways (lateral and accessory canals , apical foramen, palato-gingival grooves and dentinal tubules) and non-physiological pathways such as vertical root fractures and iatrogenic root canal perforations (Zehnder, Gold, & Hasselgren, 2002).

It has been well established that the prevalence of accessory root canals in various teeth and contributes to the complexity of the root canal system. Accessory canals are found along the length of the root canals, with varying frequencies depending on their location. Evidently, accessory canals can cause asymptomatic apical periodontitis as a result of chronic pulpal diseases. Periapical radiographs detect these lesions that usually heal after successful completion of endodontic therapy (Newman G Michael, Takei, KLOKKEVOLD, & CARRANZA, 2015).

It has been reported that, periodontal disease causes the destruction of bone in a coronal-to-apical direction while pulpal disease direction is from apex to coronal. When the pulp gets infected, it stimulates an inflammatory response of periodontal ligament. However, there is still a controversy on the effect of periodontal inflammation on the pulpal tissue (Seltzer, Bender, & Ziontz, 1963).

The most commonly used classification system for the diagnosis of endo-perio lesions (EPL) was published in 1972 (Simon, Glick, & Frank, 1972), which included the following categories: primary endodontic lesions, primary endodontic lesions with secondary periodontal involvement, primary periodontal lesion, primary periodontal lesions with secondary endodontic involvement and "true" combined lesions.

Therefore, it is imperative that differential diagnosis of endodontic and periodontal diseases be established with a correct diagnosis so as an appropriate treatment protocol can be provided.

In the course of the orthodontic treatment phase, the patient is seen by the periodontist every three months for evaluation. This is critical to maintain periodontal health, monitor progress, and to identify any periodontal changes resulting from orthodontic tooth movement. The orthodontist also plays an important role in reinforcing oral hygiene at each orthodontic visit (Newman G Michael et al., 2015).

This case report presents the diagnosis and management of periodontal abscess associated with true combined endo-perio lesion.

### Case Report

A 25-year-old male patient, presented to the Postgraduate Endo-Perio Department, University of East with localized progressive painless gum swelling for two weeks on the left mandibular canine.

Two years prior to consultation, the patient noticed a black discoloration on the offending tooth which progressively became larger eliciting sensitivity and mild pain associated

with food impaction.

One year prior to consultation, he felt moderate pain which he could rate as 7 on a verbal analogue pain scale. The pain was aggravated with chewing and food impaction on the affected tooth. The pain was localized, spontaneous and was relieved by ice pack compressions in the affected area and stopped after 3 days. His medical history was non-contributory.

On clinical periodontal examination, there was a slight, gingival swelling on the buccal surface on Tooth No. 33.

**Fig. 1. Localized gingival swelling and redness on the buccal surface of Tooth No. 33**

Tenderness on percussion was mild and a 9 mm pocket could be probed on the mid-buccal aspect of the root, with grade II mobility. The tooth was non-responsive to pulp vitality testing.

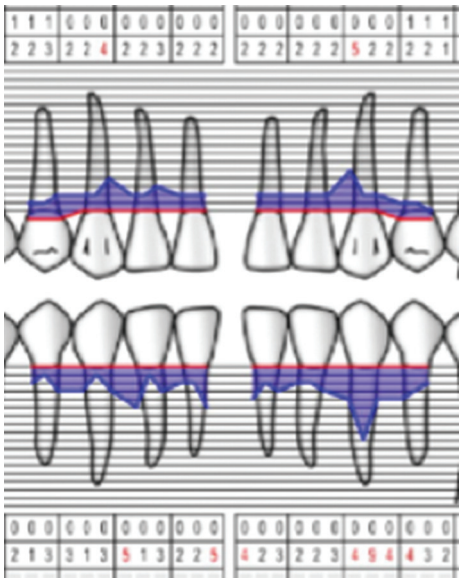

**Fig. 2. Perio-tools.com periodontal chart online - showing 9mm PPD on the mid-buccal aspect of Tooth No. 33**

Pre-operative radiographic examination revealed a coronal radiolucency consistent to a grossly carious lesion. Loss of lamina dura on the mesial aspect along the root length and a large periapical radiolucency measuring 5mm in its greatest diameter was also noted.

**Fig. 3. Pre-operative periapical radiograph showing a large periapical radiolucency**

**Fig. 4. Gutta percha tracing: A gutta percha was placed through the gingival sulcus and a radiograph was taken to identify the sinus tract**

Based on the patient's history, clinical and radiographic examination findings, a diagnosis of Pulp Necrosis and Chronic Periapical Abscess resulting as a combined endodontic – periodontal lesion was drawn. A treatment plan for Tooth No. 33 was as follows:

1. Emergency debridement and curettage of the gingival sulcus
2. Non-surgical endodontic therapy
3. Non-surgical periodontal therapy
4. Direct composite restoration
5. Fixed orthodontic treatment

**Treatment Procedure**

After obtaining signed informed consent from the patient, local anesthesia was administered through the left mental block and lingual infiltration around Tooth No. 33, using 2 cartridges of 1.8ml 0f 2% lignocaine with 1: 100,000 epinephrine.

Emergency of debridement and curettage of the gingival sulcus of Tooth No. 33 using Universal curette Columbia 2R/2L with copious irrigation using normal saline solution.

**Fig. 5. A Clinical photograph showing debridement and curettage using Universal curette Columbia 2R/2L**

To manage post-operative pain, Mefenamic acid 500mg was prescribed to be taken after every 8 hours for the first three days and thereafter as needed. Post-operative instructions were given and the patient referred for non-surgical endodontic therapy.

**Endodontic Treatment**

Non-surgical endodontic treatment was done under rubber dam isolation. Coronal access preparation was achieved using endo-access bur (Dentsply Sirona, USA). The enamel and dentin of the prepared cavity was cleaned and etched with 37% phosphoric acid for 30 and 15 seconds, respectively; rinsed for 30 seconds with a water/air spray; and gently air dried to avoid desiccation. A light-polymerizing primer bond adhesive was applied; gently air thinned and exposed to a light-emitting diode polymerization for 30 seconds. The tooth was build-up with using a resin composite (BEAUTIFILL IITM, Shofu Dental Corporation, Japan) as per the manufacturer's instructions.

In this case, a manual glide path was sequentially established using ISO file numbers 06, 08, 10 up to size 25 M-Access files (Dentsply Sirona) which was confirmed on a periapical radiograph.

**Fig. 6. Radiograph showing the Initial Apical File (IAF)**

ProGlider™ (Tip diameter of size .016mm, variable taper between 2% and 8% along the shaft) (Dentsply Sirona, USA) was mounted on the handpiece of the X-Smart Plus™ Endodontic motor (Dentsply Sirona, USA) and glide path preparation was accomplished following the manufacturer's instructions.

Biomechanical preparation was done using the Wave One Gold™ rotary files (Dentsply Sirona, USA) mounted on the X-Smart Plus™ endodontic motor (Dentsply Sirona, USA) as per the manufacturer's instructions. Chemical disinfection was achieved using positive syringe irrigation with 2.5% of sodium hypochlorite as irrigant. A concentration of 15% ethylenediaminetetraacetic acid (EDTA) (Glyde™ Dentsply Sirona, USA) was used as a lubricant.

Gauging was done with a size 80, 0.02% taper K-Flexo™ files (Dentsply Sirona, USA) to determine the master apical file and a periapical radiograph was taken to confirm its fit.

**Fig. 7. Master apical file (MAF) PA Radiograph**

The tooth was dressed with Vitapex® Calcium Hydroxide Paste with Iodoform (Neo Dental International Inc.) and a temporary restoration (IRM- DENTSPLY Sirona, USA) was used as a temporary restoration. A lateral canal was filled with the calcium hydroxide dressing in the apical third.

**Fig. 8. PA Radiograph showing calcium hydroxide intracanal dressing**

On the second appointment, Calcium hydroxide was removed from the canal and a corresponding gutta-percha point was fitted to length. In order to remove the smear layer, the canal was flushed with 17% EDTA solution and manual dynamic agitation of the chelating agent was performed for 1 minute. Final flush was performed with 2.5% sodium hypochlorite. The standards for obturation were verified and a master cone was placed in the canal until there was resistance to displacement ('tug back'). The master cone fit was confirmed radiographically.

**Fig. 9. Master Apical Cone (MAC) PA Radiograph**

Obturation was accomplished using 2% taper gutta percha cones with AH Plus (Dentsply Sirona) root canal sealer cement employing the cold lateral compaction technique.

The excess gutta-percha in the chamber was then seared off and vertically compacted with a heated plugger 1 mm beneath the canal orifices to enhance the coronal seal. Glass Ionomer cement, (GIC Fuji VII™, GC Dental, Japan) was placed on top of the gutta-percha to prevent coronal microleakage.

Dentine replacement was attained using SDR resin (Dentsply Sirona) with Ceram X Universal shade A2 as a capping composite following the manufacturer's instructions. A final radiograph revealed satisfactory restoration and a post-treatment picture was taken.

**Fig. 10. An immediate post-restorative radiograph showing the obturated canals of Tooth No. 33**

**Fig. 11. Immediate post-restorative picture of Tooth No. 33, showing the final composite restoration**

**Periodontal Treatment**

Periodontal treatment was initiated via professional supragingival biofilm control (Carnio, Moreira, Jenny, Camargo, & Pirih, 2015) (oral prophylaxis) and oral hygiene instructions, in two appointments within 7 days.

After local anesthesia infiltration, supragingival and subgingival scaling was performed with an ultrasonic device (DTE- D3 LED), in both arches. Subsequently, scaling and root planing (SRP) with hand instruments was done using Universal curette Columbia 4R/4L and 2R/2L at the sites with more than 4mm probing depth. No occlusal adjustment was performed. Re-evaluation of the initial phase was done after 6 weeks.

**Fig. 12. A photograph taken during the re-evaluation phase: Measurement of the probing depth using UNC 15 Periodontal probe clinically and on the periodontal chart**

**Fig. 13. A clinical photograph showing orthodontic strap-up done using Roth O22 Slot brackets and SS molar bands with 0.16 SS on the Upper and 0.16 NiTi on the lower arch**

Maintenance supportive periodontal therapy was performed every 2-3 months using oral hygiene index evaluation with full-mouth periodontal probing depth were recorded after the initiation of therapy (Figures 14-17).

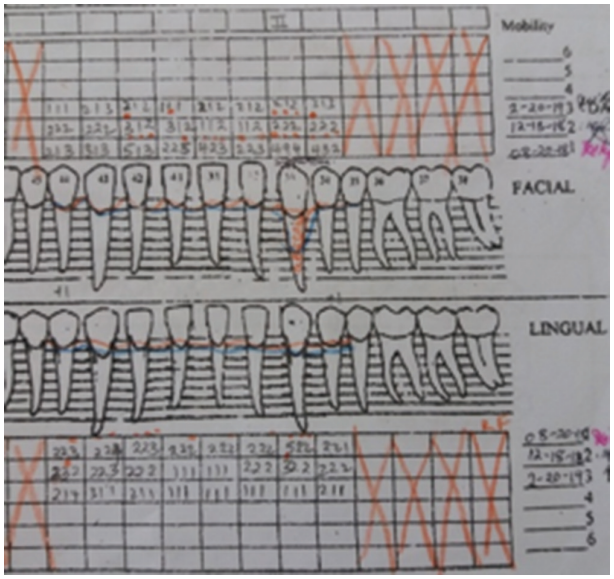


**Fig. 14. Marked pocket reduction after a 3-month recall. Measurements demonstrated distinct clinical improvements sites had markedly decreased to a maximum of 4 mm.**

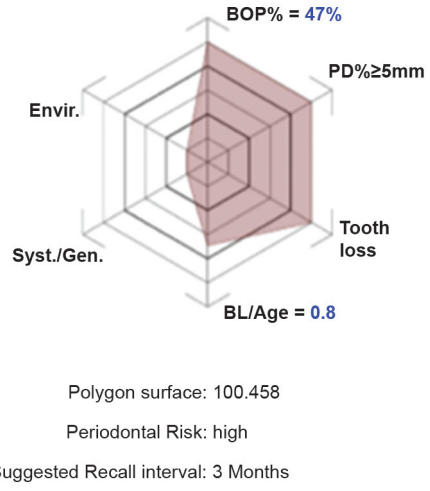


**Fig. 15. Perio-tools.com periodontal risk assessment web, used to determine the recall interval**

**Fig. 16. Clinical examination after a 3-month recall**

**Fig. 17. PA radiograph taken after a 3-month recall**

## Discussion

It has been reported that, endo-perio lesions present challenges to clinicians concerning diagnosis and prognosis of the affected teeth. Therefore, correct diagnosis plays an important role in determining the treatment and long-term prognosis. For this reason, diagnosis of primary periodontal disease and primary endodontic disease usually grants no clinical difficulty. The initial step for appropriate diagnosis is the vitality tests. Even though, the vitality test does not provide the clinician with the histological status of the dental pulp, its ability to record pulp vitality is accurate (Aksel & Serper, 2014).

In this case report, 3 months after therapy, distinct clinical improvements were indicated. PD reduction was observed 9mm pocket depth reduced to 3mm. Suppuration had been eliminated, and no gingival inflammation signs were observed. The periapical radiographs obtained 3 months after therapy showed fill of the bony defects and stability of the treatment outcome.

Periodontal assessment is dependent on the severity of periodontal involvement and response to endodontic therapy. However, the results of case reports should be confirmed by future random clinical trial studies, emphasizing on the correct diagnosis and treatment are essential requirements for long-term successful prognosis (Alfawaz, 2017).

In this case report, successful non-surgical endodontic therapy resulted in significant healing of both the endodontic and periodontal apparatuses. Evidently after the endodontic treatment, the periodontal lesion was reduced to a large extent in the radiographic evaluation after 3 months with progressive changes seen in the alveolar crest height.

For endodontic retreatment, calcium hydroxide was used as an intracanal medicament. The use of calcium hydroxide paste was designated because of its antibacterial, anti-inflammatory, and proteolytic properties (Nair, 2004). Additionally, calcium hydroxide inhibits root resorption and enhances endodontic-periodontal repair. Endodontic lesions exhibiting extensive periapical pathology and pseudo pockets have been effectively managed with calcium hydroxide, because of its provisional obturating action which inhibits periodontal contamination of the instrumented canals via patent channels of communication.

It has been shown that this regimen usually resolves the pseudo pocket within a few weeks (Schwartz, Koch, Deas, & Powell, 2006).

## Conclusion

In this case report, it is important to note that a decision-making process was used to guide the clinician in management of endodontic-periodontal lesion. Long-term clinical outcomes are more probable when optimal diagnostic processes, treatment sequences, and intervals are applied. Therefore, the immediate and correct management of endodontic-periodontal lesions can impede the loss of the involved teeth.

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**Final Support**

Nil.


**Conflict of Interest**

The authors had full autonomy of investigation and there were no conceivable conflicts of interest.


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# Treatment Considerations in Managing Hyperplastic Pulpitis

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## Abstract

**Introduction:** Primary or immature permanent teeth exposed to irritant can cause proliferative response called hyperplastic pulpitis or pulp polyp. It is classified as an asymptomatic irreversible pulpitis. It is rarely seen in the teeth of older adults, partly because they are less likely than children to have rampant caries and they lack the open apices that requires to bring an adequate blood supply to the pulp tissue of the chamber. **Case Report:** This case report describes the treatment of a tooth presenting a 5mm hyperplastic pulpitis in a 17-year-old female. The tooth was effectively managed using a spoon shape excavator and prepared using the ProTaper system. **Discussion:** Root canal treatment of a tooth presenting Hyperplastic pulpitis can cause a few alterations in the treatment, such as curetting the granulation tissue via periodontal curette or spoon shape excavator from the pulp chamber and controlling the bleeding coming from the highly vascularized tissue. **Conclusion:** This case report demonstrated a permanent maxillary right first molar diagnosed with a Hyperplastic pulpitis that is properly managed by removing the polyp and controlling the bleeding before a routine root canal treatment was made.

## Introduction

Primary or immature permanent teeth exposed to irritant can cause proliferative response called hyperplastic pulpitis or pulp polyp (1). It is the most visually noticeable pulpal response, rising out of the carious lesion of the crown and forms a red mass of tissue that is firm and not sensitive to touch (2). It is classified as an asymptomatic irreversible pulpitis, and it usually occur in young teeth that are exposed to caries and trauma (3, 8). Hyperplastic pulpitis resulted from a chronic inflammation of a young pulp, due its rich blood supply and adequate lymphatic and oral drainage allows this process to happen. The opening establishes a pathway for drainage of the inflammatory exudates. When drainage is established, acute inflammation subsides, and chronic inflammatory tissue proliferates through the opening created by the exposure to form a polyp. (5)

It is rarely seen in the teeth of older adults, partly because they are less likely than children to have rampant caries and they lack the open apices that requires to bring an adequate blood supply to the pulp tissue of the chamber. This means that it is largely a disease of the first decade of life, although later lesions do occur. It is rarely seen after 20 years of age (6).

Histologically hyperplastic pulpitis will show a proliferation of small vessels, fibroblasts and a chronic inflammatory cell infiltrate later on the surface epithelium and underlying inflamed connective tissue will form. Cells of the oral epithelium grow over the exposed surface to form an epithelial covering.

The clinical feature of hyperplastic pulpitis is a reddish mass, cauliflower or mushroom like tissue above a severely decayed tooth. Thermal and electrical sensitivity test may show normal responses (7). Although, occasionally the tooth will have spontaneous pain and lingering pain to cold and hot stimuli. Percussion and palpation will result and within normal limits (3). Radiographically it will present as a large open cavity with direct access to the pulp chamber (8). Although there are some reports that periapical involvement may present radiolucency and radiopacity in the area (7).

Hyperplastic pulpitis should be differentiated from other oral disease like proliferating gingivitis.

The treatment of choice for this kind of pulpal disease is vital pulp therapy or pulpotomy, root canal treatment and extraction (1, 2, 3,4, 5). In this case report describe a root canal treatment of a tooth presented with a chronic hyperplastic pulpitis.

## Case Report

A 17-year-old female was referred to the Department of Endodontic, in the University of the East Graduate School. Upon clinical examination an extensive caries was seen in the maxillary right 1st molar and a cauliflower like lesion was seen on the coronal surface of the tooth. (Fig. 1)

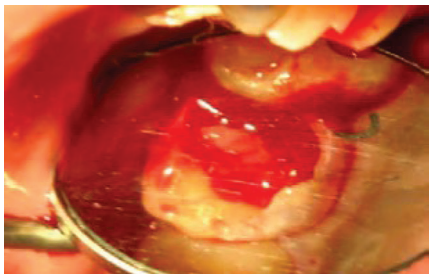

**Fig. 1. Clinical representation. Note the bleeding from excavating the carious lesion surrounding the pulp poly.**

The tooth was asymptomatic except for the patients complain that during mastication she feels a mild pain on the area. Although the patient already noticed the lesion for quite a while, no dental treatment has been done. Cold test revealed prolonged reaction while the result to percussion, palpation and mobility were all negative. The periapical radiograph (Fig. 4a) revealed a large cavity in the disto-occlusal area of the tooth reaching the pulp chamber. The tooth was diagnosed as a chronic hyperplastic pulpitis.

Patients medical status is non- contributory. Two treatment options was given to the patient, root canal treatment and extraction. The tooth was anesthetized with 2% lidocaine HCL (Xylestesin, 3M ESPE, Germany) and the removal of carious portion of the tooth was made, then a rubber dam assembly was placed.

The hyperplastic pulpitis was removed using a spoon shape excavator (Hu-Friedy, USA) and a 5mm tissue (Fig. 2) was cut from the chamber and finishing of the access cavity wall was made by a non-end cutting bur (Fig. 3). Four canal orifices were located (MB1, MB2, DB and P). The initial removal of pulp tissue was made with a #15 barbed broach (Mani Incorporated, Japan) and copious irrigation of 2.25% NaOCl solution was made until the bleeding lessened. Crown down preparation was made using SF file of ProTaper (Dentsply, Maillefer, Switzerland), during this procedure the orifices of MB1 and MB2 merged into one canal at the cervical third, since the orifices of MB1 and MB2 were near to each other. The working length (Fig. 4b) was determined by using an Apex locator (Propex, Dentsply, Maillefer, Switzerland). ProTaper Universal (Dentsply, Maillefer, Switzerland) was used during biomechanical preparation instruments up to F3.

Obturation was done with cold latera l compaction technique, using a .02 gutta percha cones (Diadent Group International, Korea) combined with Gardent root canal sealer (Gada Dental, England, UK). After radiographic confirmation of the obturation (Fig. 4c). The gutta percha was protected with a layer of GIC (GC Fuji VII, GC Corporation, Tokyo, Japan) and a direct composite onlay was placed as a final restoration (Fig. 5).

A six-month recall was scheduled, but the patient was not able to comply, instead the patient relayed the message to state that there was no discomfort and pain felt during the observation period.

**Fig. 2. Pulp poly removed from the tooth structure. Note the size.**

**Fig. 3. Access preparation. Note the four orifices.**

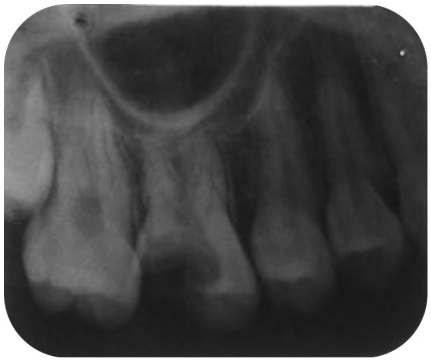

**Fig. 4a. Pre-operative radiograph**

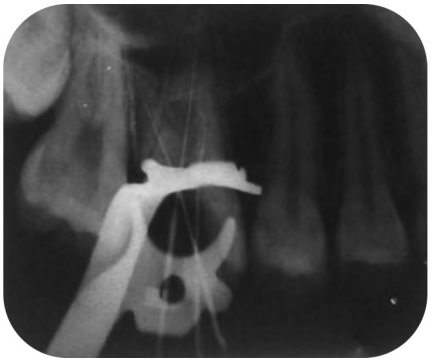

**Fig. 4b. Initial apical file**

**Fig. 4c. Obturation**

**Fig. 5. Final restoration3**

## Discussion

Hyperplastic pulpitis is rarely seen on a mature tooth (6). A case presented by Gorduysus in 2008 wherein a hyperplastic pulpitis on tooth 37 was seen on a 31-year-old patient suggesting that hyperplastic pulpitis can occur in a matured tooth. In this case, Hyperplastic pulpitis was seen on a mature maxillary right first molar of a 17-year-old patient. It had been present in the tooth for quite a while, but the patient did not bother to have it treated because the lesion was not bothering her. Treatment of Hyperplastic pulpitis may include extraction, pulpotomy and root canal treatment (1, 2, 3, 4, 5). Pulpotomy was not taken into consideration since one of the indication for pulpotomy is that it should be primary tooth or a young permanent tooth with open apices (2). Choosing between root canal treatment and extraction, the most important factor in deciding between the two is the restorability of the tooth. Two treatment plans were discussed and root canal treatment was preferred by the patient.

Hyperplastic pulpitis should be differentiated from proliferating gingival tissue (9). Based on the clinical examination of this case the polyp was traced back to the chamber of the pulp suggesting that it originated from the pulp, unlike in the case of proliferating gingivitis wherein the tissue overgrowth originated from the gingival crest covering the crown of the tooth.

Root canal treatment of a tooth presenting Hyperplastic pulpitis can cause a few alterations in the treatment. The pulp polyp is treated by curetting the granulation tissue via periodontal curette or spoon shape excavator (9) from the pulp chamber and performing endodontic procedures on the residual root structures (6, 9). A spoon shape excavator was used in this case to remove the pulp poly after the initial removal of carious tooth. The lesion was measured at a 0.5mm in diameter which is within the normal, since according to Bouquot in 2001 pulp poly does not exceed a 1cm in diameter. Excess in the bleeding of the Hyperplastic pulpitis was seen during this process.

Barbed broach was used to engage and remove soft tissue from the canal and a copious irrigation of 2.25% NaOCL was used to remove and dissolve the pulp tissue from the pulp chamber that at a higher concentration of NaOCl, the dissolving property increases. The working length was determined using an apex locator, following the manufacturer's instruction and ProTaper Universal was used to finish the biomechanical preparation.

A direct onlay restoration was placed, to provide adequate cuspal protection after root canal treatment to ensure coronal seal and prevent fracture as substantiated by the Ray & Trope studies in 1995.

## Conclusion

This case report demonstrated a permanent maxillary right first molar diagnosed with a Hyperplastic pulpitis that is properly managed by removing the polyp and controlling the bleeding before a routine root canal treatment was made. It was suggested that proper management Pulp Polyp would produce favorable results.

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# Cone-Beam Computed Tomography Study of Prevalence of MB2 Canal in the Mesiobuccal Root of the Permanent Maxillary First Molars

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## Abstract

Understanding the complexity of the root canal system is crucial to guarantee successful root canal treatment. This preliminary study aims to determine the prevalence of the second mesiobuccal canal (MB2) in the mesiobuccal root (MBR) of the permanent maxillary first molars among Filipino sub-population using a cone-beam computed tomography (CBCT). Seventy-eight CBCT images of permanent maxillary first molars from forty-four patients were included in this study. The percentage of having an MB2 canal, the relationship between gender and prevalence of MB2 canal, and the root canal configuration of the MBR were determined. Out of the 78 tooth samples, there were 52 teeth (67%) having MB2 canals, with males having more MB2 canals (87%) than females (58%). Accordingly, the most common types of Vertucci's canal configurations were IV (35%), I (33%) and II (22%). Twenty-nine (85%) out of the 34 had bilateral presence or absence of additional canal in MBR. Therefore, clinicians should always note the high occurrence of MB2 canal in the MBR of permanent maxillary first molars during endodontic treatment. In conclusion, CBCT was very useful in this study in determining the canal morphology of MBRs of the permanent maxillary first molars.

## Introduction

Thorough knowledge of the different variations in root canal (RC) anatomy is vital to ensure the success of the endodontic treatment. The maxillary molars, particularly the first molars have great variations in the mesiobuccal root (MBR) and RC morphology (1). The inability to locate an extra canal in the MBR, the mesiobuccal 2 (MB2) canal, can lead to the harboring of microorganisms that may result in failure of the endodontic treatment.

Race and ethnicity may determine the prevalence of having MB2 canals in the MBR and the canal configuration of permanent maxillary first molars. One study is about the prevalence and canal configurations in the MBR of extracted maxillary first molars in a Jordanian population (2). The prevalence of the MB2 canal was 77.23% with Type IV root canal morphology (35.05%) as the most common and Type II followed this at 27.83%. Similar results were found in other CBCT studies on Vertucci's root canal configuration (3, 4, 5, 6, 7). On the other hand, Type II canal configuration (69.1%) was more common than Type IV in the Iranian population (0.77%) (8). This result was also found in the other studies done (9, 10).

Another factor like gender may also determine the presence of MB2 canals in the MBR of permanent maxillary first molars. In 2016, Betancourt et al. (11) concluded that there is a relationship between gender and prevalence of an MB2 canal in the MBR of permanent maxillary molars. Several studies (12, 13) supported this finding where more males (55.2%) had MB2 canals in maxillary first molars than females (44.8%).

A study on the symmetry of bilateral homonymous teeth in a Taiwanese population using CBCT revealed that there was 65% chance of having bilateral occurrence of additional canals in MBR of the permanent maxillary first molars (14). Studies on Chinese (15) and on Korean (16) populations yielded similar outcomes.

In order to determine the prevalence, as well as the effect of gender to the presence of MB2 canal among the Filipino sub-population, a CBCT study on the MBR of the permanent maxillary first molars was done.

## Materials and Methods

A total of 78 tooth samples were collected, 23 teeth came from males and 55 teeth from females, with a mean age of 28 years old ranging from 16 to 49 years old. Collection of CBCT images of permanent maxillary first molars obtained from August 2015 to June 2017 at Insights Diagnostic Center (Mandaluyong City, Metro Manila, Philippines) were used. The

images taken were part of routine examination for different dental treatments. Only the age and gender of the patients were revealed in this study and was approved by the Ethical Review Committee of the University of the East Manila.

*Manipulation of CBCT Scan Image*

iRYS Viewer Software version 5.6 was used in analyzing the CBCT image in MPR mode in coronal, sagittal and axial views. Snapshots of the axial view of the CBCT images were saved and properly labeled. In the PowerPoint presentation, each image of the axial view was cropped focusing on the permanent maxillary first molar. The images were arranged and labeled: cervical third, middle third and apical third accordingly in a black background.

*Examining the Image*

There were three examiners who analyzed each image independently using Epson LCD projector EB-X31 and ASUS X55L series laptop with Windows 10 Home Single Language version 1607 and Intel Core i3-5010U, 2.1 GH in a dark room against a white background. Each examiner tabulated the findings. The inconsistent data were re-examined by the same examiners using the 3D image of the root canal in the MBR. All results were summarized and statistically analyzed.

The data were analyzed using descriptive statistics. A p-value of 0.05 or less was considered statistically significant. The relationship between the presence of MB2 canals and symmetry of canal configuration were compared using chi-square tests.

## Results

There were 78 tooth samples collected, 23 teeth (29%) came from males while 55 teeth (71%) came from females. The presence of MB2 canals in males was 87% while females had 58%. In Vertucci's canal classification, Types I, II and IV were the most common canal configurations.

**Gender vs. Presence or Absence of MB2 Canals**

Majority of males and females have MB2 canals present, (66.7%). Males however had more MB2 canals (87.0%) than the females (58.2%).

Performance of the Pearson Chi-square test analyzed the difference between gender and prevalence of MB2 canals by determining the p-value at 95% confidence interval. A p-value of 0.05 or less was considered statistically significant.

**RC Configurations of the MBR in Permanent Maxillary First Molars**

The most common RC configurations based on Vertucci's classification of the MBR in permanent maxillary first molars were types I, II and IV. For the samples with MB2 canals, 35% showed type IV (Fig. 1) followed by 22% type II (Fig. 2) root canal configurations. These two were the most common canal configurations. In males, type IV was the most common canal configuration (61%) followed by type II with 17%. Meanwhile, the most common canal configuration for females was type I (42%) (Fig. 3) followed by types II and IV (24%).

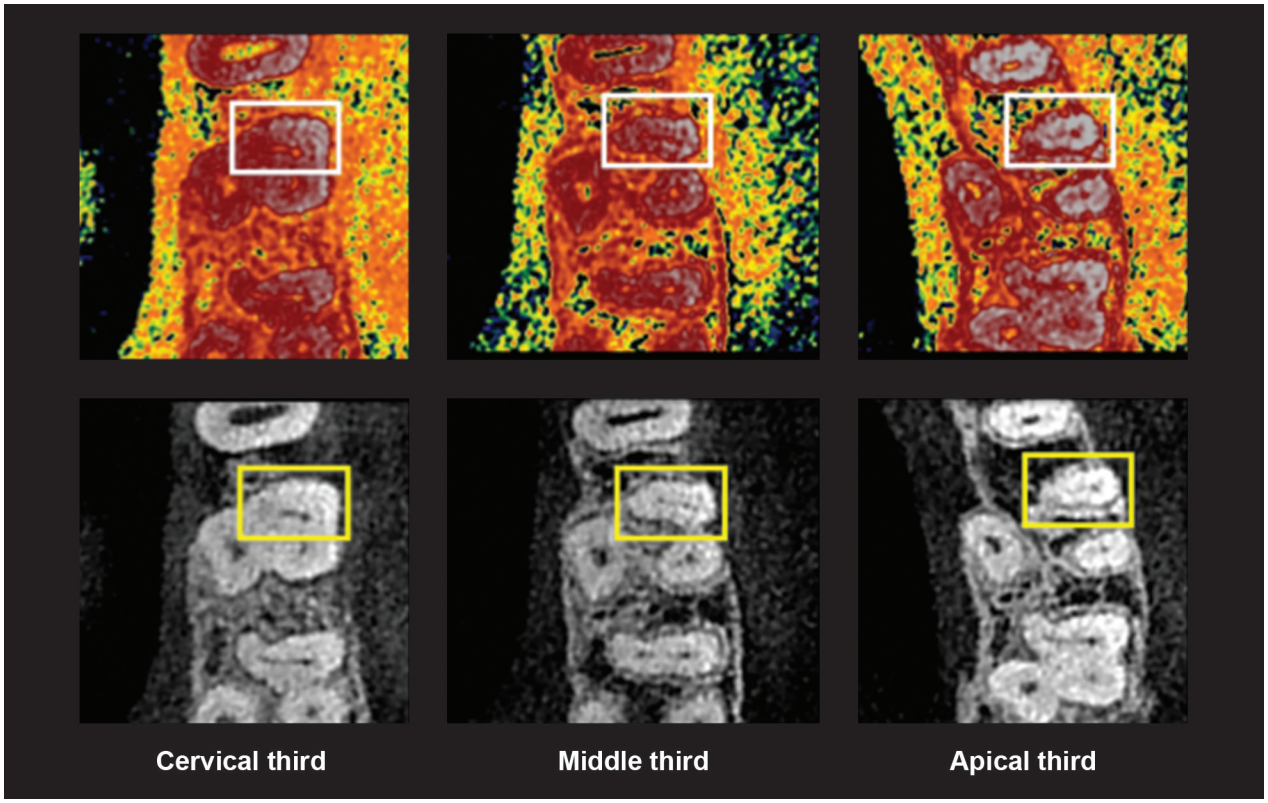


**Fig. 1. Type IV (2-2): Two separate, distinct canals extend from the pulp chamber to the apex.**

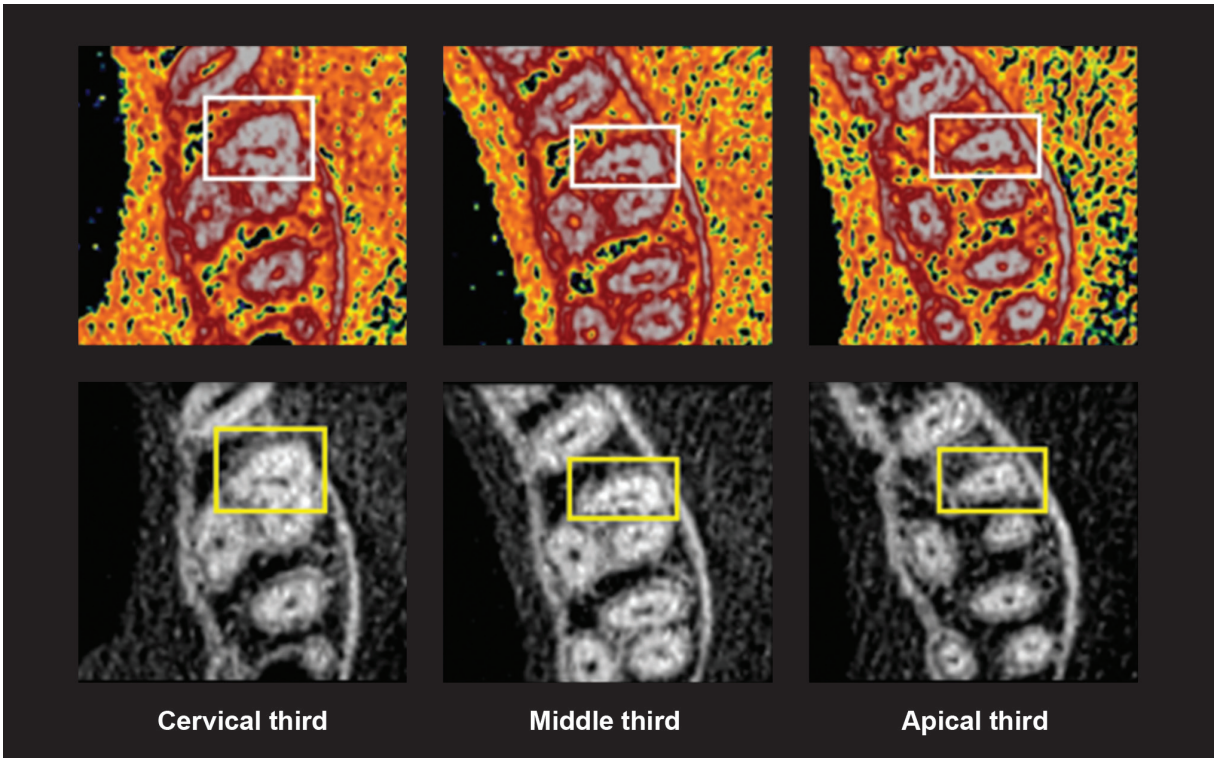


**Fig. 2. Type II (2-1). Two separate canals that leave the pulp chamber and join short of the apex to form one canal.**

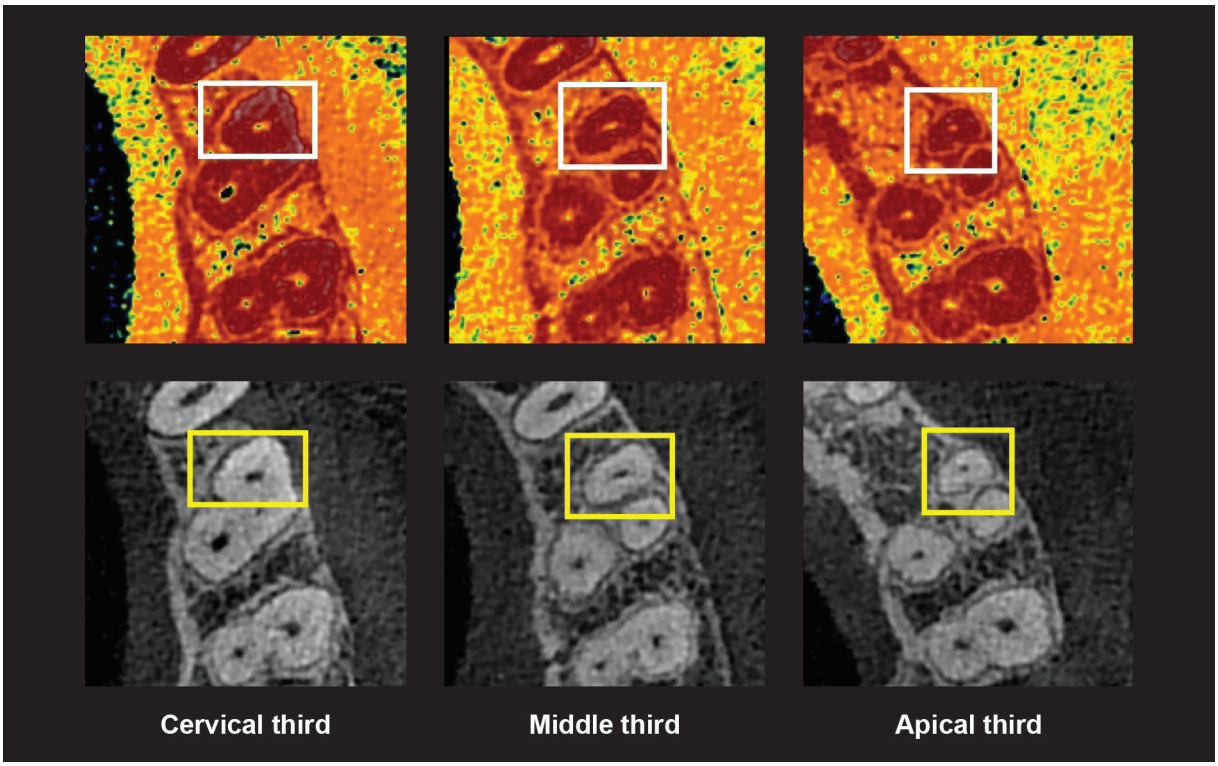


**Fig. 3. Type I (1-1): A single canal that extends from pulp chamber to the apex.**

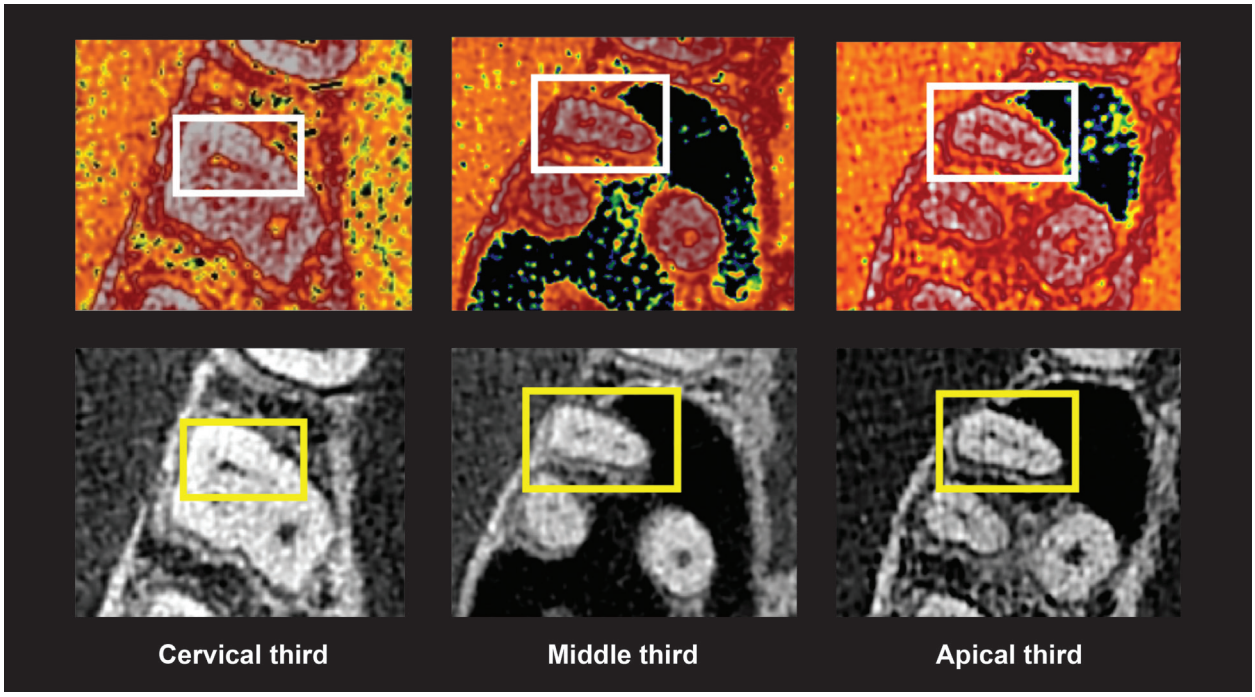


**Fig. 4a. (3-2-3): Three separate canals that leave the pulp chamber, join at the middle third of the root to form two canals and separate short of the apex to form three canals.**

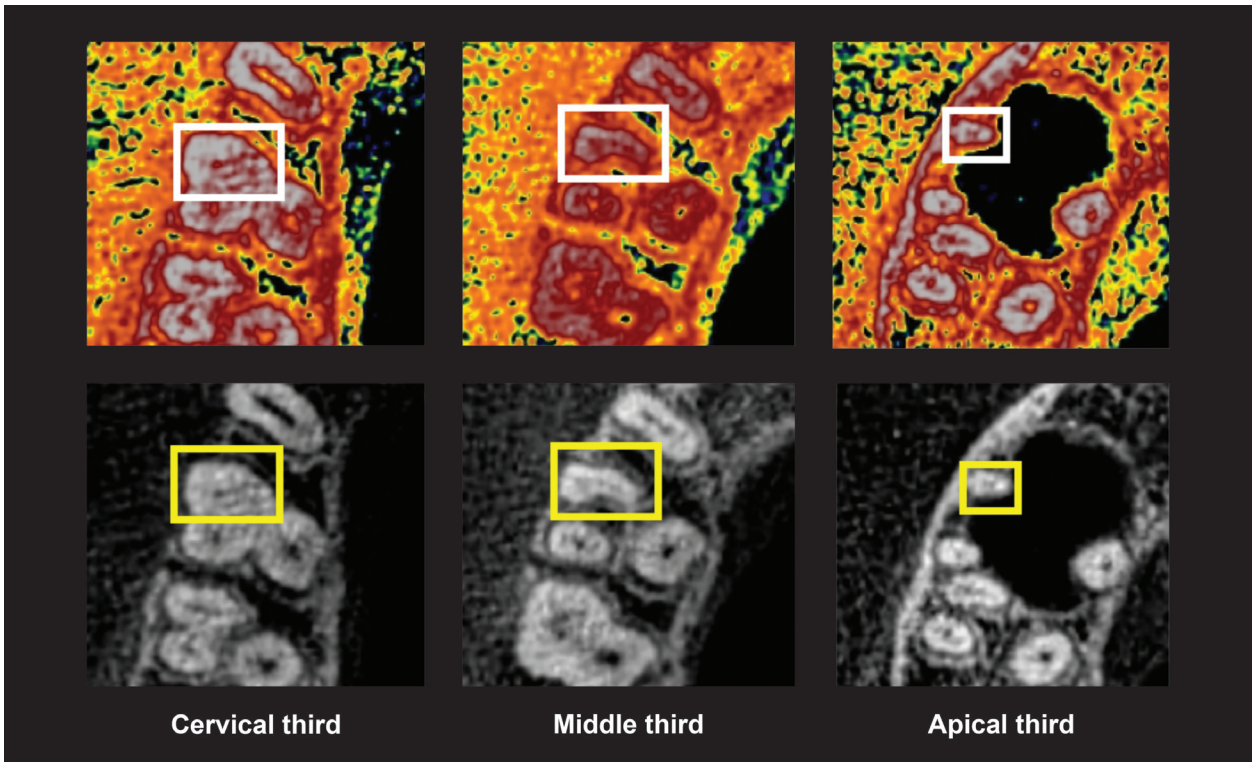


**Fig. 4b. (2-3-2): Two separate canals that leave the pulp chamber, separate at the middle third of the root to form three canals and join short of the apex to form two canals.**

**Gender vs. Occurrence of Additional Canals in MBR**
Majority of males and females have occurrence of additional canals in MBR (85.3%). However, males had greater chance of having an additional canal (100%) than females (50%).

There were 29 pairs of CBCT images of permanent maxillary first molars, 9 pairs were males and 20 pairs were females that were subjected for the study of the occurrence of additional canal in the MBR bilaterally and unilaterally. Twenty-one pairs (72%) exhibited bilateral presence of an additional canal in the MBR where 13 pairs of which come from females (62%) and 8 pairs from the males (38%). For the unilateral occurrence of an additional canal in the MBR of permanent maxillary first molars, only 5 pairs (15%) proved to have the MB2, all were females.

## Discussion

Age can be a good predictor of the detection of MB2 canals in the MBR of permanent maxillary first molars. Several studies (17, 18) stated that there was an inverse correlation between age and frequency of an MB2 canal in permanent maxillary molars. As age increases, the frequency of detection of an MB2 canal decreases. This may be due to canal calcifications of teeth resulting from outside irritations such as trauma, caries and restorative procedures. Radiography is a vital diagnostic tool necessary in the diagnosis of odontogenic and non-odontogenic infections. Likewise, it is crucial in all aspects in the practice of Endodontics. However, a complicated tooth morphology requires more than a conventional 2D radiographic image where avoidance of superimpositions of the different anatomic structures is possible.

A Cone-Beam Computed Tomography (CBCT) produces a 3D image providing better visualization of the dental and alveolar hard tissues and pathologic alterations. Furthermore, it provides information on the morphology of the tooth including location and number of canals, pulp chamber size and degree of calcification.

Detection of the possible location of the MB2 canal and the canal configurations of the MBR (19, 20) are very important. Numerous studies were conducted regarding the prevalence of MB2 canals in the MBR of the permanent maxillary first molars using CBCT scans (3, 5, 8, 11, 14, 15, 16, 17, 18, 19, 21, 22).

In this study, there was a high prevalence (67%) of MB2 canals in the MBR of permanent maxillary molars among a Filipino sub-population. One can note that there is more than 50% chance of an MB2 canal detection in permanent maxillary first molars in the Filipino sub-population. Similar results were observed from previous studies (3, 4, 8, 13, 16, 23, 24, 25).

Quite a number of investigations confirmed that gender of the patient could predict the presence of MB2 canals in the MBR of permanent maxillary first molars (11, 12, 13, 14, 26). The present study showed the relationship between male and female vis-à-vis the presence of MB2 canals. Males had a higher tendency to have MB2 canals (87%) than the females (58%). However, the strength of association between the male and female groups was weak because of the limited number of samples collected in this study.

Among the observed MB canals in this study, the most common Vertucci's canal configurations were Types I (33%), IV (27%) and II (17%). In males, Type IV (61%) is the most common, followed by Types II (17%) and I (13%). While in females, Type I (42%) is the most common and followed equally by types II and IV (24%). Likewise, other studies showed similar results where Type IV is the most common followed by Type II canal configurations (2, 3, 4, 5, 6, 7, 13, 14, 16, 27, 28). In contrast, other studies have more Type II canal configurations than Type IV (8, 10, 25, 29, 30).

The number of canals in the MBR of permanent maxillary first molars may be more than two. In this study, two samples (2%) exhibited three canals. One of the samples demonstrated a 3:2:3 canal configuration (Fig. 4a) while another, a 2:3:2 canal configuration (Fig. 4b). This may be a small percentage of prevalence but clinicians should take note of the possibility of having more than two canals in the MBR (6, 7, 28, 30).

The probability of having the bilateral occurrence of additional canals in MBR from permanent maxillary first molar pairs was very high (62%) in which it exhibited similar canal configurations with previous CBCT studies (3, 15, 16).

## Conclusion

The most important factor to have a successful endodontic treatment is thorough cleaning and shaping of canal as well as tooth restoration. The use of CBCT scan in determining the canal morphology of the tooth can greatly help clinicians understand the root morphology of the tooth. However, the clinician should bear in mind that patients should be exposed to as low as reasonably achievable radiation (ALARA principle).

Within the limitation of this study, the prevalence of MB2 canal in MBR of permanent maxillary first molars among Filipino sub-population is at 69%. The most common root canal configurations found with MB2 canals are type IV followed by type II. These results can serve as a guide to clinicians of the high probability of the presence of the MBR in permanent maxillary first molars among the Filipino sub-population. Adequate knowledge of the internal anatomy and morphology of the root canal system is paramount when performing endodontic treatment.

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**Conflict of Interest**
The authors disclosed that there is no conflict of interest.

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