Majalah Kedokteran Gigi Indonesia
Vol 10 No 3 – December 2024
ISSN 2460-0164 (print), ISSN 2442-2576 (online)
Available online at https://jurnal.ugm.ac.id/mkgi
DOI: http://doi.org/10.22146/majkedgiind.91794

CASE STUDY

Distal root hemisection of mandibular left first molar with pulp necrosis, bifurcation perforation, and symptomatic apical periodontitis

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Submitted: 12nd December 2023; Revised: 1st March 2024; Accepted: 15th November 2024

ABSTRACT

Hemisection is an endodontic surgery performed by removing one or more roots and existing crown structures to increase the retention of the remaining teeth and to correct defected dental roots that are not possible to maintain. This defect can be caused by pulp tissue or periodontal tissue. Diagnosis of endodontic-periodontal lesions is an essential determinant whether it is due to endodontic or periodontal pathogens. In this case, endodontic treatment needs to be performed in combination with hemisection surgery. The purpose of this case report is to save the tooth with furcation involvement and pulp necrosis, making it perforated on the bifurcation of mandibular first molar. A female patient aged 20 years had a large cavity in tooth 36 with symptomatic apical periodontitis. The tooth was sensitive to percussion test and negative to palpation test, and the mobility was normal. The radiographic feature showed a perforated tooth in the furcation section and furcation involvement. The diagnosis of tooth 36 was pulp necrosis with bifurcation perforation and symptomatic apical periodontitis. The patient received initial treatment, root canal treatment, and obturation on the mesial first molar, then followed by intake of the distal root of the molar. The installation of a prefabricated fiber post in the mesial root of tooth 36 and hemisection surgery were performed on tooth 36. The restoration was done in the form of a full porcelain fused to metal crown on tooth 36 with a splinted crown. Hemisection surgical treatment is a reliable alternative solution and has a good prognosis because it can maintain dental and periodontal tissue as long as possible without tooth extraction.

Keywords: bifurcation perforation; hemisection; pulp necrosis

INTRODUCTION

Current development in science has made people aware that maintaining teeth as long as possible in the oral cavity is important. Some experts believe that retaining teeth is better than completely removing them. Endodontic surgery is an alternative treatment if conventional endodontic failure occurs. The main goals of endodontic surgery are to eliminate disease, prevent disease recurrence, and facilitate the healing of tooth tissue to allow it to be restored as needed.[1]

Endodontic surgery includes surgical procedures to remove the causative agents of peri-radicular disorders and to restore periodontium tissue.[1,2] The tooth, pulp tissue, and its supporting structures constitute one biological unit. The relationships between these structures mutually influence each other. Pulp tissue and periodontal ligament have an anatomical and functional relationship. The entry of irritants from the pulp into the peri-radicular tissue results in various changes in the periodontium tissue.[3]

Periradicular changes occur limited to the apical periodontium and can spread coronally. Pathological changes in the periodontal membrane of the coronal region suggest that the mechanisms involved in a periodontal disease are the same as those involved in peri-radicular lesions. The difference between the two is the origin of the disease and the direction of its spread. Periodontal disease tends to extend apically, whereas periapical lesions can extend both apically and coronally. In determining the diagnosis, prognosis, and treatment plan for teeth with endodontic-

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ISSN 2460-0164 (print)
ISSN 2442-2576 (online)

periodontic disease, it is important to ensure that the initial lesion originates from pulp tissue or periodontal tissue.[4]

Pulp and periodontal tissue have a close relationship both anatomically and functionally. This relationship can be divided into two groups, namely vascular and tubular. There is a relationship between periodontal disease and pulp disease due to the presence of lateral canals.[5] Blood vessels running in the lateral canals form a connection between the pulp and the periodontal ligament or vice versa. Exposed dentinal tubules can function as channels between the pulp and the periodontal ligament.

Endodontic surgical treatment is the last option if conventional endodontic treatment cannot be performed. The success rate of endodontic surgery is 95.3%.[6] The success of endodontic surgery depends on diagnostic factors, case selection, accuracy of indications and contraindications, procedure, and periodic evaluation. Selection of tooth cases that will be preserved is very important to see whether there is periapical damage and whether the remaining tooth structure can be maintained or not.

Hemisection is an attempt to remove the tooth root along with part of the crown. This procedure is often performed on mandibular molars with severe furcation involvement.[7] Indications for hemisection include loss of supporting bone in one root, extensive subgingival root caries that only affects one root, root perforation due to resorption, and root canals that cannot be obturated due to obstruction, crooked root shape, or root fracture, and serious root exposure as a result of dehiscence.[8,9,10] Hemisection is a surgery procedure to divide multiple roots at the furcation boundary, and extraction is limited to the root only and/or part of the crown.[8]

Contraindications to hemisection can include severe tooth damage if one tooth root is lost and there is a lack of supporting tissue, the remaining roots cannot be treated with root canals, there are root fusions or root unions that make hemisection impossible, and there is tooth malposition.[10] The parameters used can be evaluated clinically and radiologically. The main cause of hemisection failure is persistent infection or re-contamination of the root canal by microorganisms and their products.

This case report presents a hemisection procedure, which is one of the endodontic surgical procedures and indicated for pulp necrosis cases accompanied by bifurcation perforation and symptomatic apical periodontitis. These disorders involve roots or furcation, where a single root canal is not amenable to conventional treatment. Distal root canals cannot be treated because there is extensive damage and the remaining tooth tissue cannot be restored. This case report aims to describe the distal root hemisection treatment of the lower left first molar tooth to maintain the mesial root and provide adequate restoration.

METHODS

A 20-year-old female patient came to Prof. Soedomo Dental and Oral Hospital complaining a pain in her lower left back tooth, which had a cavity. The pain occurred only when food entered the tooth cavity. The pain in the tooth had been felt for one year. The tooth had had a filling done when she was a junior high school patient. Then, the filling came off 4 years ago, but the patient had not had time to go to the dentist. The patient denied any history of drug allergies and/or systemic diseases. The patient wanted the tooth to be retained and not extracted.

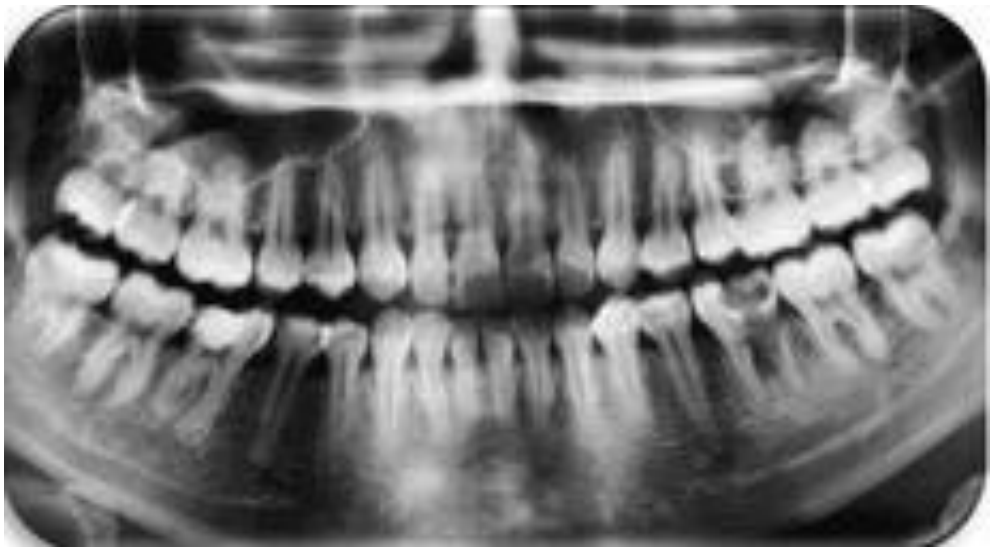
The objective examination showed that there was a cavity at the distolingual part and a perforation at the bifurcation of the distal part (Figure 1A). At the perforation, there was granulation tissue covering the base of the distal root pulp chamber, and the base of the mesial root pulp chamber and its orifice were visible (Figure 1B). The percussion examination showed (+), palpation showed (-), and mobility showed grade 1. The periapical radiographic examination (Figure 1C) and panoramic radiography (Figure 1D) showed a radiolucent image from the distal part of the tooth crown to the bifurcation area and the coronal 1/3 of the distal root. Apart from that, the

periodontal ligament space was widened in the apical 1/3 of the distal part, and the lamina dura appeared to be disconnected in the apical 1/3 of the distal part, and there was no visible subsidence of the alveolar bone.

The diagnosis made in this case was tooth 36 pulp necrosis accompanied by bifurcation perforation and symptomatic apical periodontitis. The treatment plan included communication information education, mesial root canal treatment of tooth 36, installation of a prefabricated fiber post on the mesial root of tooth 36, hemisection of tooth 36, and finally restoration in the form of a porcelain fused to metal jacket crown on tooth 36 with a splinted crown. The prognosis was good because the remaining hard tissue structure of tooth 36 was still good and could be restored, the supporting tissue of tooth 36 mesial root was good with the alveolar bone remaining more than half the length of the tooth, the mesial root canal could still be treated with root canals, there was no mobility in teeth, the oral hygiene was good, and the patient had no history of systemic diseases.

On the first visit, subjective, objective, radiographic, and vital sign examinations were performed before the treatment began. The objective examination revealed an overbite of 2.3 mm, an overjet of 2.5 mm (Figure 2A), an Angle Class I occlusion relationship on the right (Figure 2B), and an Angle Class I occlusion relationship on the left (Figure 2C). The attrition pattern was normal in the upper jaw (Figure 2D) and lower jaw (Figure

(A) (B) (C)



(D)

Figure 1. Clinical and radiographic features of tooth 36 before treatment: (A) Cavity at the distolingual part and perforation at the distal bifurcation (arrow). (B) At the perforation, there was granulation tissue covering the base of the distal root pulp chamber, and the base of the mesial root pulp chamber and its orifice were visible (arrow). (C) Periapical radiographic image of tooth 36 before treatment. (D) Panoramic radiographic image before treatment. A radiolucent image was visible on the crown of tooth 36 reaching the pulp and bifurcation area and there was widening of the periodontal ligament space at the distal root of tooth 36.

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ISSN 2442-2576 (online)

2E). the saliva test obtained moderate hydration (30-60 seconds), moderate viscosity (foamy), normal pH (6.8-7.8), and good OHI-S (1.17).

On the first visit, after subjective and objective examinations as well as determination of the diagnosis and treatment plan, the operator provided communication, information, and education. Then, the patient signed informed consent. Afterwards, the carious tissue was removed using an excavator and round metal bur. The cavity was visible with the pulp and mesial root orifice exposed. An artificial wall was created on the distolingual part of tooth 36 (Figure 3A). Then, isolation of tooth 36 with a rubber dam was performed. Subsequently, the operator measured the estimated working length of the mesiobuccal root canal at 16.5 mm and mesiolingual at 13mm. Tthe pulp debridement used a barbed broach irrigated with 2.5% NaOCl. The root canal exploration and negotiation used K-Files #8, #10, and #15. The root canal preparation used the crown down technique and Protaper hand use (Dentsply). In the mesiobuccal and mesiolingual root canals, coronal section 2/3 of the root canal was prepared by using files S1 followed by S2. The actual working length calculation used the apex locator, mesiobuccal root canal of 16.5 mm, and mesiolingual of 13 mm. Then, preparation of the mesiobuccal root canal of tooth 36 was carried out (working length of 16.5 mm), followed by mesiolingual root canal preparation of tooth 36 (working length of 13 mm). During the root canal preparation, the root canal was irrigated with 2.5% NaOCl solution, given 15% EDTA gel for lubrication, and interspersed with saline. The mesial root canal orifice of tooth 36 after root canal

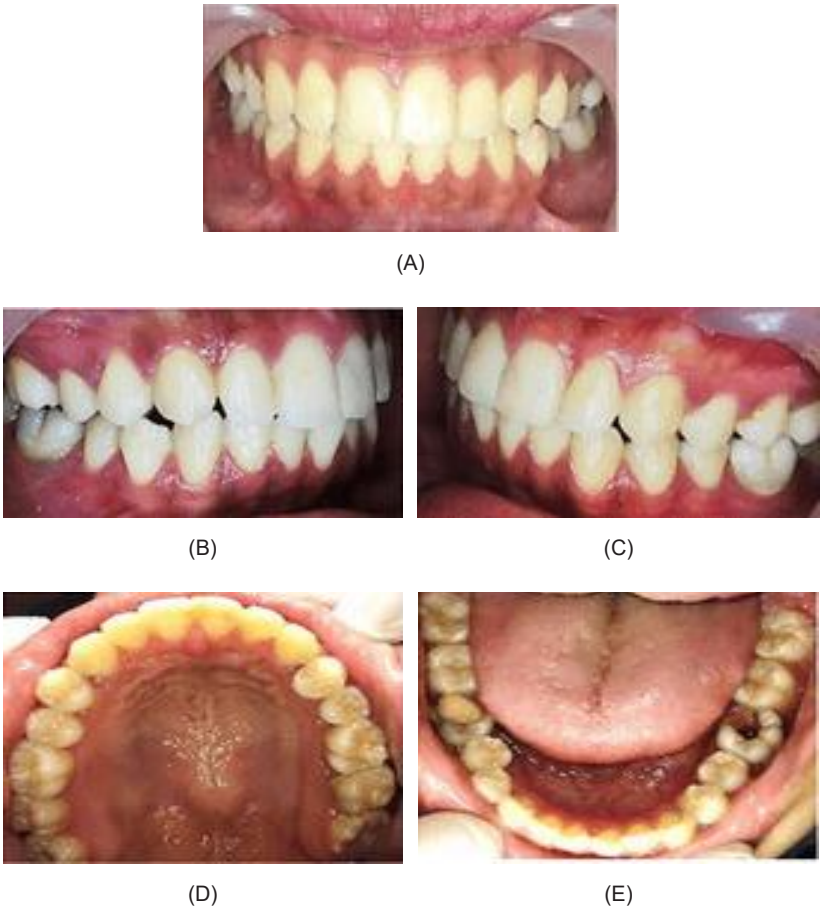
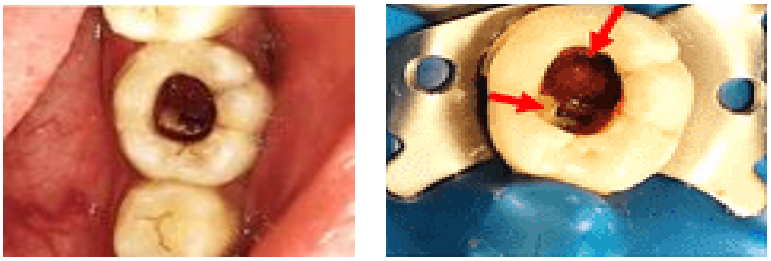


Figure 2. Objective examination: (A) Centric position of occlusion. (B) Angle Class I occlusion relationship on the right. (C) Angle Class I occlusion relationship on the left. (D) Normal attrition pattern of the maxilla. (E) Normal attrition pattern of the mandible



(A) (B)

Figure 3. (A) Results of creation of an artificial wall of tooth 36. (B) Mesial root canal orifice of tooth 36 after root canal preparation and bifurcation perforation to the distal root of tooth 36

Figure 4. Periapical radiographic image of the mesial root canal filling of tooth 36

preparation and bifurcation perforation to the distal root of tooth 36 is shown in Figure 3B. All the root canals were irrigated with 2.5% NaOCl, 17% EDTA, and 2% chlorhexidine. Each change of solution was alternated with saline irrigation. Ca(OH)2 paste dressing (Ultracal, Ultradent) was applied, and the cavity was temporarily closed.

On the second visit, there were no complaints found in the subjective examination, the objective examination showed that the temporary filling was still good, with negative result of percussion examination and negative palpation. Then, tooth 36 was isolated using a rubber dam, and the temporary filling was removed. Calcium hydroxide paste cleaning, 2.5% NaOCl irrigation, and saline irrigation were carried out. Protaper (Dentsply) #F2 gutta percha was fitted in 16.5 mm mesiobuccal and 13 mm mesiolingual root canals. Both root canals were irrigated with 2.5% NaOCl, 17% EDTA, and 2% chlorhexidine solution, and each change of irrigation material was given an intermediate irrigation agent of saline. Gutta percha was sterilized by being soaked in 2.5% NaOCl solution for 1 minute then rinsed with 70% alcohol and dried. The obturation used a single cone technique. A resin-based sealer (Top Seal, Dentsply) was inserted in the root canal. The cavity was closed with glass ionomer cement and filled temporarily. Then, a periapical x-ray was performed as a result of obturation of the mesial root of tooth 36 (Figure 4).

On the third visit, control was carried out after root canal filling. The subjective examination showed no complaints from the patient. The objective examination showed that the temporary filling was still good. The surrounding gingiva was normal, not swollen or reddish. The percussion examination was (-), with palpation (-), and degree 1 mobility. Then, a post-channel preparation was carried out. The post used on the mesiobuccal root of tooth 36 was a prefabricated fiber post no. 1. Then, the gutta-percha was taken using a peeso-reamer according to the peg length of 12.5 mm. The post channel was prepared with prefabricated fiber precision drill no. 1. Then the prefabricated fiber post for tooth 36 was installed (Figure 5A). Prefabricated fiber stakes were smeared in silane (RelyX Ceramic Primer, 3M ESPE). Then, the procedure for etching and bonding the post channel as well as the cavity was performed. Cementation of the posts was done with dual-cure resin fiber-reinforced composite core build-up material (Build-It FR, Pentron). The post was cut up to the height of 2/3 of the tooth crown.

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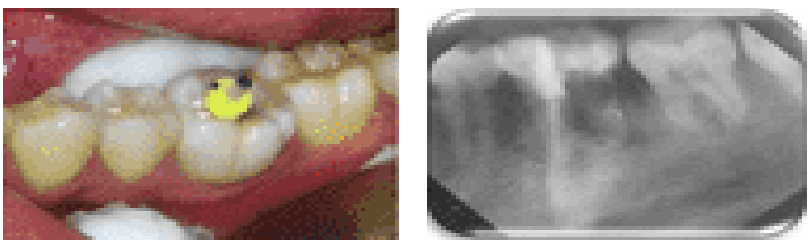
Then, a periapical x-ray of the cemented post was performed (Figure 5B).

On the fourth visit, the hemisection surgery was performed. The patient's conditions comprised the general condition (good, compos mentis) and vital signs (blood pressure: 100/70 mmHg[2], pulse: 86x per minute, respiration: 20x per minute, temperature: 36°C). The intraoral examination of teeth 36 showed percussion (-), palpation (-), and degree 1 mobility. The temporary filling was initially opened, and the operation area and surrounding tissue were disinfected with iodine solution. The mandibular block anesthesia (inferior alveolar nerve and lingual nerve) as well as infiltration of the mucobuccal fold for buccal nerve used 2% lidocaine HCl with 1:80,000 epinephrine (Pehacaine). An incision was made with blade #15 for a triangular flap shape, starting from the mesial of tooth 35 along the gingival margin to the distal of tooth 36 (Figures 6A and 6B). The flap was opened by using a raspatorium (Figure 6C). Then separation was carried out on the crown of tooth 36 using a fissure-shaped carbide bur (Figures 6D and 6E). The distal part was separated from the gingiva by using an elevator (Figure 6F). Using radix forceps, the distal root of tooth 36 was removed, and then the root was taken with tweezers (Figure 6G). The walls of the socket and bifurcation area were smoothed with a bone file. The bifurcation area and distal roots were given a curettage procedure. The sharp parts of the teeth were smoothed with a fine finishing bur (Figures 6H and 6I). Irrigation with saline was done to remove blood and remnants of granulation tissue as well as debris from the cutting and smoothing process for the separation area. Bone graft (GamaCHA) was applied in the socket where the distal root of tooth 36 was extracted, and it was then covered with a pericardial membrane (Figures 6J and 6K). The flap was repositioned and then sutured with 3-0 non-resorbable sutures from the buccal vertical incision followed by the occlusal section using an interrupted suture technique of 4 stitches (Figure 6L). Then a post-operative periapical radiograph was taken (Figure 6M). The gum area was covered with a periodontal pack, then the occlusion was checked. This was followed by oral administration of medication, including amoxicillin 500 mg (3x1) after eating as an antibiotic for five days, paracetamol 500 mg as an analgesic, and diclofenac potassium 50 mg (3x1) as an anti-inflammatory taken if sick.

After the operation was completed, the patient was given several post-operative instructions. These instructions included patient being advised to apply a cold compress to the cheek near the surgical area for 2 hours, followed by a warm compress if swelling occurred, not to talk too much to prevent the stitches from coming loose, and not to brush the operated area. The patient was also advised to use Minosep mouthwash containing 0.2% chlorhexidine gluconate, eat a soft food diet for 3 days, and follow the schedule for control 1 week after surgery to evaluate the wound.

On the fifth visit, or the control 1 week after hemisection surgery (Figures 7A and 7B), the subjective examination showed that there were no patient complaints between the visits. Then, in the objective examination, the clinical results showed that the gingiva was good, there was no



(A) (B)

Figure 5. (A) Fitting of prefabricated fiber post for tooth 36; (B) Periapical radiograph of the cemented prefabricated fiber post

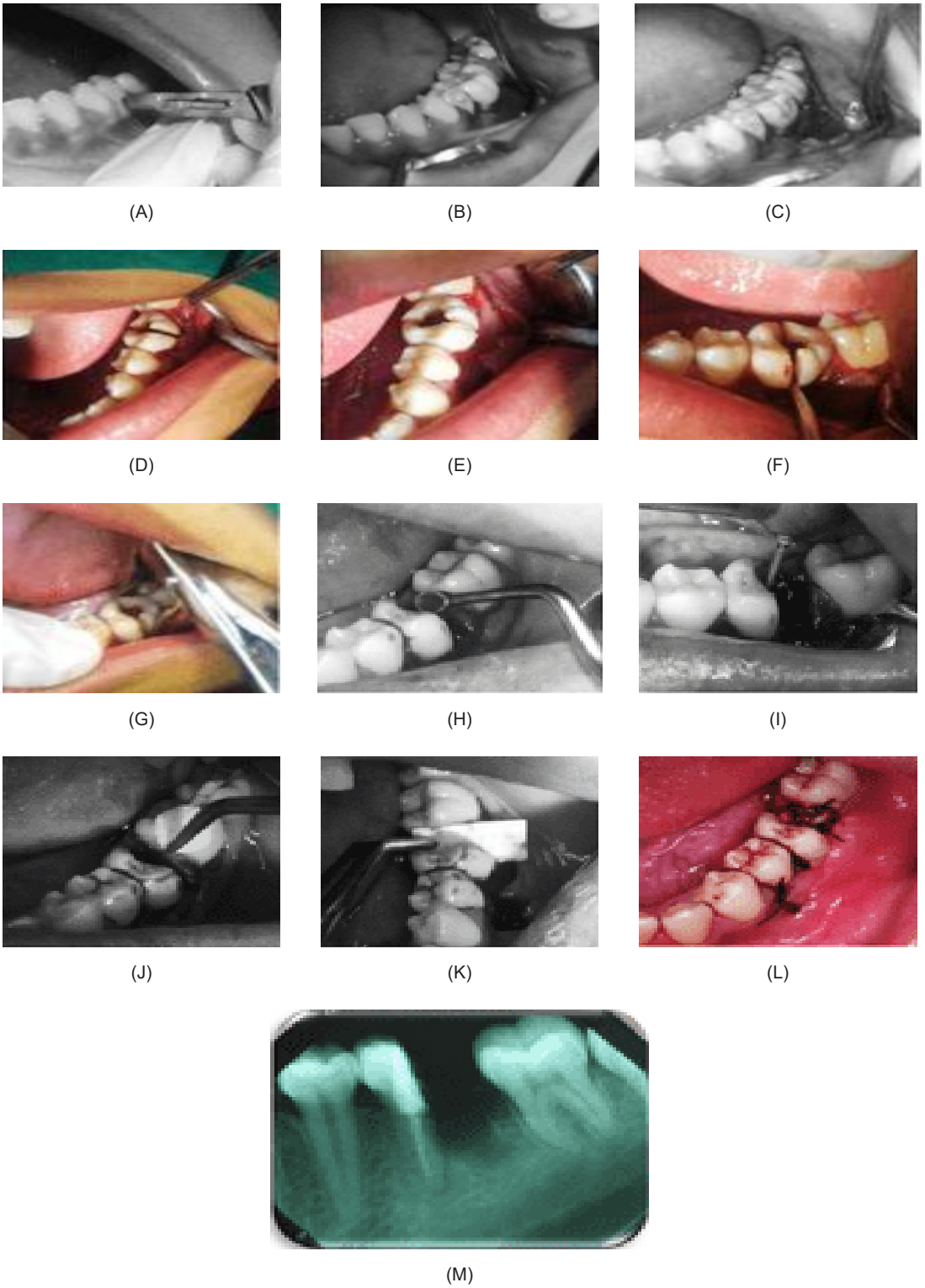


Figure 6. (A and B) Incision with a triangular flap design using blade no. 15; (C) Opening of the flap with a raspatorium; (D and E) Separation of tooth 36 from the crown to bifurcation, separating the tooth into two parts, namely mesial and distal; (F) Separation of the mesial and distal roots of tooth 36 with an elevator; (G) Distal root removal using mandibular molar root forceps; (H and I) Curettage of the distal root socket of tooth 36 followed by smoothing of the sharp part of the tooth; (J and K) Application of bone graft and membrane to the distal root socket of tooth 36; (L) Reposition of the flap followed by suturing using the interrupted suture technique; (M) Periapical radiograph after hemisection, the distal root of tooth 36 has been taken

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redness, and the wound had closed well. In a further examination, the percussion of tooth 36 was negative (-), palpation was negative (-), and mobility was grade 1. Then, the periodontal pack was opened, the surgical area was cleaned by using glycerin iodine, and the sewing thread was taken. Then, the patient was instructed to have a control visit again to continue the process of restoration on tooth 36.

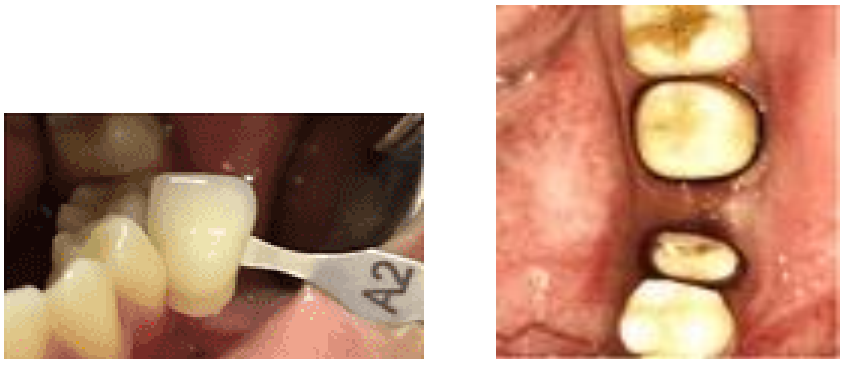
On the sixth visit, or 1 month after hemisection surgery, the subjective examination showed that there were no complaints of pain from the patient. Then, based on the objective examination, there was no visible gingival inflammation around the surgical area. The color of the patient's teeth was matched by using a shade guide, and the color A2 was obtained (Figure 8A). Next, the preparation of tooth 36 was carried out, starting with gingival retraction, reduction of the occlusal part with a wheel diamond bur, and reduction of the buccal, lingual, and proximal parts to a thickness of approximately 1 mm using a round end tapered fissure diamond bur ending in a chamfer-shaped shoulder. The preparation was then smoothed by using a round end tapered fissure (yellow tape). After the preparation of tooth 36 was completed, the next step was preparation of tooth 37. The preparation of tooth 37 began with gingival retraction, followed by preparation for reduction of the occlusal part by using a wheel diamond bur. Then, reduction of the buccal, lingual, and proximal parts by 1 mm was done with a round-end tapered fissure diamond bur ending in a chamfer-shaped shoulder. Finally, the preparation was smoothed by using a round-end tapered fissure (yellow tape). The results of tooth preparation 36 and 37 can be seen in Figure 8B. Next, the maxillary teeth were printed by using irreversible hydrocolloid impression (alginate), and the lower jaw was molded by using double-impression hydrophilic polysiloxane impression material type 3 light body (Exaflex, GC) and polysiloxane vinyl printing material (Putty, GC). The mold was sent to the dental engineering laboratory for restorations in the form of PFM splinted crowns for teeth 36 and 37. Then, cementation of the temporary crowns was carried out.

On the seventh visit, or 1 week after printing, the Porcelain Fused to Metal (PFM) splinted crown was fitted and inserted into teeth 36 and 37. Initially, a subjective examination was carried out, resulting in no complaints from the patient. Th objective examination also showed that the percussion and palpation examination results were negative (-). Then, the work area was isolated, and the temporary crown was removed. The PFM crown splinter was fitted while the occlusion, proximal contact, embrasure contour, and edge density were being checked. Teeth 36 and 37 were dried and isolated again. The crown splinter was sterilized by using 70% alcohol and dried. Then, an etching application containing 5% HF (IPS Ceramic Etching Gel, Ivoclar) was applied to the fitting surface of the crown splinter, left for 60 seconds, and then washed. The crown splinter was smeared with bonding material (Monobond-S, Ivoclar), left for 60 seconds, and dried by gently spraying air. The crown splinter cementation was carried out by using self-adhesive resin cement (RelyX U200, 3M). The excess cement around the crown splinter was cleaned before the resin cement hardened. The proximal part was cleaned with dental floss and then illuminated for 20 seconds. The occlusion was checked, and the patient was given education and instructions for a control visit 1 week after cementation. The clinical and radiographic features of PFM splinted crowns that have been cemented on teeth 36 and 37 can be seen in Figures 9A, 9B, and 9C.

On the eighth visit, or 1 week after PFM splinted crown cementation for teeth 36 and 37, the subjective examination indicated that there were no complaints from the patient. Then, the objective examination of teeth 36 and 37 showed that the occlusion results were good, there was no traumatic occlusion, there was no gingival inflammation, and there was no food impaction on teeth 36 and 37 which had been cemented with PFM splinted crowns. The percussion and palpation examinations showed a negative result (-). After the subjective and objective examinations were carried out, the patient was given education about dental

(A) (B)

Figure 7. (A and B) Clinical appearance of tooth 36 during post-hemisection control.



(A) (B)

Figure 8. (A) Color matching with a shade guide; (B) Results of preparation of teeth 36 and 37

(A) (B) (C)

Figure 9. Cemented PFM splinted crowns of teeth 36 and 37, views from (A) buccal and (B) occlusal; (C) Radiographic image after cementation, there was no visible overhanging of the restoration, the contact point was good. The radiolucent image of the socket after mesial root extraction was smaller, there had been reinforcement in the area.

care related to the installation of splinted crown. The clinical and radiographic images of PFM splinted crowns on teeth 36 and 37 during control can be seen in Figures 10A, 10B, and 10C.

DISCUSSION

Hemisection is one of the arsenals in the endodontics discipline that utilizes both conservative and surgical measures to retain compromised teeth. Hemisection is a useful alternative treatment to extraction to save multi-rooted teeth through an endodontic approach, which includes root canal treatment of the remaining roots and their restoration with suitable restorative material to splint it with the adjacent tooth to decrease the risk of displacement, followed by a fixed prosthodontic prosthesis to maintain the occlusal balance.[15]

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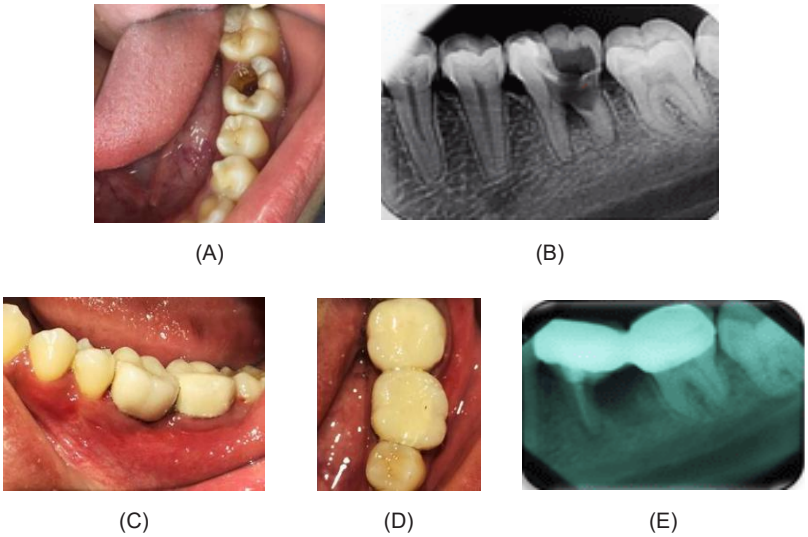
(A) (B) (C)

Figure 10. Clinical picture of PFM splinted crowns of teeth 36 and 37 during control, seen from (A) buccal and (B) occlusal; (C) Periapical radiograph during post-hemisection control. The post-extraction radiolucent image of the socket was smaller, it appeared that there was an ossification process.



(A) (B)

(C) (D) (E)

Figure 11. Clinical and radiographic photos before and after treatment: (A) clinical photo before treatment; (B) pre-treatment radiograph; (C) clinical photos after treatment from buccal views and (D) occlusal views; (E) radiograph after treatment.

The reason for performing hemisection on the distal root of tooth 36 was because of the extensive pulp necrosis in the distal part of the tooth and the presence of perforation in the furcation as well as furcation involvement, indicating that conventional endodontic treatment would likely fail. The root canal filling was only on the mesiobuccal and mesiolingual roots. Previous studies have shown that the hemisection procedure is able to provide a good environment for maintaining oral hygiene by eliminating plaque retention morphology and affected roots.[8]

Before the hemisection procedure was carried out, conventional treatment was given to the mesiobuccal and mesiolingual root canals. The preparation stage used 2.5% sodium hypochlorite (NaOCl) irrigation because this solution not only is a pulp tissue solvent and root canal irrigator but also has significant anti-microbial properties. In addition, NaOCl at certain concentrations can be used to prevent secondary infections through root canal irrigation.[11]

Hemisection can be performed with or without a surgical flap. After the flap is raised, a vertical cut is made from the crown to the furcation

using a fissure bur. Roots that cannot be saved are removed. The success rate of teeth that have been given a hemisection procedure is reported to be 70% up to 85%. The main factors influencing the long-term success of this procedure are case selection and patient's oral hygiene.[12]

The selected restoration was a splinted crown with tooth 37. This was done to increase retention and resistance as well as to hold the mastication load of tooth 36 that has been given distal root hemisection.[13] This procedure aims to prevent teeth from moving when chewing. In the evaluation of the periapical tissue, the healing of the extraction wound was completely visible in two months after the hemisection procedure. Installation of the splinted crown should be done after the extraction wound has healed.

Addition of prefabricated fiber stakes on the mesial root of tooth 36 is highly recommended. This is related to the small number of the remaining crowns and the need for retention for the restoration. Adequate mesial root length and anatomically straight shape can potentially meet retention requirements for crown restorations. The crown design is also made in such a way that the occlusal load received is not too large.[8]

A complication that may occur during and after the hemisection procedure is root fracture. Occlusal modifications are necessary to balance occlusal forces on the remaining roots. Hemisection is a better treatment option than tooth extraction and replacement with a dental implant or conventional prosthesis.[14]

CONCLUSION

Hemisection is a procedure to maintain teeth as long as possible in the oral cavity. In this case, the hemisection procedure can be successful because it is supported by good anatomical conditions of the roots and tooth supporting tissue. A correct diagnosis, prognosis, and appropriate treatment plan can determine the success of the procedure.

CONFLICT OF INTEREST

The authors declare no competing interests.

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