IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 20, Issue 6 Ser.4 (June. 2021), PP 24-28
www.iosrjournals.org

Management of type III canal transportation in curved root canal with large periapical lesion: A case report

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Abstract: *Successful endodontic treatment depends on adequate biomechanical preparation, proper disinfection and three dimensional obturation of the root canals. But procedural accidents that occur during clinical practice may compromise the prognosis of the tooth under root canal treatment. Canal transportation is one of the most frequently encountered endodontic mishaps in curved root canals. It results in un-instrumented areas in the original canal and harbor microorganisms which ultimately leads to treatment failure. There are different management strategies for canal transportation either surgical or nonsurgical depending on extent of the defect. This case report is on surgical management of type III canal transportation in curved maxillary lateral incisor with large periapical lesion in which nonsurgical management with MTA barrier method had been failed to achieve a good apical seal.*

Keywords: *Apical transportation, Curved root canal, Endodontic mishap, MTA, Periapical lesion,* ***,*** *Surgical management*

Date of Submission: 30-05-2021 Date of Acceptance: 13-06-2021

I. Introduction

Chemo-mechanical disinfection of the entire root canal system is necessary for a successful endodontic treatment outcome. Elimination of microorganisms from the root canal and removal of pulp tissue that supports microbial growth while preserving sound root dentin are the main goals of chemo-mechanical preparation. It also determines the quality of subsequent procedures especially, irrigation and obturation. Lack of adequate knowledge or a compromise in ideal treatment methods can lead to a number of procedural errors or accidents which are called as 'endodontic mishaps.' These accidents can occur during diagnosis, access cavity preparation, biomechanical preparation, obturation and even during post space preparation.[1,2] These iatrogenic errors have a negative impact in the prognosis of tooth undergoing endodontic therapy.

Instrumentation of curved root canals is a confront even for experienced clinicians. One of the most common procedural error that may occur, in dilacerated tooth is the apical transportation. According to the Glossary of Endodontic Terms of the American Association of Endodontists, canal transportation is defined as 'the removal of canal wall structure on the outside curve in the apical half of the canal due to the tendency of files to restore themselves to their original linear shape during canal preparation; may end up in ledge formation and possible perforation'.[3] Unfortunately, the majority of teeth have curved canals in different planes, which complicates root canal treatment. In general, root canals with more severe curvature and shorter radius are more challenging.[4,5] During cleaning and shaping, canal curvatures must be taken into account because root canal preparation may result in canal transportation due to the restoring force of the pre-curved instrument. It causes excessive dentin removal at the outer aspect of the curvature apically, whereas more coronal transportation happens at the inner aspect of the straight part of the canal.

The introduction of Nitinol shape memory alloys by Buchler enabled easier and faster instrumentation of the root canal, and also provided consistent and predictable shaping with less chances of iatrogenic errors especially in curved canals. Whereas, stainless steel instruments have a tendency to straighten and cause iatrogenic damages such as stripping, zipping and perforation[6,7,8]. The major clinical problem associated with canal transportation is that a part of the original root canal will remain unprepared and insufficiently cleaned. It may provide a site for microbial growth and ultimately results in endodontic treatment failure[9].

There are different treatment strategies in the management of apical transportation. Either surgical or nonsurgical management can be carried out depending on the size and accessibility of the defect[10,11]. Surgical intervention can be attempted if the nonsurgical treatment modalities neither helpful to negotiate the original canal nor provide adequate repair of the transported area. This case report is on surgical management of iatrogenic apical transportation in a curved maxillary lateral incisor, in which nonsurgical approach was not found to be successful.

II. Case report

A 23-year-old male patient reported to the department of conservative dentistry and endodontics with complaints of pain and swelling in relation to root canal treated upper right front tooth for past 3 days. History revealed that the patient had trauma to that particular tooth about 10 years ago. He had noticed pus discharge in relation to that tooth for last 1 month and had undergone root canal treatment by a general dentist 2 weeks back. But the symptoms got worsened after endodontic therapy. He experienced pain and swelling involving the right upper part of the face and consulted for expert treatment.

On extraoral examination, a tender, firm swelling involving the right upper part of face was noted. Intraoral examination showed a sinus opening between the maxillary right lateral incisor and canine with pus discharge. The lateral incisor was tender on percussion with normal mobility. Periodontal probing was within normal limits.

Radiographic examination showed a large periapical radiolucency in relation to obturated 12 and the lesion extended to 11 and 13. Apical transportation in the curved root canal of 12 was also detected from the radiograph (Fig 1). EPT and cold testing on 11 and 13 showed no response. Treatment options were discussed with the patient. Endodontic re-treatment for 12 by nonsurgical management of the transportation was planned along with conventional root canal treatments for 11 and 13.

Under rubber dam isolation, gutta percha was removed from the root canal of 12. Copious purulent discharge was observed from the canal. Later, canal was irrigated with 5.25% sodium hypochlorite and normal saline. Apical transportation was confirmed with periapical radiographs by inserting 35 k file. Curved apical part of the original canal was negotiated using a 10 k file (Fig 2) and apical enlargement was done using pre-curved k files up to 30 size. Access opening followed by biomechanical preparation was performed in 11 and 13. After that, calcium hydroxide mixed with 2 % chlorhexidine intracanal medicament was placed in all the three teeth for two weeks. Oral analgesics and antibiotics were also given.

Symptoms subsided in the second visit. But purulent exudate persisted in 12. Therefore, calcium hydroxide intracanal medicament was placed again in that tooth for 1 week. Obturation was done in 11 and 13 by cold lateral compaction technique with zinc oxide eugenol sealer. In the subsequent visit, 12 was re-opened, thoroughly instrumented and irrigated with saline in order to remove the intra canal medicament. Canal appeared to be dry and ready for obturation. Copious irrigation was carried out with 5.25% NaOCl and 17% EDTA. The gutta-percha master cone inserted in the root canal did not provide accurate fit at the apical third. Hence, it was decided to repair the defect with 4mm MTA apical plug. Unfortunately, MTA could not be compacted in to the apical 2 mm of the canal due to the curvature of the root (Fig 3). Remaining coronal root canal space was obturated with cold lateral compaction technique. It was planned to surgically remove the unsealed apical portion of the root with apicectomy.

Patient was recalled after 1 week. Surgical management was done under local anesthesia (2% lignocaine) and a full thickness rectangular muco-periosteal flap was raised from distal of 13 to the mesial of 11(Fig 4). Upon flap elevation, a large bony defect of size 1.5cm×2 cm was discernible (Fig 5). Complete loss of the buccal cortical plate in right maxillary lateral incisor with intact palatal cortical plate was noted. Lesion was curetted and the periapical granulation tissue was removed (Fig 6). Then, the area was rinsed with saline solution. Apical 3 mm of the root was resected (Fig 7,8). Following this, flap was repositioned and sutured using simple, interrupted suturing technique (Fig 9). Periodontal pack was placed for better healing of the surgical site (Fig 10).

The patient was recalled after 7 days for suture removal and examined after 3 weeks. The healing of the site was uneventful with complete absence of symptoms (Fig 11). 3 months follow-up radiograph showed evidence of bone formation in the site of periapical lesion (Fig 12).

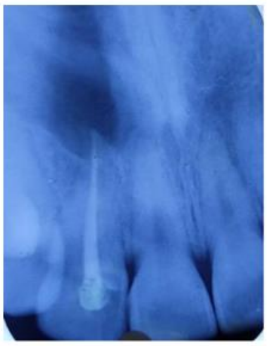

Fig 1: Pre-operative radiograph showing canal transportation in 12.

Fig 2: Original canal of 12 was negotiated.

Fig 3: MTA barrier in 12 didn't seal apical 2 mm.

Fig 4: Incisions for rectangular fullthickness flap

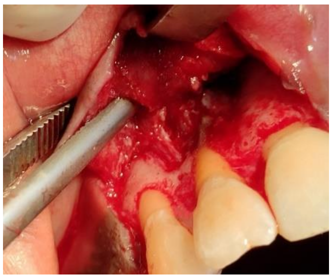

Fig 5: Periapical lesion after elevation of the flap

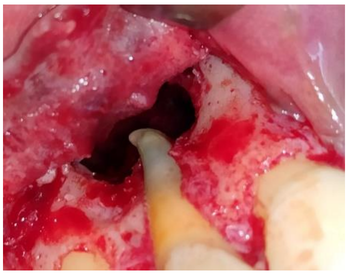

Fig 6: Lesion after removal of granulation tissue

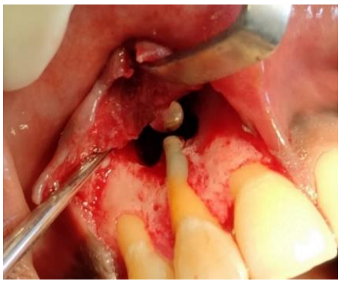

Fig 7: Apicectomy of 12

Fig 8: Radiograph after apicectomy

Fig 9: Suturing

Fig 10: Periodontal pack placed

Fig 11**:** Photograph after 3 months

Fig 12: Radiograph after 3 months

III. Discussion

Like any other medical fields, a dentist may also face unsolicited clinical situations during patient management. Endodontic mishaps are the unfortunate procedural accidents that may occur during root canal therapy. These accidents can occur during diagnosis, access cavity preparation, biomechanical preparation, obturation and even during post space preparation. These iatrogenic errors result in undesirable effects in the prognosis of tooth under endodontic therapy[1,2].

Instrumentation of severely curved root canals is still a challenge even for experienced clinicians. One of the most common endodontic mishap that may encounter in dilacerated tooth is canal transportation. Apical canal transportation is defined as moving the position of canal's normal anatomic foramen to a new location on the external root surface. Lately, a classification of canal transportation based on the extent of defect has been proposed[12].

Type I: Shows minor movement of the physiologic apical foramen. (Figure 13B)
Type II: Shows moderate movement of the physiologic apical foramen to a new location. (Figure 13C)
Type III: Shows severe movement of the physiologic apical foramen. (Figure 13D)

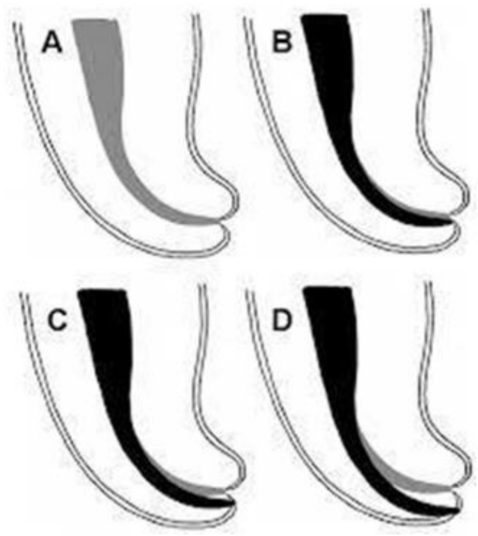

Fig 13

Other procedural errors associated with canal transportation include damage of the apical foramen, elbow formation, zip formation and perforation.

Precise diagnosis, appropriate case selection, and adherence to basic management principles may prevent occurrence of endodontic mishaps to a certain extent. The following factors are associated with an increased risk of canal transportation:

- Insufficiently prepared access cavity which restricts the straight-line access to the apex.
- Degree and radius of the canal curvature
- Alloy type (nickel–titanium instruments cause only reduced amount of deviation from the original curvature than stainless-steel) and design features of root canal instruments.
- Use of instruments with sharp cutting tips.
- Use of inflexible instruments of sizes above #20 in severely curved root canals.
- Instrumentation technique
- Insufficient irrigation during biomechanical preparation.
- Operator-related factors.

In this case, curvature of the root in the apical third and lack of adequate experience of the operator would have been increased the risk of apical transportation. The greater degree of curvature (>20^0) and the smaller radius of curvature (<4mm) increase the chance of canal transportation[4,5].

According to the new classification mentioned above, canals presenting with type I apical transportation can be cleaned and obturated. Clinician can try to achieve positive canal architecture to improve the prognosis of tooth if, sufficient residual dentin can be maintained. Type II cases may compromise the prognosis but these cases can be managed by biocompatible materials like MTA to control bleeding and to provide an apical barrier against which obturating material can be compacted. Type III cases are difficult to treat and the prognosis is poor[10]. In such situations, barrier technique is usually not successful. Hence, surgical intervention for correction of the defect is inevitable.

In the present case, type III apical canal transportation was diagnosed and conservative nonsurgical management was attempted initially. Therefore, original canal in the curved part of the root canal was negotiated and chemo-mechanical preparation was carried out. The apical defect was large and irregular hence, the gutta-percha master cone could not provide proper fit. MTA is the material of choice for managing various preparation defects, so we tried to seal the defect using MTA[13,14]. It is a bioactive material with excellent biocompatibility and the sealing ability of it is not affected by presence of blood or periapical fluid. In addition, MTA inducts hard tissue formation and allows normal periodontal attachment[15]. Here, we tried to create MTA barrier, but it didn't flow properly to the defective area due to the curvature of the canal in apical third. So, obturation followed by apicectomy was unavoidable to repair the apical defect caused by transportation.

IV. Conclusion

Instrumentation of curved root canal is a challenge to clinicians. The procedural accidents occur in such cases can be prevented with proper diagnosis, case selection and appropriate management principles. Canal transportation is one of the most common endodontic mishap that may encounter during biomechanical preparation of the curved canals. Based on the extent and accessibility of the defect, there are different management strategies for transportation. In this case, MTA barrier was not successful in repairing the defect; so corrective apical surgery was done for better outcome. Follow up of this case indicated excellent result with complete resolution of symptoms.

Acknowledgement

The authors deny any conflicts of interest related to this study.

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