International Journal of Dentistry and Oral Science (IJDOS)
ISSN: 2377-8075

Clinical Practice Guidelines On Endodontic Mishaps That Occur During Cleaning And Shaping

Research Article

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Abstract

Introduction: Root canal treatment involves access cavity preparation, cleaning and shaping of the canal followed by three dimensional obturation of the canal. Close observation and strict adherence to the principles will allow the clinician to perform the treatment correctly.
However mishaps are bound to occur as patients bring in a variety of teeth with various canal anatomies which pose a challenge for the clinician. Failure to know the rationale behind the concept of biomechanical preparation can lead to the chances of occurrences of unnecessary complications such as canal blockage, ledge formation, transportation and perforation.
Aim: The aim of this review is to compile the factors affecting the occurrence of mishaps while cleaning and shaping and their preventive and corrective measures.
Materials and Methods: The guidelines were framed based on the data collected from the articles searched on electronic databases such as Pubmed, Pubmed central and google scholar.
Conclusion: The incidence of endodontic mishaps can be reduced by accurate diagnosis, correct case selection and adherence to basic principles of endodontic therapy.

Keywords: Canal Blockage; Endodontic Mishaps; Ledge Formation; Instrument Separation; Perforation.

Introduction

Endodontic mishaps or procedural accidents are those unfortunate occurrences that happen during treatment, some owing to inattention to detail, others totally unpredictable. Endodontic mishaps can be access related, instrumentation related, obturation related or miscellaneous.[1] It is important to manage the mishaps once they are encountered. [2] Also it is very important to frame preventive measures to prevent such accidents from occurring.[3]

Endodontic mishaps that occur during cleaning and shaping are more taxing. These mishaps are the most frequently occurring mishaps compared to access cavity related mishaps or obturation related mishaps.[4] Cleaning and shaping is considered to be the most vital step of root canal treatment. Not only does it focus on disinfection, it also aims to provide space for a three dimensional seal of the canal. It is important to focus on the errors that occur during cleaning and shaping, follow measures to prevent accidents and also to correct the errors.[5]

The endodontic mishaps related to cleaning and shaping can be canal blockage, ledge formation, instrument separation and perforation. [1] There are various causes for such accidents to occur. The first step in management of such mishaps is to recognise the error. It is of key importance to recognise, locate the site of mishap followed by corrective measures. [6, 7]

Recognition is the first step in management which includes clinical and radiographic observation. The next step is correction of the mishap which depends on the type and extent of the procedural accident. The final step requires re-evaluation and assessing the prognosis of the tooth.

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Received: May 04, 2021
Accepted: July 29, 2021
Published: August 02, 2021

Citation: Mulumoodi Rama Sowmya, Sandhya Raghu. Clinical Practice Guidelines On Endodontic Mishaps That Occur During Cleaning And Shaping. *Int J Dentistry Oral Sci.* 2021;8(8):3607-3612. doi: http://dx.doi.org/10.19070/2377-8075-21000738

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Previously our team had a rich experience in working on various research projects across multiple disciplines [8-21] Now the growing trend in this area motivated us to pursue this project.

Clinical Practice Guidelines

Figures

Ledge Formation

A Ledge is an artificially created irregularity on the extersurface of the root canal wall that prevents the placement of the instrument till the apex of an otherwise patent canal [22].

Recognition

- Recognition of ledge can be clinical or radiographic examination.
- The canal is usually "straightened" at that point, where a ledge is formed.
- The file can no longer negotiate the curve but catches on a "dead end".
- Normal tactile sensation of the tip of the instrument will be lost while binding in the canal.[23]

Prevention

- The use of precise radiographs both preoperative and "working radiographs" to determine the root canal length, copious irrigation, precurving of the files, and incremental instrumentation will reduce the chances of ledge formation.[24]
- Frequent recapitulation, irrigation, along with the use of lubricants are mandatory during root canal instrumentation.[25]
- The chances of ledge formation are greatly reduced when passive step-back and balanced force techniques are employed.
- The incidence of ledge formation is lesser with the use of flexible files (such as NiTi files) when compared to the use of conventional stainless steel files.[23]

Correction

Depending on the extent of the procedural accident, the correction of a ledge might be accomplished in one of several ways.[9]

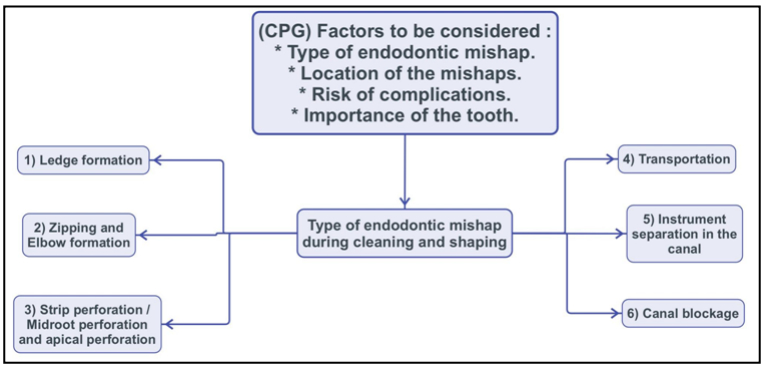
- Relocating and renegotiation of the canal anatomy.
- Bypassing the ledge.
- In cases where the canal cannot be negotiated, it is recommended to obturate till the level of ledge formation.[26]

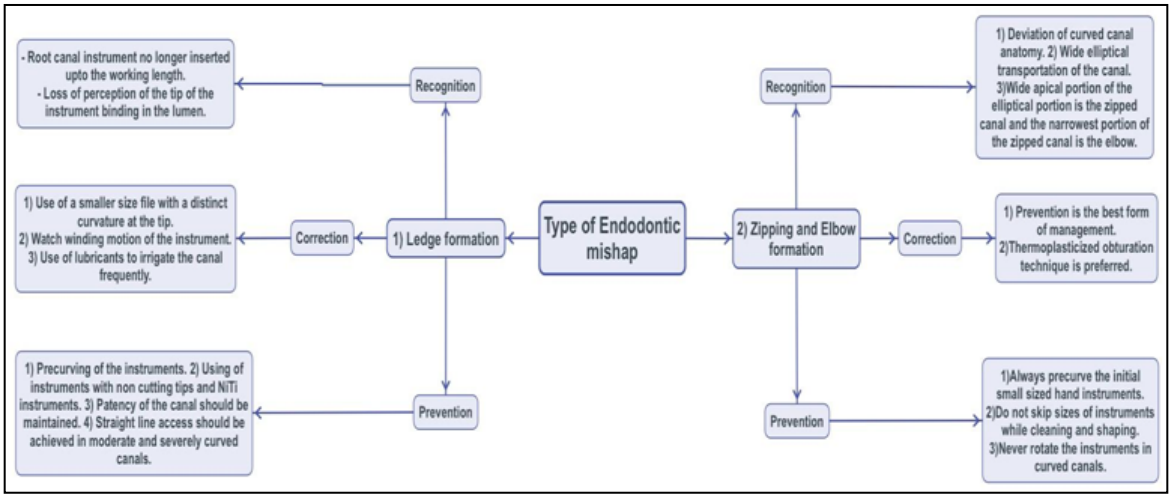
Zipping and Elbow Formation

Zipping is the transportation of the apical portion of the canal which usually occurs in curved canals. When a file is rotated in a curved canal, the apical portion tends to become a teardrop shape or wide elliptical shaped portion. The wide apical portion of the elliptical portion is called "Zip" whereas the narrow portion of the elliptical portion is called " Elbow."

Recognition

- Deviation of curved canal anatomy.
- Wide elliptical transportation of the canal.
- Wide apical portion of the elliptical portion is the zipped canal and the narrowest portion of the zipped canal is the elbow.





Prevention

- Pre curve the initial size instruments.
- Use incremental filing technique.
- Use flexible instruments.
- While cleaning and shaping, the sizes of the instruments should not be skipped.[27]
- Never rotate the instruments in curved canals.

Correction

- Prevention is the best form of management.
- Thermoplasticized obturation technique is preferred.

Perforations

Perforation is defined as a mechanical or pathological communication between the root canal system and external tooth surface. The type of perforation that can occur during cleaning and shaping are Midroot/Strip perforation and Apical perforation.[24]

Mid Root perforation/ Strip perforation

Strip perforation is a procedural mishap which can negatively affect the prognosis. Mesiobuccal root of maxillary molars and the mesial root of mandibular molars are highly susceptible to strip perforation because of thin dentinal walls.[28, 29]
"Stripping" is lateral perforation that is caused by overinstrumentation through a thin wall in the root.[30]

Recognition

- Stripping is easily detected by sudden haemorrhage from a previously dried canal or by a sudden complaint by the patient.[31]
- It is detected radiographically on the lateral surface of the root canal.[31]
- By using paper points the location and extent of strip perforation can be detected.

Correction

Management of strip perforation is often difficult because of the inability to gain access and is often unpredictable.

- Non surgical management by MTA obturation.[33, 34]
- Surgical management

Prevention

- Can be prevented by previewing the canal morphology prior to the treatment.
- Maintaining the curvature of the canal by pre-curving the instruments.[35]
- Usage of flexible NiTi instruments in curved canals.[32]
- By using anti curvature filing technique.

Apical perforation

Apical perforation occurs as a result of file not negotiating the curved canal or not establishing the accurate working length and instrumenting beyond the apical confines.

Figure 1. Ledge formation in curved canal(Courtesy: Theodor Lambrianidis).

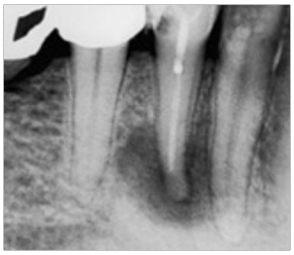


Figure 2. Zipping noticed in the distal canal of mandibular first molar. (Courtesy: Dentomedia).

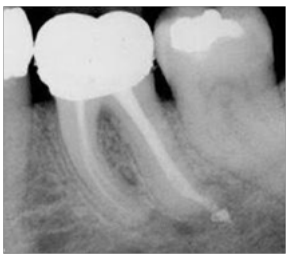


Figure 3. Strip perforation in the distal root (Courtesy: Ciobanu et al, Case reports in dentistry).

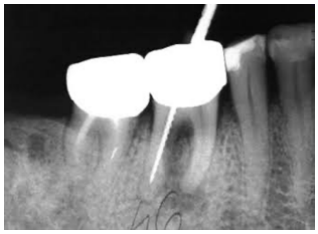


Figure 4. Radiograph with #20 file in place confirming lateral perforation in the distal aspect of the tooth (Courtesy: Savita et al, Saudi Dental Journal).

Figure 5. Instrument separation in the mesiobuccal canal of the first molar.

Figure 6. Apical transportation noticed in mesial and distal roots of mandibular molar. (Courtesy: Pocket dentistry).

Recognition

- Patient suddenly complains of pain during treatment.
- Canal is flooded with haemorrhage.
- Tactile resistance of the canal space is lost within the confines of the root canal space.[36]

Correction

- Re establish the tooth length short of original length and enlarge the canal upto that length.[37]
- Create an artificial apical barrier.
- Use of sealing materials such as MTA, bio aggregate, calcium enriched mixtures to seal the perforation.[38]
- Guided endodontics can be followed to achieve a precise outcome.[26]

Prevention

- Maintain the working length while instrumentation.
- Do not over instrument the canal space.[39]

Instrument Separation

A wide range of instruments has been reported to fracture within the root canal system including Gates-Glidden burs, stainless steel files nickel-titanium (NiTi) rotary instruments, lateral spreaders, peeso reamers. [40]Visible signs of permanent deformation and potential fracture are more often evident in manually operated SS files rather than NiTi rotary instruments. As a result, rotary NiTi instruments have been associated with fracture without warning. The rationale behind increased susceptibility of fracture of NiTi compared to SS is due to their low yield and tensile strength at lower loads.[41]

Recognition

- Fracture of the tip of the instrument.
- Obstruction in the canal during passage of instrument.
- Radiographic examination of the instrument separated.

Correction

- Attempt to remove the separated instrument(H files or Ultrasonics).[42]
- Attempt to bypass the instrument.
- If the instrument isn't beyond the apex, obturation till the separated instrument.
- If the instrument is beyond the apex, apical surgery is considered.[43]

Prevention

- Creation of glide path.
- Ensure straight line access.
- Avoid hurrying or forcing the instrument.[44]

● Discarding the unwinded instruments and use of a new set of instruments frequently.[45]

Transportation

According to the Glossary of Endodontic Terms of the American Association of Endodontists, Canal transportation is defined as " 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 lead to ledge formation and possible perforation."

Recognition

Apical transportation can be categorized into:[46]

Type 1: represents a minor movement of the position of the physiologic foramen, which results in the iatrogenic relocation of the apical foramen.

Type II: represents a moderate movement of the physiologic position of the foramen, which also results in an iatrogenic relocation of the foramen on the external root surface. In this type, a larger communication with the periapical area exists, and attempts to instrument further might weaken or perforate the root.

Type III: represents a severe movement of the physiologic position of the canal, which results in a significant iatrogenic relocation of the physiologic foramen.

Correction: [46]

Three types of apical transportations have different treatment strategies.[47]

● Type I:bio mechanical preparation and obturation , if sufficient residual dentin is maintained and shape created above the foramen.
● Type II: A barrier material to control the bleeding and provide a backstop (MTA / Biodentine) to pack against during subsequent obturation procedures should be placed.[48]
● Type III: A barrier technique might not be feasible. Obturation with thermoplastic obturation technique followed by corrective surgery.

Prevention:[49]

● Always precurve the initial small sized hand instruments.
● While cleaning and shaping the sizes of the instruments should not be skipped.
● Never rotate the instruments in curved canals.
● Use of watch winding motion while instrumentation.

Our institution is passionate about high quality evidence based research and has excelled in various fields [11, 50-59]

Conclusion

Endodontic mishaps due to canal aberrations like calcifications, severe root curvatures, do not contribute to the treatment failure directly. The technological advancements like dental microscope, ultrasonics, NiTi instruments should be utilised to achieve successful endodontic therapy. The incidence of endodontic mishaps like ledge, perforations, and canal blockage due to instrument separation can be reduced by accurate diagnosis, correct case selection and adherence to basic principles of endodontic therapy.

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