ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF RESEARCH IN PHARMACEUTICAL SCIENCES

Published by JK Welfare & Pharmascope Foundation Journal Home Page: www.ijrps.com

Assessment of Different Areas of Perforation While Performing RCT

Keerthiga Nagarajan[1], Iffat Nasim[*2], Arthi B[3]

[1]Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India
[2]Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India
[3]Department of Public Health Dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India

Article History:

Received on: 17 Nov 2020
Revised on: 26 Dec 2020
Accepted on: 31 Dec 2020

Keywords:

Endodontic complications, Iatrogenic perforations, Perforation sites, Procedural errors, Root canal therapy

ABSTRACT

Root perforation is defined as an iatrogenic or pathological communication between the root canal system and the external tooth/root surface. They may be pathologic or iatrogenic in etiology. Iatrogenic perforations during root canal therapy account for a large portion of endodontic failures and may necessitate the need for extraction. Assessing the sites commonly perforated helps anticipate such complications and thereby formulate means to improve the quality of treatment offered. This study aims to assess the different areas of perforation while performing root canal treatment. A retrospective cross-sectional study was conducted using the patient records from the OPD of Saveetha Dental College, Chennai from June 2019 to April 2020, and patients above the age of 18 years who underwent perforation management were selected by non-probability sampling. Data was collected and then subjected to statistical analysis using Statistical Package for Social Science for Windows (version 20.0, SPSS Inc., Chicago Ill., USA). Chi-square test was employed with a level of significance set at $p<0.05$. It was found that the most common site of perforation was the furcation area (50%), followed by crown perforations (44.1%). There were more males (52.9%) who experienced perforations than females and the most common age group was 35-55 years (50%). There was a significant difference between the site of perforation and tooth involved (p=0.032). There also was a significant difference between the perforation site and the arch involved (p=0.044). The most commonly perforated tooth was found to be mandibular molars.

*Corresponding Author

Name: Iffat Nasim
Phone: +91 9940063567
Email: iffatnasim@saveetha.com

ISSN: 0975-7538

DOI: https://doi.org/10.26452/ijrps.v11iSPL4.3776

Production and Hosted by

IJRPS | www.ijrps.com

INTRODUCTION

Root canal therapy is extensively acknowledged as a complex dental procedure. The key objective of endodontic therapy is to eliminate or decrease the microorganisms from the root canal space by chemomechanical preparation and to prevent re-infection and promote periapical healing by sealing the root canal space airtight (Kabak and Abbott, 2005). When the highest standards are followed during the procedure, endodontic therapy has a high success rate. Literature shows a success rate of 90–95% for root canal treatments (Kerekes and Tron-

stad, 1979; Sjögren, 1990; Adebayo, 2012).

In spite of the high success rate of root canal treatment, failures do occur in a large number of cases and most of the times may be attributed to persistence of bacteria (intra-canal and extra-canal), inadequate filling of the canal, overextension of root filling materials, improper coronal seal (leakage), untreated major and accessory canal, iatrogenic procedural errors such as poor access cavity design and complications of instrumentation such as ledges, perforations, or separated instruments (Siqueira, 2001; Ramamoorthi *et al.*, 2015; Tabassum and Khan, 2016).

A perforation is a communication that arises between the periodontium and the root canal space. Perforations may be pathological, resulting from caries or resorptive defects, but most commonly are iatrogenic, occurring during or after root canal treatment. Perforations are found to account for as many as 10% of all failed endodontic cases (Fuss and Trope, 1996). The etiology of iatrogenic perforations may be understood as follows:

Perforations of the coronal third often result from endeavors to locate and open canals. The common causes of coronal and furcation perforation include calcifications of the pulp chamber and the orifices, misidentification of canals, significant crown-root angulations and excessive removal of coronal dentine.

Strip perforations of the middle third may occur if there is overzealous instrumentation typically following an aggressive crown-down approach using GG-drills or large files in narrow canals as well as sclerosed canals. Characteristically, this occurs in curved molar roots resulting in a furcational strip perforation and may also occur while negotiating sclerosed canals.

Perforations of the apical third may be due to inadequate cleaning and shaping of the canal leading to blockages and ledges causing instruments to deviate, transporting the canal until a perforation occurs. Stiff instruments placed into curved canals may also straighten the canal, causing zip perforations. Apical perforations occur when the dentist aggressively passes the files through the apical constriction.

Post-space preparation following obturation may result in both apical and strip perforation. Sometimes the post is not placed into the root canal but the adjacent dentine, resulting in catastrophic consequences

Iatrogenic perforations during root canal therapy account for a large portion of endodontic failures and may compel the need for extraction of the tooth. This study therefore aims to shed light on the sites commonly perforated during endodontic therapy in order to stress the importance of foreseeing such mishaps and improve the quality of treatment offered.

MATERIALS AND METHODS

Study design and setting

This retrospective study examined the records of patients from June 2019-April 2020 undergoing treatment at Saveetha Dental College, Chennai. Ethical approval was obtained from the Institutional Ethics Committee. The study population included patients of age 18 years and above who underwent perforation management at the OPD of Saveetha Dental College by means of non-probability convenience sampling. Patients with mental or physical disability were excluded from the study.

Data collection

Saveetha Dental College's patient records were analysed to identify 34 patients in the hospital database who underwent perforation repair. All the data available were included to minimize sampling bias. Relevant data such as patient age, sex, tooth involved, site of perforation and operator qualification was recorded. Repeated patient records and incomplete records were excluded. Data was verified by an external reviewer.

Statistical analysis

Data was recorded in Microsoft Excel/2016 (Microsoft office 10) and later exported to the Statistical Package for Social Science for Windows (version 20.0, SPSS Inc., Chicago Ill., USA) and subjected to statistical analysis. Chi-square test was employed with a level of significance set at $p<0.05$.

RESULTS AND DISCUSSION

The final dataset consisted of 34 patients of Indian origin who underwent perforation repair. The mean age of the population was found to be 41.50 ± 13.97 years. The most common age group undergoing perforation repair was found to be 35-55 years (50%), followed by the age group less than 35 years (35.3%), 55-75 years (11.8%) and more than 75 years being the least (2.9%) [Table 1].

Most of the patients who underwent perforation repair were found to be males (52.9%), while 47.1% of them were females [Figure 1].

The most perforated site was found to be furcal perforations (50%), followed by crown perforations (44.1%) and root perforations (5.9%) [Figure 2, Table 2].

Table 1: Age distribution

Age groups	Frequency	Percentage (%)
Less than 35 years	12	35.3
35-55 years	17	50
55-75 years	4	11.8
More than 75 years	1	2.9
Total	34	100
Mean ± S.D	41.50 ± 13.97	

Table 2: Frequency distribution of perforation sites

Site of perforation	Frequency	Percentage (%)
Crown perforation	15	44.1
Furcal perforation	17	50
Root perforation	2	5.9
Total	34	100

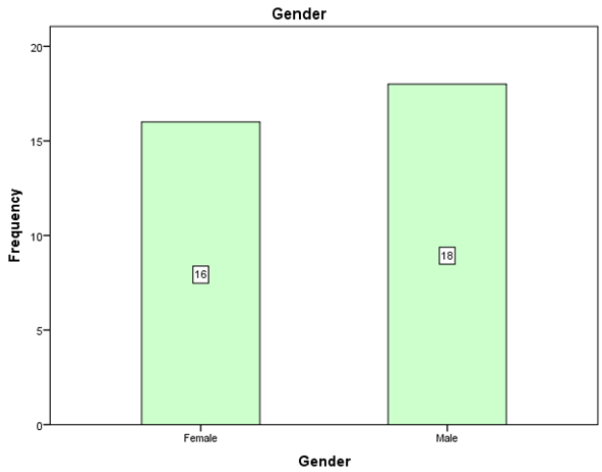

Figure 1: Gender distribution. Graph shows the gender distribution of the study population (N=34)

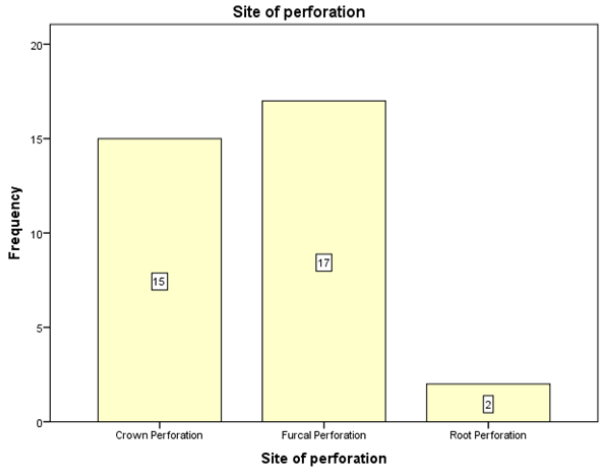

Figure 2: Perforation sites. Graph depicts the different sites of perforation

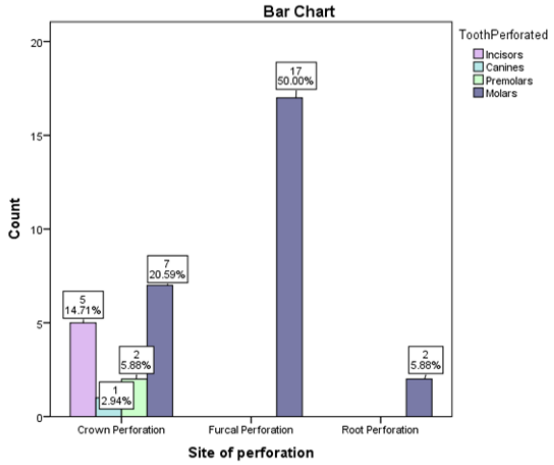

Figure 3: Perforation site vs tooth perforated. Bar graph depicting the association of site of perforation with the tooth perforated

There was a statistically significant difference between perforation site and tooth perforated. (p=0.039) The most commonly perforated site being furcation of molars, followed by crown perforations in molars followed by incisors [Figure 3]. There also was a statistically significant difference between perforation site and arch involved (p=0.044). The most commonly perforated site was furcation involving mandibular teeth, followed by crown perforations in maxillary teeth and crown perforations of mandibular teeth [Figure 4]. The current study showed that the most commonly affected site is furcation of mandibular molars.

Table 1 shows the age distribution of the study population. Mean age of the population is 41.50±13.97 years. Most common age group was found to be

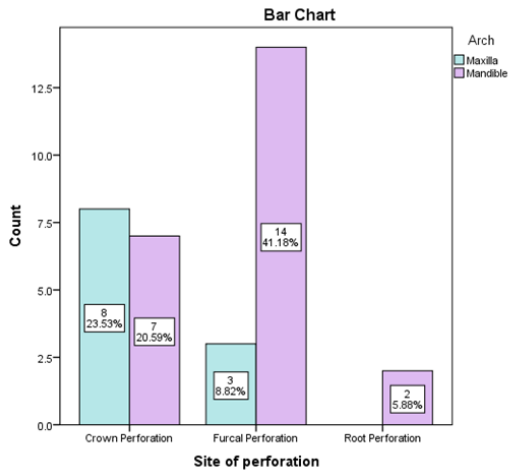

Figure 4: Perforation site vs arch involved. Bar graph depicting theassociation of site of perforation with arch involved

35-55 years (50%), followed by <35 years (35.3%), 55-75 years (11.8%) and >75 years (2.9%). In Figure 1, X-axis represents gender and Y-axis represents the frequency. 52.9% were males, while 47.1% were females. In Figure 2, X-axis depicts the site of perforation and Y-axis shows the frequency of perforation. Most of perforations were at the furcation (50%), followed by crown perforations (44.1%) and root perforations (5.9%). In Figure 3, X-axis shows the site of perforation and Y-axis shows the frequency of perforations. Purple depicts incisors, blue depicts canines, green depicts premolars and violet depicts molars. Graph shows that the most commonly perforated site was furcation with the tooth involved being molars, followed by crown perforations with involvement of molars followed by incisors. There is a significant difference between perforation sites and tooth perforated. (Chi-square test, p=0.039-significant)

In Figure 4, X-axis shows the site of perforation and Y-axis shows the frequency of perforations. Blue depicts the maxillary arch and purple depicts the mandibular arch. Graph shows that the most commonly perforated site was furcation involving mandibular teeth, followed by crown perforations in maxillary teeth and crown perforations of mandibular teeth. There is a significant difference between perforation sites and arch involved. (Chi-square test, p=0.044-significant).

The data for this retrospective study was based on residents of Chennai seeking treatment at Saveetha Dental College. Currently, there are no existing studies investigating the distribution of sites perforated while performing root canal therapy in Chennai. Since all the data available were included without a sorting process, no bias was expected in the selection of patients. The current study aims to shed light on the sites commonly perforated during endodontic therapy in order to stress the importance of foreseeing such mishaps and improve the quality of treatment offered.

Diagnosis and pre-treatment investigations are of utmost importance (Shihaab *et al.*, 2016; Janani *et al.*, 2020). The position of the perforation relative to the level of the crestal bone and the epithelial attachment is critical when assessing prognosis (Frank, 1974). Perforations at the furcation of multi-rooted teeth, are regarded to be in the critical zone due to its proximity to the epithelial attachment and the gingival sulcus. Perforations that are coronal to the critical zone have a good prognosis as they are easily accessible and it is possible to achieve an adequate seal without periodontal involvement (Sinai, 1977). The current study showed a higher prevalence of furcation perforations, which was contradictory to the findings from the study carried out by Kvinnsland I et al. which showed a higher prevalence of root perforations (Kvinnsland *et al.*, 1989) and the study by Haji-Hassani N et al. which showed a higher prevalence of strip perforations (Haji-Hassani *et al.*, 2015). This disparity may be accounted to the regional variation and operator hand skill.

The current study revealed a male predominance for iatrogenic perforations. This was also observed in the various case reports available in literature such as the studies carried out by Bains R et al. and Ciobanu IE et al. (Bains, 2012; Ciobanu, 2016). This male predilection may be accounted to root canal morphology variation between genders as documented by M Kazemipoor et al. (Kazemipoor *et al.*, 2015).

The results of the current study showed a higher frequency for mandibular molars to be perforated. This was in congruence with the study by Sivakumar P et al and Tsesis I et al, which showed more frequency in mandibular molars as well (Sivakumar, 2020; Tsesis *et al.*, 2014). This could be due to the fact that mandibular molars are the most commonly treated teeth as they are most prone to caries (Zaatar *et al.*, 1997). However, other studies like the ones carried out by Kvinnsland I et al. and Haji-Hassani N et al. showed greater frequency in maxillary molars (Kvinnsland *et al.*, 1989; Haji-Hassani *et al.*, 2015). This variation may be due to operator skill and experience. It could also be due to ethnic differences. Ethnic differences and root canal morphology have been evaluated in various studies like, Trope et al. and Amos among African American

and Caucasian population (Trope *et al.*, 1986; Amos, 1955), Caliskan et al. and Sert and Bayirli on Turkish population (Çalişkan *et al.*, 1995; Sert and Bayilri, 2004), Lu et al. and Walker on Chinese population (Lu *et al.*, 2006; Walker, 1988), and Zaatar, et al. on the Kuwaiti population (Zaatar *et al.*, 1997).

Proper analysis of the root canal morphology prior to treatment (Ramanathan and Solete, 2015), along with anticipation of such endodontic complications in the critical zone would aid considerably in reducing their incidence and rendering quality treatment. Advancements in treatment modalities for negotiation of calcified canals (Kumar and Antony, 2018) may also be considered to improve the quality of treatment. Dental professionals need to be educated on these advancements (Nasim *et al.*, 2018; Nasim and Nandakumar, 2018; Siddique, 2019) using effective teaching techniques.

The results of the current study showed a high prevalence of perforations in the critical zone, all the more necessitating the need to anticipate such mishaps in an attempt to render quality treatment. However, further studies are needed to establish these findings due to the small sample size of this study and the inclusion of only postgraduate and undergraduate students. More extensive research including all kinds of practitioners as well would establish more significant results.

CONCLUSION

Perforations can result in chronic infection and ultimately loss of teeth. The prevention of iatrogenic perforation is an integral part of all healthcare interventions. It is imperative that the clinician is able to identify a perforation when it has occurred and has knowledge of the best strategy for correcting the damage. This study revealed a predominance of the furcation of mandibular molars to be more frequently perforated. More extensive studies therefore need to be carried out to reiterate the need for more vigilant root canal therapy and to prevent mishaps that lead to endodontic failure.

Funding Support

The authors declare that they have no funding support for this study.

Conflict of Interest

The authors declare that there is no conflict of interest for this study.

REFERENCES

Adebayo, E. T. 2012. Technical quality of root canal fillings done in a Nigerian general dental clinic. *BMC Oral Health*.

Amos, E. R. 1955. Incidence of bifurcated root canals in mandibular bicuspids. *Journal of the American Dental Association*, 50(1):70–71.

Bains, R. 2012. Management of pulpal floor perforation and grade II Furcation involvement using mineral trioxide aggregate and platelet rich fibrin: A clinical report. *Contemporary clinical dentistry*, 3:223–230.

Çalişkan, M. K., Pehlivan, Y., Sepetçioğlu, F., Türkün, M., Tuncer, S. Ş. 1995. Root canal morphology of human permanent teeth in a Turkish population. *Journal of Endodontics*, 21(4):200–204.

Ciobanu, I. E. 2016. Root Canal Stripping: Malpractice or Common Procedural Accident-An Ethical Dilemma in Endodontics. *Case Reports in Dentistry*, pages 1–5.

Frank, A. L. 1974. Resorption, perforations, and fractures. *Dental clinics of North America*, 18(2):465–487.

Fuss, Z., Trope, M. 1996. Root perforations: classification and treatment choices based on prognostic factors. *Dental Traumatology*, 12(6):255–264.

Haji-Hassani, N., Bakhshi, M., Shahabi, S. 2015. Frequency of Iatrogenic Errors through Root Canal Treatment Procedure in 1335 Charts of Dental Patients. *Journal of international oral health*, (7):14–17.

Janani, K., Palanivelu, A., Sandhya, R. 2020. Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp vitality: an in vivo study. *Brazilian Dental Science*, 23(1).

Kabak, Y., Abbott, P. V. 2005. Prevalence of apical periodontitis and the quality of endodontic treatment in an adult Belarusian population. *International Endodontic Journal*, 38(4):238–245.

Kazemipoor, M., Hajighasemi, A., Hakimian, R. 2015. Gender difference and root canal morphology in mandibular premolars: A cone-beam computed tomography study in an Iranian population. *Contemporary Clinical Dentistry*, 6(3):401.

Kerekes, K., Tronstad, L. 1979. Long-term results of endodontic treatment performed with a standardized technique. *Journal of Endodontics*, 5(3):83–90.

Kumar, D., Antony, S. D. P. 2018. Calcified Canal and Negotiation-A Review. *Research Journal of Pharmacy and Technology*, 11(8):3727.

Kvinnsland, I., *et al.* 1989. A clinical and roentgenological study of 55 cases of root perforation. *International Endodontic Journal*, 22(2):75–84.

Lu, T. Y., Yang, S. F., Pai, S. F. 2006. Complicated Root Canal Morphology of Mandibular First Premolar in a Chinese Population Using the Cross Section Method. *Journal of Endodontics*, pages 932–936.

Nasim, I., Hussainy, S. N., Thomas, T., Ranjan, M. 2018. Clinical performance of resin-modified glass ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up. *Journal of Conservative Dentistry*, 21(5):510–510.

Nasim, I., Nandakumar, M. 2018. Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis. *Journal of Conservative Dentistry*, 21(5):516–516.

Ramamoorthi, S., Nivedhitha, M. S., Divyanand, M. J. 2015. Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: A randomised controlled trial. *Australian Endodontic Journal*, 41(2):78–87.

Ramanathan, S., Solete, P. 2015. Cone-beam Computed Tomography Evaluation of Root Canal Preparation using Various Rotary Instruments: An in vitro Study. *The Journal of Contemporary Dental Practice*, 16(11):869–872.

Sert, S., Bayilri, G. 2004. Evaluation of the Root Canal Configurations of the Mandibular and Maxillary Permanent Teeth by Gender in the Turkish Population. *Journal of Endodontics*, 30(6):391–398.

Shihaab, S. S., Pradeep, Noor, E. 2016. Chlorhexidine: Its properties and effects. *Research Journal of Pharmacy and Technology*, 9(10):1755–1755.

Siddique, R. 2019. Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi. *Journal of conservative dentistry*, 22(1):40–47.

Sinai, I. H. 1977. Endodontic perforations: their prognosis and treatment. *The Journal of the American Dental Association*, 95(1):90–95.

Siqueira, J. F. 2001. Aetiology of root canal treatment failure: why well-treated teeth can fail. *International Endodontic Journal*, 34(1):1–10.

Sivakumar, P. 2020. Prevalence of Perforations in RCTs and Knowledge of Management among Under-Graduate Students. *J. Pharm. Sci. & Res*, 12(2):310–313.

Sjögren, U. 1990. Factors affecting the long-term results of endodontic treatment. *Journal of Endodontics*, pages 498–504.

Tabassum, S., Khan, F. R. 2016. Failure of endodontic treatment: The usual suspects. *European Journal of dentistry*, 10(1):144–147.

Trope, M., Elfenbein, L., Tronstad, L. 1986. Mandibular premolars with more than one root canal in different race groups. *Journal of Endodontics*, 12(8):343–345.

Tsesis, I., *et al.* 2014. Medicolegal aspects of iatrogenic root perforations. *Refu'at ha-peh veha-shinayim*, 31(2):15–18.

Walker, R. T. 1988. Root canal anatomy of mandibular first premolars in a southern Chinese population. *Dental Traumatology*, pages 226–228.

Zaatar, E. I., Al-Kandari, A. M., Alhomaidah, S., Yasin, I. M. A. 1997. Frequency of endodontic treatment in Kuwait: Radiographic evaluation of 846 endodontically treated teeth. *Journal of Endodontics*, 23(7):453–456.