

KNOWLEDGE, ATTITUDE AND PRACTICE BASED SURVEY ON THE INCIDENCE OF C SHAPED CANALS IN THE MANDIBULAR MOLARS AMONG UNDERGRADUATE STUDENTS

¹Naz Fathima Raj Mohamed and ^{2*}Dr. Adimulapu Hima Sandeep

¹Undergraduate Student, Saveetha Dental College and Hospital Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-600077

²Associate Professor, Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-600077, Tamil Nadu, India

himas.sdc@saveetha.com² and 151901061.sdc@saveetha.com¹

ABSTRACT

Objective: The C-shaped root canal is a unique root morphology that is mostly present in mandibular second permanent molars. C-shaped root canal networks may make endodontic procedures more difficult due to their structure's complexity. For accurate diagnosis and successful treatment, a complete grasp of root canal morphology is required. This survey aims to summarize current knowledge, attitude and practice based survey on the incidence of c shaped canals in the mandibular molars among undergraduate students.

Materials and methods: The online survey was conducted among 100 participants among dental practitioners on google forms. The survey was done in January 2021. The Questionnaire consisting of 25 questions were framed based on the incidence of c shaped canals in the mandibular molars and circulated. Responses from the participants were collected and exported to SPSS software. The results were acquired and statistically analysed using SPSS software. The results were represented as pie charts and bar graphs.

Results: The association between participants with different years of study was analysed and found that the majority of first year and second year participants agreed that c shaped canals often have conical or square configuration than others. The association is statistically significant. Chi square analysis value (p -value) = 0.025 ($p < 0.05$ is statistically significant).

Conclusion: From this, it can be concluded that undergraduate students had a moderate amount of awareness about C shape canals. As a result, more awareness has to be created in the UG curriculum regarding the various aberrant root canal morphologies.

Keywords: C shaped root canals, Canal Variations, Etiology, Mandibular molars, Management. Aberrant anatomy.

INTRODUCTION

Root canal therapy requires a complete understanding of root canal anatomy and its variations, as well as diagnosis, treatment planning, and clinical expertise. The C-shaped canal arrangement is one such modification of the root canal system.^[1] Cooke and Cox were the first to describe it in the literature. The shape and number of roots are determined by Hertwig's epithelial sheath during the root development stage. It bends horizontally beneath the cement enamel junction and fuses in the centre, leaving root holes^[2] The main reason for a C-shaped root with a C-shaped canal is failure of fusion on the lingual or buccal root surface^[3]. In the pulp chamber of the C-shaped canal, there is normally a single ribbon-shaped opening with a 180-degree arc or greater. The canal begins at the mesiolingual line angle and travels around the buccal aspect before terminating at the pulp chamber's distal end^[4]. As a result of their significant anatomical differences, debridement and obturation of these C-shaped canals is tough^[5]. The cleaning procedure has traditionally been used to investigate the shape of the root canal. However, other techniques have been used as well, including polyester resin cast replicas, histology, transmission electron microscopy, X-ray imaging and more recently computed tomography and micro-computed tomography^[1]

Teeth with C-shaped roots were previously compared to taurodents, however the definition of teeth that fulfill this description has altered^[6]. The gene(s) that cause C-shaped roots in mice can be found on either chromosome 5 or chromosome 17. These investigations, however, did not identify the gene(s) responsible for the creation of a C-shaped root^{[7],[8]}

The C-shaped tooth may contain two or three canals, or it may be continuous throughout the length of the root. Canal structure has been found to be very common in mandibular second molars, with a prevalence of 2.7 percent to 45.5 percent^[9]. Incidence studies in mandibular premolars have been documented in the Chinese, Indian, and Iranian populations, with the Chinese population having the highest incidence (29.7%). The C-shaped variation in canal morphology has also been documented in maxillary first molars (0.12 %), maxillary third molars (0.12%), and maxillary fourth molars (0.12 %), maxillary third molars (4.7%), mandibular third molars (3.5%-4%) and mandibular second premolars (1%)^[10]

A substantial quantity of data on C-shaped roots and root canals has already been accumulated, as seen by the vast number of reviews published in the last two decades^{[11]-[12]}. Our research and knowledge have resulted in high-quality publications from our team^[13-26]

The internal root canal anatomy is based on two-dimensional images, despite the fact that these publications covered a wide variety of general and particular subjects^[27]. To review current knowledge on the etiology, incidence, and morphology of C-shaped roots and root canals, as well as therapeutic management, in order to better comprehend the distinctive and complex tooth morphology known as the C-shaped root canal. Our goal was to analyse undergraduate students' knowledge, attitude, and practice regarding the occurrence of c-shaped canals in mandibular molars.

MATERIALS AND METHODS

The questionnaire-based research was conducted using Google Forms. When the subjects completed the survey, their anonymity was protected. The participants who are dental undergraduate students undertook the survey. A questionnaire contains a total of 25 questions which were framed based on knowledge, attitude and practice based on incidence of c-shaped canals in mandibular molars. We received responses from 100 participants. The study setting used was prospective observational study. Because this is easy to create and has a wide reach. But it didn't overcome survey bias and survey fatigue. The approval was obtained from the Scientific review board, Saveetha Dental College, Chennai. The sampling method used here was simple random sampling. The questions are designed to assess the awareness, knowledge, attitude and practice based on the incidence of c shaped canals in the mandibular molars. Validation of the study was done by principal investigators. Sex, Other profession of individuals were excluded. The survey was done in February 2021, and the results/responses were statistically analysed for descriptive analysis using SPSS software. The student's knowledge is one of the dependent factors, whereas gender, weight, and height are independent variables. To check the association, association graphs and Chi square analysis were used, and a p value of 0.05 was considered statistically significant. A pie chart and a bar graph were used to display the results.

RESULTS

Total of 100 participants, in which 21.82% of individuals were first year, 35.45% were second year, 20% were third year, 18.18% were fourth year and 4.55% were interns. The questionnaire was asked as in **Table 1** in which, about 71.56% of individuals were aware about c shape canals and 28.44% were unaware about it. 47.71% of participants responded that the tooth mostly involved was mandibular 2nd molar, 28.44% responded for mandibular 3rd molar and 23.85% for mandibular 1st molar. Similarly, a study shows that mandibular second molars (90.4%) were the most commonly involved teeth followed by maxillary second molars and maxillary first molar with a low prevalence (7.2% and 2.4%, respectively)^[2]. These results were similar to the results of previous studies^[28] 39.45% of participants reported that ethnic group which has more incidence of c shape canal was Asians, 38.53% of participants reported as Europeans and 22.02% of participants as Americans. About 62.39% of individuals were aware of Melton's classification of c-shaped canals and 37.61% were unaware about it. 54.13% knew about the

three categories of cross section shape of c shaped canals but 45.87% did not know about it. Similarly, about classification, Melton et al.^[29] proposed three categories of c shape of category I, category II of semicolon shape, category III of two or three discrete orifices.

Melton, Krell, and Fuller (1991) proposed a classification based on the cross-sectional shape of C-shaped canals because they come in a variety of configurations. Their shape, on the other hand, can change as the root canal progresses. As a result, the coronal contour of the canal visible on the pulp chamber floor after endodontic treatment may not be typical of deeper canal configurations (Fan, Chen, & Fan, 2001). As a result, Fan et al. (2001) offered a more thorough canal type classification. Because one or more cross-sections in categories I-III, the canal in 11 root-sample cross sections was classified as C-shaped. The diversity in C-shaped canal architecture along the length of the root is accounted for by this categorization. 49.54% of participants responded that the most common shape of canals was semicolon shape, 28.44% responded as c shape and 22.02% as two or three discrete orifices. 35.78% agreed that the best method to diagnose c shape canals was panoramic radiograph, 23.85% agreed as IOPA and 23.85% as both. 62.39% of participants were aware that dyes are used for diagnosing c shape canals and 37.61% were unaware. About 45.87% of participants responded that c shaped root in mandibular 2nd molar radiographically present as two distinct roots with communication, 17.43% as single fused root and 36.70% as both. In this study, 79.82% agreed that type 1 c shape can detect radiographically because of the thin isthmus that links the mesial and distal canals and 20.18% did not agree with it. 57.80% of participants agreed that the configuration of c shape canal has conical or square configuration and 42.20% of participants had contrary opinion about it. 56.88% of participants were aware that A conical or ribbon-shaped canal would result if the sheath failed to fuse on both the buccal and lingual surfaces and 43.12% were unaware.

Majority of participants about 36.70% responded that the most common cause of failure of c shape RCT was isthmus, 34.86% for leaky canal, 19.27% of participants responded for missing canals and 9.17% for Iatrogenic problems as shown in **Figure 1**. Because of the high prevalence of C-shaped canals and a variable canal design depending on the root level, nonsurgical root canal treatment of the mandibular second molar is problematic. A leaky canal (45.2 %) and isthmus (23.8%) were shown to be the most common causes of endodontic failure in C-shaped root canals, according to the study^[2] which was similar to the present study. 50.46% of participants responded that the shape of orifice in c shape canal after axis opening was round shape, 26.61% for oval shape and 22.94% for ribbon shape. About 34.86% of participants responded that rotary and hand instrumentation assisted with sonics and ultrasonics would be the effective management of c shaped canal configuration, 31.19% thought modifications in the obturation techniques, 11.93% thought restoration like amalgam or composites for effective management and 11.93% thought all of it 77.98% of participants agreed that it is possible of passing instrument from mesial to distal aspect without obturation and 22.02% did not agree with the statement. Similarly, study shows that A C-shaped longitudinal groove on the lingual or buccal surface of the root may exist, predisposing the tooth to localised periodontal disease. The occluso-apical dimension of the pulp chamber in teeth with C-shaped canals can be large, and an instrument can travel from a mesial to a distal aspect without being obstructed.^[30] 69.72% of participants were aware that CEJ could be reliable landmark for detecting c shape canal and 30.28% were unaware. About 62.39% of participants were aware that Fiber Optic transillumination would enhance identification of variant canal anatomy and 37.61% were unaware as shown in **Figure 2**. 45.87% of participants were aware that thermoplasticized Gutta-percha could be used for effective obturation because of irregular canal morphology and 54.13% were unaware. Because of diverse anatomical types of C-shaped root canals, Ordinola-Zapata et al. found that the mean percentage of gutta-percha-filled sections at the apical level was 74.5 percent^[31] which related in this study that participants were lacking awareness about gutta-percha in effective obturation. 62.39% of participants prefer rotary files and 37.61% prefer hand files. Recent research shows that the H-files or K-files can be passively put into the canal following instrumentation with nickel titanium rotating instruments, therefore they appear to be safe in C-shaped canals. The injectable thermoplasticized gutta percha technology is preferred because it allows for precise temperature control and uniform viscosity.

The unshaped diverging portions that offer resistance to the flow of the obturating material and the communications between the major contribute to the obturation quality. Regardless of the obturation approach, proper sealer placement using ultrasonic endodontic files is crucial.

About 70.64% of participants were aware that files should not be used larger than no.25 for preparing isthmus to avoid perforation and 29.36% were unaware. 44.04% of participants prefer the core carrier system for obturation technique, 20.18% prefer cold lateral compaction technique, 19.27% prefer continuous wave obturation system and 16.51% prefer injectable cold filling method. Compared to lateral condensation and injectable thermoplasticized gutta-percha procedures, the core-carrier technique was the most successful obturation technique in simulated C-shaped canals in a recent study^[32] which supports this study. 33.94% of participants responded that standard technique was core carrier system, 21.10% prefer cold lateral compaction technique, 32.11% prefer continuous wave obturation system and 12.54% prefer injectable cold filling method. About 82.57% of participants were aware that Gates-Glidden burs should not be used for preparing mesiobuccal and buccal isthmus areas and 17.43% were unaware. Glidden Gates Drilling is used to enlarge the slit or connection in the C-shaped canal system so that all of the anomalies can be accessed. However, these drills cannot be utilised in cases with thin, interconnected isthmuses because they risk perforating the preparation; in such cases, a 25 file size or lower is recommended. To minimise hazard zones in C-shaped canals, Abou-Rass et al suggested using an anticurvature filing technique^[33] which was also agreed in this study. About 42.20% of participants prefer irrigant as Sodium hypochlorite (NaOCl) and 37.61% prefer chlorhexidine and 20.18% prefer Ethylene Diamine tetraacetic acid (EDTA) 54.13% of participants used ultrasonics as irrigation activation device used for better efficacy, 23.85% used Sonic-EndoActivator and 22.02% used negative pressure technique-Endovac. Antimicrobial treatment resistance is increased in microorganisms that have formed biofilms. A combination of mechanical instruments, irrigation using various devices, and the application of antimicrobial drugs in the root canal can be used to destabilize biofilms and reduce bacteria. As a result, employing ultrasonic files or a sonic instrument like the EndoActivator to agitate a C-shaped root canal system can assist remove debris and necrotic pulp tissue^[34] which supports our study. Ultrasonic irrigation approaches were found to be efficient in attaining enough debridement in canals. However, just a few investigations have shown that ultrasonic instrumentation used improperly can cause perforation^[35] which supports this study. 66.06% of participants chose retreatment as a viable option if restoration of c shaped roots fails and 33.94% chose extraction. Results of the following correlation graph mentioned below as **Figure 3, 4 and 5.**

DISCUSSION

According to the results of the current study, Early detection of these configurations allows for root canal cleaning and contouring. Knowledge, attitude, practice-based learning, and a superb c-shaped won't be able with more accurate canal identification or unneeded destruction of healthy tooth structure in the quest for missing canals. Clinicians should know the correct morphology of C-shaped root canals, make an effort to remove pulp tissue and germs, and thoroughly seal the root canal system without voids to decrease endodontic failure of C-shaped root canals. Dentists face a significant obstacle when it comes to negotiation, debridement, and obturation because of the C-shaped anatomy. With advancements in diagnostic techniques, however, the illnesses should no longer be a mystery to clinicians. As a result, more long-term clinical investigations are required to support the identification of this variant in mandibular molars using multiple diagnosis methods in order to better understand this variant of the root canal system and provide better therapy for patients.

CONCLUSION

This study could be stated from this study that undergraduate students had a moderate understanding of C shape canals. The C-shaped root canal architecture in mandibular second molars has an ethnic predilection and a high incidence rate. If the clinician understands the anatomical manifestations, they will be able to adequately address this variance.

Authors Contribution

Naz Fathima Raj Mohamed- Contributed to conception, design, data acquisition and interpretation.

Dr. Adimulapu Hima Sandeep - Contributed to conception, design, and critically revised the manuscript.

All authors gave final approval and agreed to be accountable for all aspects of the work.

Acknowledgement

The authors would like to thank the management of Saveethadental college, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai for giving a platform to carry out this project.

Conflict of interest

The authors declare no conflict of interest.

Source of Funding**The Present Study was supported by the Following Agencies.**

- Saveetha Dental College
- SIMATS, Saveetha University
- Jahabardeen Agencies, Thanjavur, Tamil Nadu

REFERENCES

1. Solomonov M, Paqué F, Fan B, Eilat Y, Berman LH. The Challenge of C-shaped Canal Systems: A Comparative Study of the Self-Adjusting File and ProTaper [Internet]. *Journal of Endodontics* 2012;38(2):209–14. Available from: <http://dx.doi.org/10.1016/j.joen.2011.10.022>
2. Kim Y, Lee D, Kim DV, Kim SY. Analysis of Cause of Endodontic Failure of C-Shaped Root Canals. *Scanning* 2018;2018:2516832.
3. Vivek Babu B, Sandeep AH. Matrix Band Used for Restoration of Class Ii Amalgam Cavities in University Set Up. *SU* 2022;1(43):10374–84.
4. Ranjan M, Hemmanur S, Adimulapu Hima Sandeep. Survival Rate Of Endodontically Treated Teeth With Custom Made Cast Post-A Systematic Review. *Int J Dentistry Oral Sci* 2021;8(05):2574–80.
5. Sowmya MR, Pradeep S, Sandeep AH. Assessment of Knowledge, Attitude and Practice based Survey on the Use of Ultrasonics in Endodontics among Practitioners. *Indian J Forensic Med Toxicol* [Internet] 2020;14(4). Available from: <https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09739122&AN=148410028&h=RSObAJISzkC2X0VqelezS1Ap4vKvzeIh4vLdWY%2BNmXLiVBaXPIYy9B1%2FTB4P7w27QFxmFdL%2FqRLC9QTb4mY8Wg%3D%3D&crl=c>
6. Behera K, Adimulapu Hima Sandeep. Dynamic Navigation System-A current Breakthrough in Dentistry. *Int J Dentistry Oral Sci* 2021;8(5):2910–2.
7. Shimizu T. Mapping of a gene causing mouse gutter-shaped tooth root to chromosome 5. *Arch Oral Biol* 1999;44(11):917–24.
8. Matsune K. Molecular genetic study of the gutter shaped root (GSR) on mouse chromosome 17. *J Oral Sci* 2000;42(1):21–6.
9. Aishwarya Reddy B, Sandeep AH. Etching Technique Used for Composite Restoration in Class I Cavities. *SU* 2022;1(43):10385–97.
10. Donyavi Z, Shokri A, Khoshbin E, Maryam M, Faradmal J. Assessment of root canal morphology of maxillary and mandibular second molars in the Iranian population using CBCT [Internet]. *Dental and Medical Problems* 2019;56(1):45–51. Available from: <http://dx.doi.org/10.17219/dmp/101783>

11. Kato A, Ziegler A, Higuchi N, Nakata K, Nakamura H, Ohno N. Aetiology, incidence and morphology of the C-shaped root canal system and its impact on clinical endodontics [Internet]. *International Endodontic Journal* 2014;47(11):1012–33. Available from: <http://dx.doi.org/10.1111/iej.12256>
12. Taluja C, Shah N, Joshi H. Root Canal Morphology and Variations of Mandibular Premolars by Clearing Technique: An in vitro Study [Internet]. *The Journal of Contemporary Dental Practice* 2011;12(4):318–21. Available from: <http://dx.doi.org/10.5005/jp-journals-10024-1052>
13. Paramasivam A, Priyadharsini JV. Novel insights into m6A modification in circular RNA and implications for immunity [Internet]. *Cellular & Molecular Immunology* 2020;17(6):668–9. Available from: <http://dx.doi.org/10.1038/s41423-020-0387-x>
14. Ponnaniakamideen M, Rajeshkumar S, Vanaja M, Annadurai G. In Vivo Type 2 Diabetes and Wound-Healing Effects of Antioxidant Gold Nanoparticles Synthesized Using the Insulin Plant *Chamaecostus cuspidatus* in Albino Rats. *Can J Diabetes* 2019;43(2):82–9.e6.
15. Priyadharsini JV, Vijayashree Priyadharsini J, Smiline Girija AS, Paramasivam A. In silico analysis of virulence genes in an emerging dental pathogen *A. baumannii* and related species [Internet]. *Archives of Oral Biology* 2018;94:93–8. Available from: <http://dx.doi.org/10.1016/j.archoralbio.2018.07.001>
16. Anita R, Paramasivam A, Priyadharsini JV, Chitra S. The m6A readers YTHDF1 and YTHDF3 aberrations associated with metastasis and predict poor prognosis in breast cancer patients. *Am J Cancer Res* 2020;10(8):2546–54.
17. Vigneshwaran S, Sundarakannan R, John KM, Joel Johnson RD, Prasath KA, Ajith S, et al. Recent advancement in the natural fiber polymer composites: A comprehensive review. *J Clean Prod* 2020;277:124109.
18. Nambi G, Kamal W, Es S, Joshi S, Trivedi P. Spinal manipulation plus laser therapy versus laser therapy alone in the treatment of chronic non-specific low back pain: a randomized controlled study. *Eur J Phys Rehabil Med* 2018;54(6):880–9.
19. Mohanavel V, Ashraff Ali KS, Prasath S, Sathish T, Ravichandran M. Microstructural and tribological characteristics of AA6351/Si3N4 composites manufactured by stir casting. *Journal of Materials Research and Technology* 2020;9(6):14662–72.
20. Vijayashree Priyadharsini J, Smiline Girija AS, Paramasivam A. An insight into the emergence of *Acinetobacter baumannii* as an oro-dental pathogen and its drug resistance gene profile - An in silico approach. *Heliyon* 2018;4(12):e01051.
21. Packiri S, Gurunathan D, Selvarasu K. Management of Paediatric Oral Ranula: A Systematic Review. *J Clin Diagn Res* 2017;11(9):ZE06–9.
22. Babu S, Jayaraman S. An update on β -sitosterol: A potential herbal nutraceutical for diabetic management. *Biomed Pharmacother* 2020;131:110702.
23. Rajakumari R, Volova T, Oluwafemi OS, Rajesh Kumar S, Thomas S, Kalarikkal N. Grape seed extract-soluplus dispersion and its antioxidant activity. *Drug Dev Ind Pharm* 2020;46(8):1219–29.
24. Ramamoorthi S, Nivedhitha MS, Divyanand MJ. Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: A randomised controlled trial. *Aust Endod J* 2015;41(2):78–87.
25. Iswarya Jaisankar A, Smiline Girija AS, Gunasekaran S, Vijayashree Priyadharsini J. Molecular characterisation of *csgA* gene among ESBL strains of *A. baumannii* and targeting with essential oil compounds from *Azadirachta indica*. *Journal of King Saud University - Science* 2020;32(8):3380–7.

26. Wadhwa R, Paudel KR, Chin LH, Hon CM, Madheswaran T, Gupta G, et al. Anti-inflammatory and anticancer activities of Naringenin-loaded liquid crystalline nanoparticles in vitro. *J Food Biochem* 2021;45(1):e13572.
27. Behera. A K, Sandeep AH, S, HARIPRIYA. Assessment of knowledge, attitude and practice based survey towards successful restorations of composite among practitioners. *J contemp issues bus gov* 2021;27(02):352–64.
28. Kim SY, Kim BS, Kim Y. Mandibular second molar root canal morphology and variants in a Korean subpopulation [Internet]. *International Endodontic Journal*2016;49(2):136–44. Available from: <http://dx.doi.org/10.1111/iej.12437>
29. Melton DC, Krell KV, Fuller MW. Anatomical and histological features of C-shaped canals in mandibular second molars. *J Endod* 1991;17(8):384–8.
30. Zheng Q, Zhang L, Zhou X, Wang Q, Wang Y, Tang L, et al. C-shaped root canal system in mandibular second molars in a Chinese population evaluated by cone-beam computed tomography [Internet]. *International Endodontic Journal*2011;44(9):857–62. Available from: <http://dx.doi.org/10.1111/j.1365-2591.2011.01896.x>
31. Ordinola-Zapata R, Bramante CM, de Moraes IG, Bernardineli N, Garcia RB, Gutmann JL. Analysis of the gutta-percha filled area in C-shaped mandibular molars obturated with a modified MicroSeal technique [Internet]. *International Endodontic Journal*2009;42(3):186–97. Available from: <http://dx.doi.org/10.1111/j.1365-2591.2008.01495.x>
32. Soo WKM, Thong YL, Gutmann JL. A comparison of four gutta-percha filling techniques in simulated C-shaped canals [Internet]. *International Endodontic Journal*2015;48(8):736–46. Available from: <http://dx.doi.org/10.1111/iej.12371>
33. Chai WL, Thong YL. Cross-sectional morphology and minimum canal wall widths in C-shaped roots of mandibular molars. *J Endod* 2004;30(7):509–12.
34. Ma JZ, Shen Y, Al-Ashaw AJ, Khaleel HY, Yang Y, Wang ZJ, et al. Micro-computed tomography evaluation of the removal of calcium hydroxide medicament from C-shaped root canals of mandibular second molars [Internet]. *International Endodontic Journal*2015;48(4):333–41. Available from: <http://dx.doi.org/10.1111/iej.12319>
35. Jerome CE. C-shaped root canal systems: diagnosis, treatment, and restoration. *Gen Dent* 1994; 42(5):424–7; quiz 433–4.

Table 1: Questionnaire distributed to the participants with responses

	Questions	Options	Responses
1	Are you aware of c shaped canals?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 71.56% ● 28.44%
2	Which tooth is mostly involved?	<ul style="list-style-type: none"> ● Mandibular 1st molar ● Mandibular 2nd molar ● mandibular 3rd molar 	<ul style="list-style-type: none"> ● 23.85% ● 47.71% ● 28.44%
3	Which ethnic group has more incidence of c shape canal	<ul style="list-style-type: none"> ● asians ● europeans ● americans 	<ul style="list-style-type: none"> ● 39.45% ● 38.53% ● 22.02%

4	Are you aware of melton's classification of c shaped canals?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 62.39% ● 37.61%
5	Do you know about the three categories of cross section shape of c shaped canal?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 54.13% ● 45.87%
6	Among them, which is most common?	<ul style="list-style-type: none"> ● C shape ● Semicolon shape ● Two or three discrete orifices 	<ul style="list-style-type: none"> ● 28.44% ● 49.54% ● 22.02%
7	Which is the best method to diagnose c-shaped canals?	<ul style="list-style-type: none"> ● IOPA ● panoramic radiograph ● both 	<ul style="list-style-type: none"> ● 23.85% ● 35.78% ● 40.37%
8	Do you know that dyes are also used for diagnosing c shape canal?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 62.39% ● 37.61%
9	How does the c-shaped root in the mandibular 2nd molar present radiographically?	<ul style="list-style-type: none"> ● single fused root ● two distinct roots with communication ● both 	<ul style="list-style-type: none"> ● 17.43% ● 45.87% ● 36.70%
10	Do you know that, Because of the thin isthmus that connects the mesial and distal canals, the type I C-shaped canal system is not detectable radiographically?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 79.82% ● 20.18%
11	Do you agree that c shaped canals often have conical or square configurations?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 57.80% ● 42.20%
12	Do you know that the creation of a conical or ribbon-shaped root occurs when the sheath fails to fuse on both the buccal and lingual sides?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 56.88% ● 43.12%
13	Which one of the following, you think as the most common cause of failure of c shaped RCT?	<ul style="list-style-type: none"> ● Leaky canal ● Isthmus ● Missing canal ● Iatrogenic problems 	<ul style="list-style-type: none"> ● 34.86% ● 36.70% ● 19.27% ● 9.17%
14	After the axis opening, what is the shape of the orifice in the c -shaped canal?	<ul style="list-style-type: none"> ● round ● oval ● ribbon shape 	<ul style="list-style-type: none"> ● 50.46% ● 26.61% ● 22.94%
15	What do you think of the Effective management of this c shape canal	<ul style="list-style-type: none"> ● Modifications in the obturation techniques 	<ul style="list-style-type: none"> ● 31.19%

	configuration?	<ul style="list-style-type: none"> ● rotary and hand instrumentation assisted with sonics and ultrasonics ● Amalgam or composite repairs that remain in the chamber ● all the above 	<ul style="list-style-type: none"> ● 34.86% ● 11.93% ● 22.02%
16	Is it conceivable to move an instrument from the mesial to the distal aspect of a true c-shaped channel without obturation?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 77.98% ● 22.02%
17	Do you know that, CEJ can be used as a reliable landmark for detection of c shape canal?	<ul style="list-style-type: none"> ● Yes ● no 	<ul style="list-style-type: none"> ● 69.72% ● 30.28%
18	Are you aware that Fiber Optic transillumination enhances variant canal anatomy identification?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 62.39% ● 37.61%
19	Do you believe that using thermoplasticized Gutta-percha for effective obturation will be beneficial due to the uneven canal morphology?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 45.87% ● 54.13%
20	What do you prefer for shaping c shaped canals?	<ul style="list-style-type: none"> ● rotary files ● hand files 	<ul style="list-style-type: none"> ● 62.39% ● 37.61%
21	Do you think that for preparing isthmus, files should not be larger than no.25 to avoid perforation?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 70.64% ● 29.36%
22	Which Technique do you prefer for obturation?	<ul style="list-style-type: none"> ● cold lateral compaction Technique ● core carrier system ● continuous wave obturation system ● Injectable cold filling method 	<ul style="list-style-type: none"> ● 20.18% ● 44.04% ● 19.27% ● 16.51%

23	What may be the Standard technique ?	<ul style="list-style-type: none"> ● cold lateral compaction Technique ● core carrier system ● continuous wave obturation system ● Injectable cold filling method 	<ul style="list-style-type: none"> ● 21.10% ● 33.94% ● 32.11% ● 12.84%
24	Do you know that the mesiobuccal and buccal isthmus areas should not be prepared with Gates-Glidden burs?	<ul style="list-style-type: none"> ● yes ● no 	<ul style="list-style-type: none"> ● 82.57% ● 17.43%
25	Which Irrigant do you prefer in the case of RCT?	<ul style="list-style-type: none"> ● sodium hypochlorite (NaOCl), ● chlorhexidine, ● ethylenediaminetetraacetic acid (EDTA), 	<ul style="list-style-type: none"> ● 42.20% ● 37.61% ● 20.18%
26	What is the irrigation activation device used in c shape canal for better efficacy?	<ul style="list-style-type: none"> ● Ultrasonics ● Sonic- EndoActivator ● negative pressure technique- Endovac 	<ul style="list-style-type: none"> ● 54.13% ● 23.85% ● 22.02%
27	which is the viable option, if restoration of c shaped roots fails?	<ul style="list-style-type: none"> ● re treatment ● extraction 	<ul style="list-style-type: none"> ● 66.06% ● 33.94%

Which one of the following, you think as the most common cause of failure of c shaped RCT?

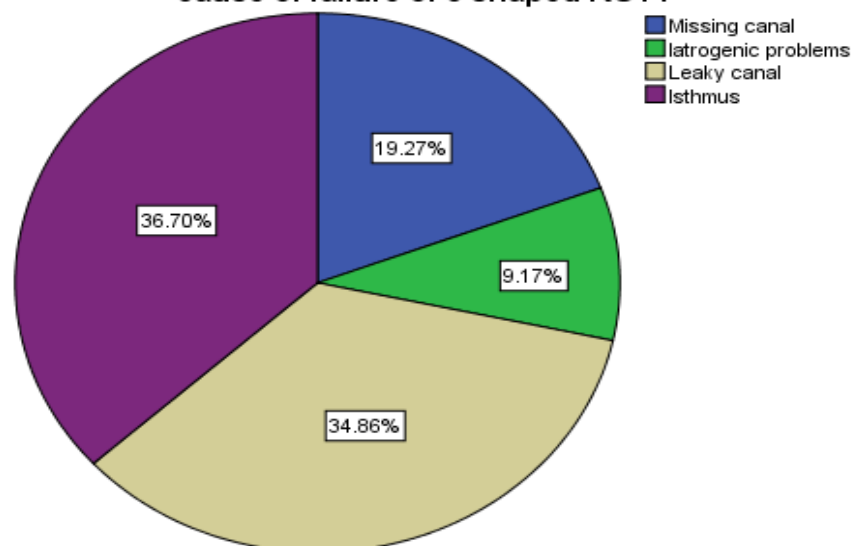


Figure 1: The pie chart represents the percentage distribution of most common cause of failure of C shape RCT, in which majority of participants of about 36.70% responded for isthmus(purple), 34.86% for leaky canal(beige), 19.27% of participants responded for missing canals(blue) and 9.17% for Iatrogenic problems(green)

Are you aware that Fiberoptic transillumination enhance variant canal anatomy identification?

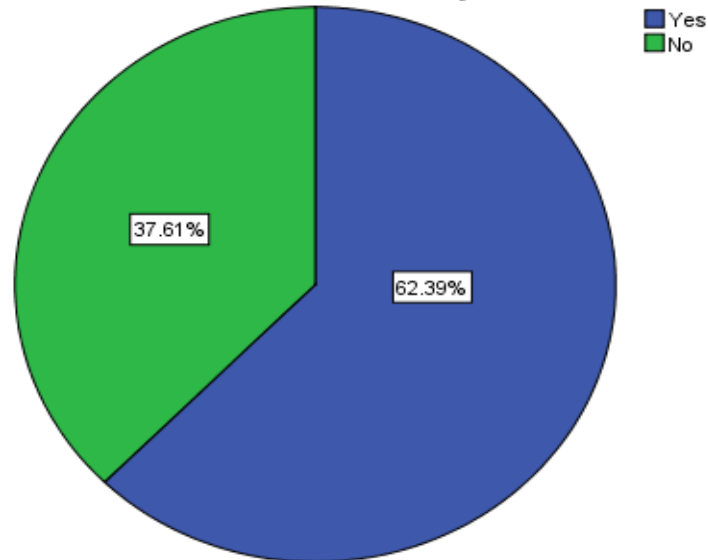


Figure 2: The pie chart represents the percentage of awareness of participants regarding Fiberoptic transillumination enhancing identification of variant canal anatomy in which 62.39% of participants were aware (blue) and 37.61% were unaware (green)

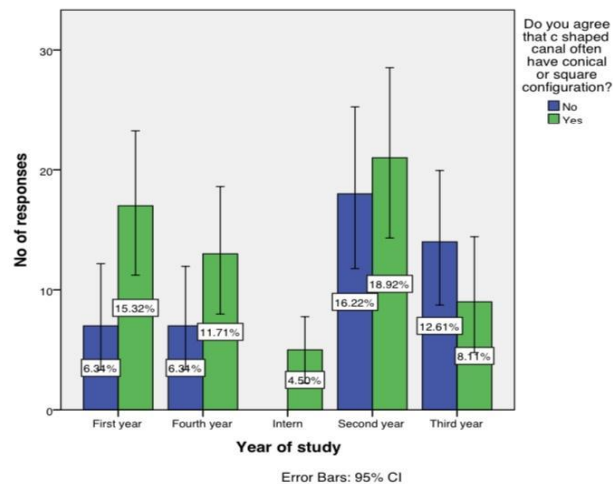


Figure 3: Bar graph represents the association between year of study and configuration of C shape canal.

X axis represents the year of study and the Y axis represents the number of responses. Here, blue represents agreement with square or conical configuration and green does not agree with it. Majority of first year and second year participants agreed that C shaped canal often have conical or square configuration than others. The association is statistically significant. Chi square analysis value (p - value) = 0.025 ($p < 0.05$ is statistically significant).

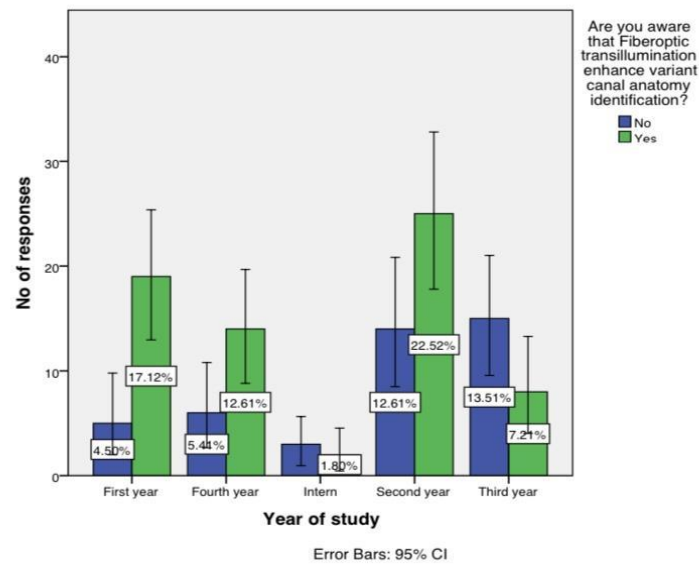


Figure 4: Bar graph represents the association between year of study and opinion on fiber optic transillumination enhancing variant canal anatomy identification. X axis represents the year of study and Y axis represents the number of responses. Here, blue represents it can be identified and green represents contrary opinions about it. Majority of first year and second year participants are aware that fiber optic transillumination enhances variant canal anatomy identification than other participants. The association is statistically significant. Chi square analysis value (p - value) = 0.04 ($p < 0.05$ it is statistically significant).

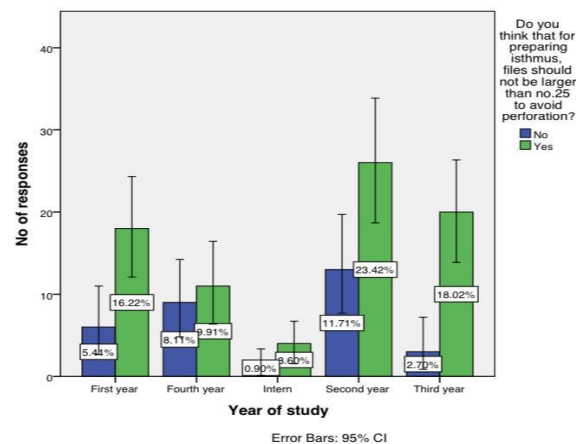


Figure 5: Bar graph represents the association between year of study and opinion on files which should not be used larger than no.25 for preparing isthmus to avoid perforation. X axis represents the year of study and the Y axis represents the number of responses. Here, blue represents yes and green represents no. The majority of second year participants agreed that files should not be used larger than no.25 for preparing isthmus to avoid perforation than others. The association is statistically significant. Chi square analysis value (p - value) = 0.25 ($p > 0.05$ it is not statistically significant). (Pearson chi-square value: 5.388, df:4)