



KNOWLEDGE, ATTITUDE AND PRACTICE AMONG SPECIALISTS ON ROTARY ENDODONTIC INSTRUMENTATION

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Abstract: Introduction: Nickel–titanium (NiTi) rotary devices have greatly enhanced the quality of root canal cleaning and shaping over the last two decades because of its superelasticity. This makes them more suitable for effective instrumentation. The purpose of this study is to determine the level of awareness and current state of knowledge among specialists regarding rotary endodontic instrumentation. **Methodology:** An online survey of endodontists was conducted to determine their skills, attitudes, and understanding of rotary instrumentation. A total of 20 questions were included in the survey, including open-ended and closed-ended questions about use, favourite brand, and properties. Data was collected from each participant based on their clinical experience with the rotary systems in order to get insight into the thoughts of endodontists and ideas about the current technology of rotary NiTi equipment. **Statistical analysis:** Data were subjected to appropriate statistical measures and analyzed. **Results:** According to the survey, 39.3 percent of endodontists prefer both manual and rotary instrumentation in their practice, while 32.7 percent prefer only rotary instrumentation, and the key drawbacks for rotary endodontic instrumentation are file fracture (51.9 percent) and excess dentin removal (32.7 percent). Overuse was cited by 43.9 percent of endodontists as the primary cause of rotary Ni-Ti file separation, while complex root canal anatomy was cited by 21.5 percent. The occurrence of file separation can be reduced by using a handpiece with speed and torque control, according to 83.2 percent of respondents. In addition, 46.7 percent said that proper irrigation protocol helps to avoid file separation. ProTaper was chosen by 30.4 percent of endodontists as their favourite rotary file brand. **Conclusion:** Even though file fracture was a common occurrence among respondents, endodontists continued to use rotary instrumentation. According to the findings of this study, endodontists' implementation of new endodontic technology, as well as proper protocols and procedures, has significantly contributed to the progress of endodontic care by improving quality and reducing procedural errors.

Keywords: Ni-Ti, rotary instrumentation, file separation, root canal anatomy, quality of life, knowledge

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INTRODUCTION

Endodontic treatment success is almost entirely determined by how well the root canal is shaped and cleaned. The root canal procedure involves eliminating bacterial particles from the canal utilising biomechanical approaches including cleaning and shaping to prevent reinfection. The removal of necrotic pulp and contaminated tissues to a low level that does not trigger a flare-up that necessitates retreatment is critical to a successful endodontic treatment outcome.^{1,2} The anatomy of root canals is very complex, and effective cleaning and shaping these canals

necessitates the use of specially designed instruments.³ Various approaches are utilised to clean and shape root canal structures with hand devices and rotational instruments. The goal of root canal therapy is to generate a tapering funnel shape with the lowest diameter at the apex and the greatest at the canal orifice. The key to a successful root canal surgery is to preserve the native root canal anatomy while avoiding instrument fracture during preparation⁴ and also preventing other iatrogenic processes such as reduction of working length, threshold formation, transport of the apex⁵.

Although the stainless steel utilised in root canal shaping hand devices is sturdy, it lacks flexibility, especially in bigger sizes, which can lead to procedural errors.⁶ As a result, the success rate of endodontic treatment has declined. Nickel-Titanium (NiTi) Rotary instrumentation gained prominence shortly after the invention of NiTi instruments.⁷ Because of its superelastic properties due to Ni-Ti, as well as advanced instrument design, it was possible to instrument small and curved root canals safely and effectively with handpiece-driven instruments operating at low speeds⁸. Burs and endodontic files are the most common rotary instruments. Practitioners favour rotary instruments because of their super-elasticity, exceptional adaptability, increased cutting efficiency, and better centering ability⁹. These devices have been found to remove filled restorative substance effectively and securely. Rotary instruments offer a higher sterilisation fatigue resistance, which prevents torsional stress. Other brands of rotary instruments include Dentsply

protaper, Mtwo, endostar, k3 XF files, Hero Shaper, and others. Efficiency, ductility, sharpness, cross-section, and adaptability are all characteristics that impact a dentist's choice of rotary device¹⁰. However, rotating instruments have a number of disadvantages, including high costs and the risk of instrument fracture¹¹. Rotating NiTi devices in the clinic have the potential to detach in the canal, and even new instruments can fail suddenly on their first usage¹². It may be due to a flaw in the production process^{13,14}. According to survey studies, file breakage is one of the most common difficulties with NiTi rotary instruments.¹⁵

The shaping efficacy of various file systems varies, and combining two or more systems to achieve improved shaping efficacy and minimise file breakage has been suggested^{16,17}. Some NiTi rotary file systems are regarded to be reliable when used sequentially throughout the entire working length. They frequently consider the practitioner's experience, preparation method, and overuse as factors in file fracture^{18,11}. However, little is known about the clinical experience of the operators, the level of reuse, and the occurrence of file separation.¹⁹. The goal of this research is to find out how often rotary files are used and what causes file fractures in root canals, as well as to raise awareness about safer endodontic instrumentation practises^{20, 21, 22, 23}.

MATERIALS AND METHODS

An online survey of endodontists was conducted to determine their knowledge, attitude, and practice of rotary instrumentation. The questionnaire was sent out by mail to endodontists in India. Data was collected from each participant based on their clinical experience with the rotary systems in order to get insight into endodontists' thoughts and ideas about the latest endodontic technology of rotary NiTi instruments. The research took place from January 31 to February 28, 2021. In prior investigations, the usage of rotating instruments was shown to be quite common⁹, a sample size of 300 people was estimated. The research samples were selected using a practical sampling technique. In an email to the endodontists, the study's goal was described. Out of 300 endodontists, 214 agreed to participate in the research. There were 20 open-ended and closed-ended items on the pre-tested questionnaire. There were

no time limits or true/false questions to contend with. The inquiries centred on endodontists' preventive techniques, as well as their preferred brand, frequency of usage, advantages and disadvantages of the rotary instrument in use, and how they dealt with particular bad scenarios in their profession. The questions in the survey were culled from national and international polls. No personal information was collected, and participation was fully optional and confidential.

Questionnaires were mailed to them, and only those that were fully filled out were eligible for review. Unanswered Questions on the returned questionnaire were disqualified. Data was entered into an excel spreadsheet, and descriptive statistics were calculated using the data.

RESULTS

This study achieved an overall response rate of 71.33%. From 214 respondents of the current survey, 70.6% were Postgraduate students (Conservative Dentistry and Endodontics) and 29.4% were Endodontists. The experience of rotary file usage is less than 6 months in 31.8% and about 6 months to 2 years in 30.4% and more than 2 years in 23.4%.

Mostly 65.4% of the study respondents were about 23-30 years old and their year of experience after Post-graduation was less than 5 years in 29.9% and about 56.1% were undergoing Post graduation in Endodontics.

The data from the responses received were categorized accordingly with the data regarding the Knowledge about the property of rotary instruments [Graph 1], Type of file fracture [Graph 2], data about the attitude of respondents regarding the preference of endodontic instrumentation [Graph 3], reason for rotary file breakage [Graph 4], Role of irrigation protocol in preventing rotary file breakage [Graph 5], preference of initial canal enlargement with K file [Graph 6] and reason for discard of rotary file system [Graph 7], data about their practice regarding the frequency of Ni-Ti file breakage [Graph 8], Commonplace of file separation [Graph 9], Position of file separation [Graph 10], Time of rotary file reuse [Graph 11], Frequency of Rotary file breakage in clinical practice [Graph 12], Management of separated instrument [Graph 13], Main preparation method [Graph 14] and Preferred brand of the rotary instrument [Graph 15].

Table 1: Demographic representation of study participants

Demographic variables	Categories	No. of respondents	Percentage %
Gender	Male	116	54.2%
	Female	98	45.8%
Age (years)	23-30 years	140	65.4%
	31-40 years	43	20.1%
	41-50 years	20	9.3%
	Above 50 years	11	5.2%
Speciality	Postgraduates	151	70.6%
	Endodontists	63	29.4%
Years of clinical experience	Undergoing PG	120	56.1%
	Less than 5 years	64	29.9%
	More than 5 years	30	14%

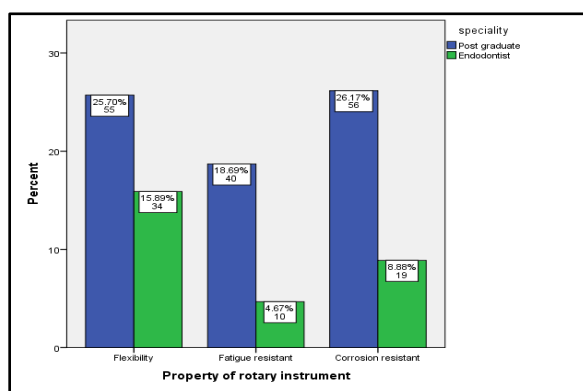
Table 2: Practice of Endodontists in root canal instrumentation using rotary Ni-Ti instruments

Practice	Categories	No. of respondents	Percentage %
Pre-enlargement of canal	15k file	83	38.8%
	20k file	63	29.4%

	25k file	41	12.6%
	Depends on the canal	27	19.2%
Preparation method	Crown down technique	83	38.8%
	Step back technique	76	35.5%
	Hybrid preparation	55	25.7%
Preferred brand	Protaper	65	30.4%
	Hero Shaper	49	22.9%
	Mtwo	38	17.8%
	K3	30	14%
	Others	32	15%
Frequency of Ni-Ti breakage	Once a week	77	36%
	Once a month	60	28%
	Less than 5 times a year	50	23.4%
	Extremely rare	27	12.6%

The data from the responses received were categorized accordingly with the data regarding the Knowledge about property of rotary instruments[Graph 1],Type of file fracture[Graph 2],data about attitude of respondents regarding the preference of endodontic instrumentation[Graph 3],reason for rotary file breakage [Graph 4],Role of irrigation protocol in preventing rotary file breakage[Graph 5],preference of initial canal enlargement with K file[Graph 6] and reason for discard

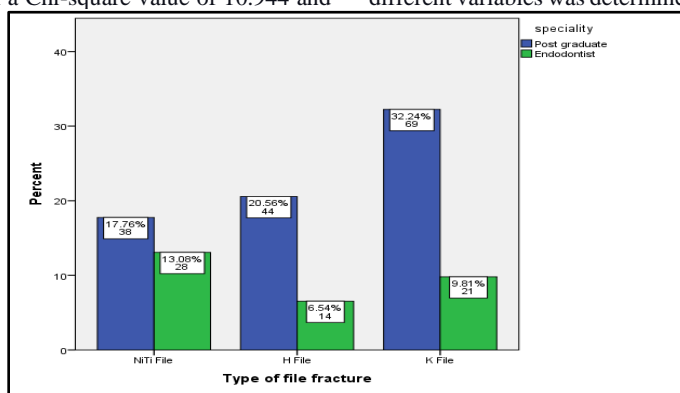
of rotary file system[Graph 7],data about their practice regarding the frequency of Ni-Ti file breakage[Graph 8],Common place of file separation[Graph 9],Position of file separation[Graph 10],Time of rotary file reuse[Graph 11],Frequency of Rotary file breakage in clinical practice[Graph 12],Management of separated instrument[Graph 13],Main preparation method[Graph 14]and Preferred brand of rotary instrument [Graph 15]



Graph 1: Property of Rotary instruments

Bar chart in which the X-axis indicates the property of rotational instruments, while the y-axis represents the quantity of participant answers. With a Chi-square value of 10.944 and

a p-value of 0.004(p<0.05), the association between Postgraduates (Blue) and Endodontists (Green) among the different variables was determined to be statistically significant.

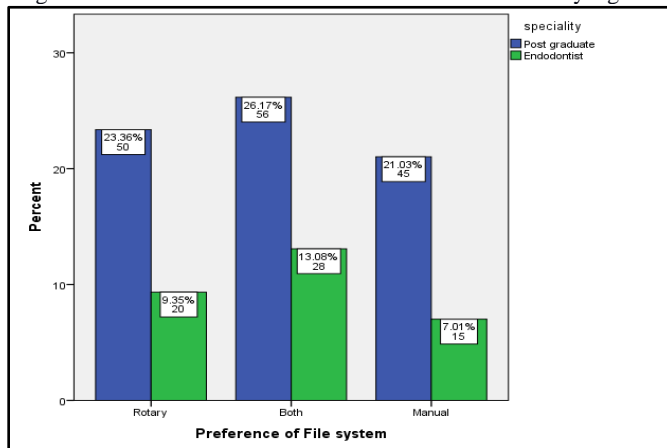


Graph 2: Type of File fracture

The type of file fracture is represented on the X-axis, and the quantity of replies from the participants is represented on the y-

axis. With a Chi-square value of 7.776 and a p-value of 0.020(p<0.05), the relationship between Postgraduates (Blue)

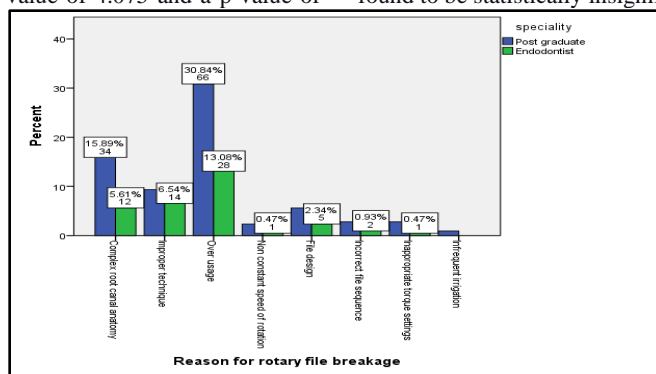
and Endodontists (Green) among the different variables was found to be statistically significant (Chi-square test)



Graph 3. Preference of the File system

The X-axis shows the preferred file system, while the y-axis represents the number of responses from the participants in a bar chart. With a Chi-square value of 4.075 and a p-value of

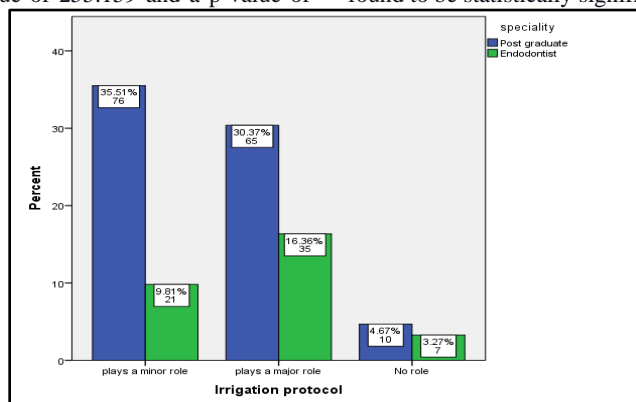
0.130 ($p > 0.05$), the association between Postgraduates (Blue) and Endodontists (Green) among the different variables was found to be statistically insignificant (Chi-square test).



Graph 4: Reason for rotary file breakage.

The rotary file fracture reason is represented on the X-axis, and the number of replies from the participants is represented on the y-axis. With a Chi-square value of 255.159 and a p-value of

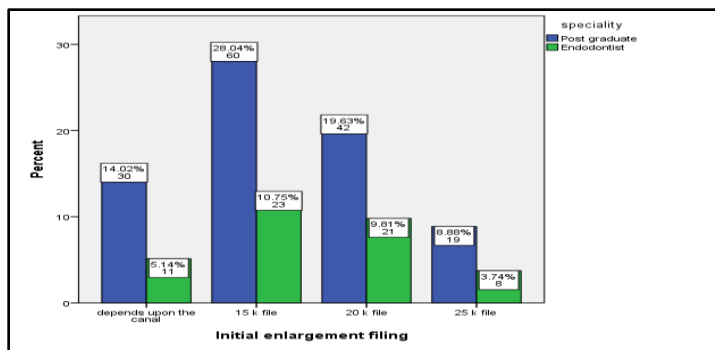
0.000 ($p < 0.05$), the relationship between Postgraduates (Blue) and Endodontists (Green) among the different variables was found to be statistically significant (Chi-square test)



Graph 5: Role of irrigation protocol in preventing rotary file breakage.

The role of irrigation protocol is represented on the X-axis, while the number of replies from participants is represented on the y-axis. With a Chi-square value of 62.140 and a p-value of

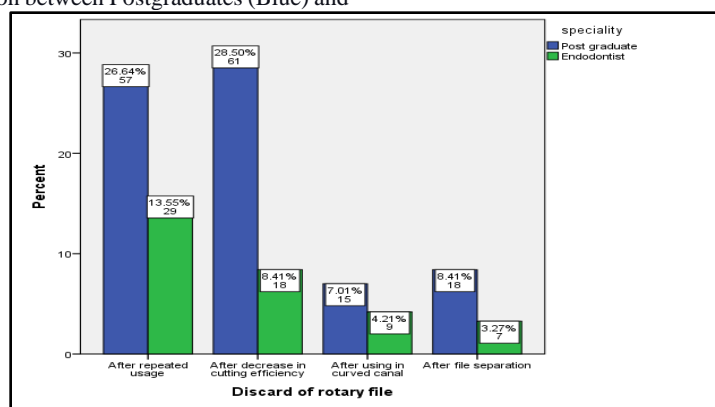
0.000 ($p < 0.05$), the relationship between Postgraduates (Blue) and Endodontists (Green) among the different variables was found to be statistically significant (Chi-square test)



Graph 6: Preference of Initial canal enlargement

The X-axis reflects the participants' preference for initial canal expansion, and the y-axis represents the number of responses. With a Chi-square value of 34.000 and a p-value of 0.000(p<0.05), the association between Postgraduates (Blue) and

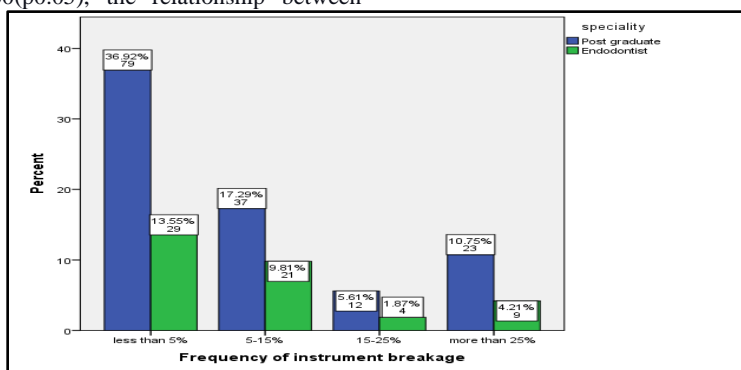
Endodontists (Green) among the different variables was determined to be statistically significant. (Using the Chi-square test)



Graph 7: Reason for discard of rotary file

The reason for discarding the rotational file is represented on the X-axis, while the number of responses from the participants is represented on the y-axis. With a Chi-square value of 63.346 and a p-value of 0.000(p<0.05), the relationship between

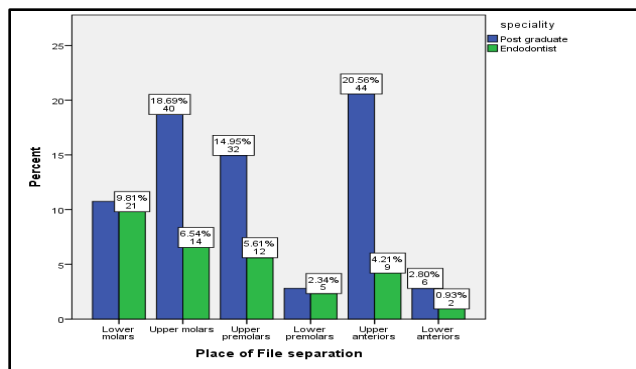
Postgraduates (Blue) and Endodontists (Green) among the different variables was found to be statistically significant. (Chi-square analysis)



Graph 8: Frequency of Ni-Ti instrument breakage

The frequency of file breakage is represented on the X-axis, while the number of replies from participants is represented on the y-axis. With a Chi-square value of 90.822 and a p-value of

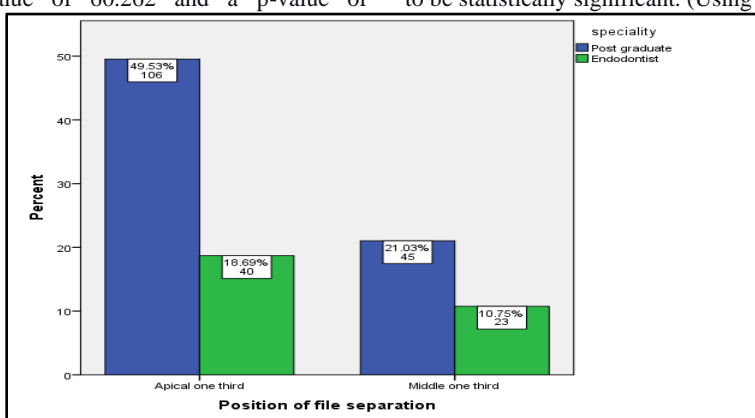
0.000(p<0.05), the relationship between Postgraduates (Blue) and Endodontists (Green) among the different variables was found to be statistically significant. (Chi-square analysis)



Graph 9: Common Place of file separation

The X-axis indicates the speed of rotational file separation, while the y-axis reflects the number of participant answers. With a Chi-square value of 60.262 and a p-value of

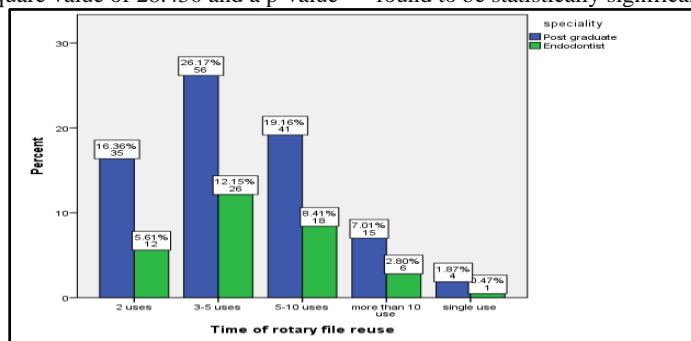
0.000(p<0.05), the association between Postgraduates (Blue) and Endodontists (Green) among the different variables was found to be statistically significant. (Using the Chi-square test)



Graph 10: Position of rotary file separation.

The rotary file breakage position is represented on the X-axis, and the number of answers from the participants is represented on the y-axis. With a Chi-square value of 28.430 and a p-value

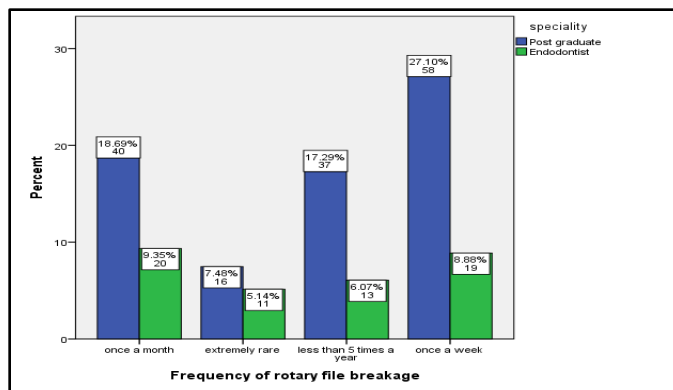
of 0.000(p<0.05), the relationship between Postgraduates (Blue) and Endodontists (Green) among the different variables was found to be statistically significant (Chi-square test)



Graph 11: Time of rotary file reuse

The number of times a particular file was reused is represented on the X-axis, while the number of replies from the participants is represented on the y-axis. With a Chi-square value of 86.935 and a p-value of 0.000(p<0.05), the relationship between

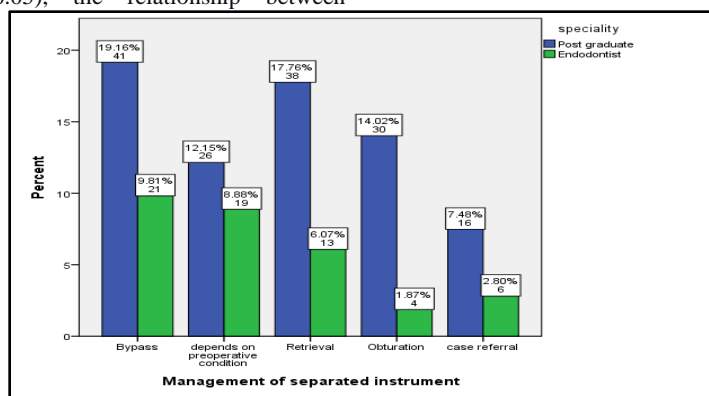
Postgraduates (Blue) and Endodontists (Green) among the different variables was found to be statistically significant. (Chi-square analysis)



Graph 12: Frequency of Rotary file breakage in clinical practice

The X-axis shows the frequency of Rotary file breaking in clinical practise, whereas the y-axis represents the number of participants' responses. With a Chi-square value of 24.467 and a p-value of 0.000(p<0.05), the relationship between

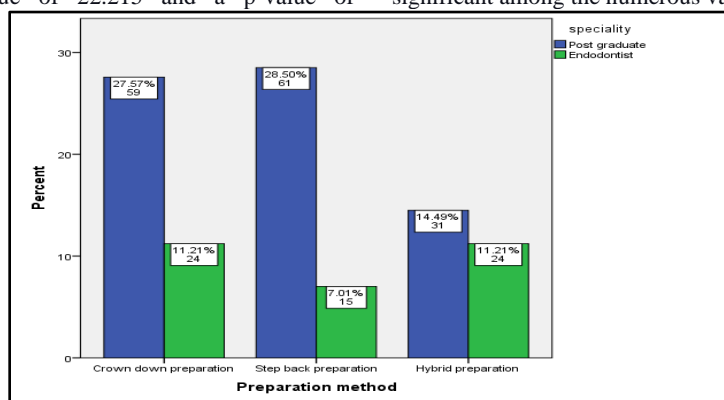
Postgraduates (Blue) and Endodontists (Green) was determined to be statistically significant among the numerous variables (Chi-square test)



Graph 13: Management of separated instruments-

The X-axis indicates the management of isolated rotatable files, while the y-axis reflects the number of participant responses. With a Chi-square value of 22.215 and a p-value of

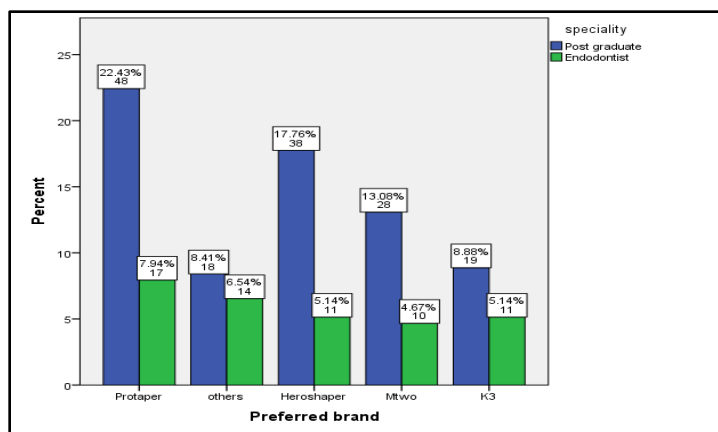
0.000(p<0.05), the relationship between Postgraduates (Blue) and Endodontists (Green) was found to be statistically significant among the numerous variables (Chi-square test).



Graph 14: Root canal preparation method

The root canal preparation procedure is represented on the X-axis, and the number of replies from the participants is represented on the y-axis. With a Chi-square value of 5.953 and a p-value of 0.051(p<0.05), the relationship between

Postgraduates (Blue) and Endodontists (Green) among the different variables was found to be statistically significant. (Chi-square analysis).



Graph 15: Preferred brand of the rotary instrument

The X-axis reflects the favourite brand of rotary instrument, while the y-axis represents the number of participant replies. With a Chi-square value of 19.505 and a p-value of 0.01 ($p < 0.05$), the correlation between Postgraduates (Blue) and Endodontists (Green) among the different variables was determined to be statistically significant. (Using the Chi-square test).

DISCUSSION

Root canal treatment has become simpler and more efficient after the introduction of rotary instrumentation in endodontics. The function of "hand" instruments has altered since the introduction of NiTi rotary instrumentation, and they are now largely used to collect intracanal reconnaissance data and, when necessary, to create sufficient space before deploying more powerful NiTi instruments. The purpose of this survey was to gather information from Indian endodontists on their level of expertise and awareness of rotary endodontic instrumentation. Despite the availability of survey data from various countries, including India, clinical experience, frequency of reuse, incidence of file separation, and cause of file separation among operators are all unknown in the current context due to recent advances and understanding. This research lays the path for endodontists to acquire easy strategies and protocols that they may use in their clinical practise to reduce procedural errors and to learn which rotary file system brand they prefer. According to our findings, approximately 39.3 percent of endodontists tend to use both rotary and hand instruments in their endodontic work, while approximately 32.7 percent prefer to use only rotary instruments. Because of its super-elasticity, exceptional adaptability, improved cutting speed, better centering ability, and time-saving qualities, operators choose rotary instruments. It has been reported in our study that time saving, maintaining the canal anatomy, cleaning and cutting efficiency are the most common reasons given by the endodontists for using rotary file systems. It is consistent with a previous study, which looked at endodontists' preferences for rotary instrument use²⁴. Protaper is the most common rotary file system among endodontists, followed by Heroshaper and Mtwo file systems, according to our research. According to one study, protaper next reduces canal transportation while maintaining canal curvature²⁵ and is efficient even in curved root canals. Instrument separation is more likely when root curvatures are more pronounced. The

ability of the instrument to withstand torsional forces is reduced as the radius of curvature is reduced, raising the chances of file separation²⁶. To overcome this issue, changes in instrument design have been undertaken. Because the stress distribution is more even and less, triangular cross-sectional instruments are more resistant to failure than S-shaped files and H-type cross-sections. This may be the reason for Protaper instruments for their increased cutting efficiency and increased fracture resistance^{27,28} compared to other file systems. The main limitation for rotary instrument usage is said to be file fracture by 51.9% endodontists in this present study. In both clockwise and anticlockwise directions, the force used to fracture stainless steel and NiTi instruments is the same²⁹. Stainless steel instruments, on the other hand, show symptoms of distortion before they fracture, whereas NiTi instruments do not^{30, 31}. Instrument fracture may be caused by a variety of causes. One of the most common causes is improper or excessive use of an endodontic instrument³². This is due to the fact that long-term use reduces cyclic flexural fatigue resistance^{33,34}. According to certain research, complicated root canal anatomy raises the likelihood of instrument separation. In this analysis, the same reasons for file fracture were also recorded. In this study, 43.9 percent of endodontists reported excessive use, 21.5 percent reported complicated root canal anatomy, and 15.9 percent reported incorrect instrumentation techniques. Other limitations listed in this study include excessive dentin removal and strip perforation of curved canals. Furthermore, molars have a higher risk of instrument fracture³⁵. The upper and lower molars were the commonly reported tooth for instrument fracture in this present study. According to our research, the majority of endodontists prefer to use a handpiece with speed and torque control to reduce the risk of file separation. Operators who use low torque (less than 1 N/cm) had a decreased risk of file fracture than those who use high torque (more than 3 N/cm), according to one study. However, it should be remembered that the torque values displayed on different electric motors may not be accurate³⁶. As a result, it is often safer to use instruments with light apical pressure for a short period of time rather than pecking continuously^{15,36}. Most of the Endodontists reported that proper irrigation with EDTA usage helps in preventing file separation. Among the root canal specialists, postgraduates reported that irrigation protocol plays a minor role in preventing rotary file fracture. Chelating agents like ethylenediaminetetraacetic acid (EDTA) remove the smear

layer while also lubricating the file, reducing the likelihood of file breakage. Therefore, knowledge and practice of proper irrigation protocol are still necessary to prevent rotary file fracture. Added to these protocols, initial enlargement of the root canal with 15/20 size K file is also followed by 84.1% of endodontists in our study to prevent file separation. This may be because preflaring the canal provides a glide path, making rotary instrumentation easier³⁷. Endodontists re-used rotary files 3 to 5 times on average, with a median of 5 to 10 times, according to our research. The number of times an instrument can be used is determined by the operator's ability, canal shape, and instrument features^{38,39}. Also, according to one report, there is no connection between fracture of the instrument and frequency of use⁴⁰. Most of the separation of files occurs in apical one third^{41,42}. Instrument separation was reported by nearly 73.4 percent of endodontists in our study, with 68.2 percent claiming that file separation occurred primarily in the apical third of the root canal. The majority of Postgraduate root canal specialists see rotary file separation once a week. Around 29% of them deal with the situation by bypassing the instrument, while 23.8 percent deal with it by retrieving the split instrument. One researcher looked at the prognosis by obturating root canals with separated files and found that the broken instrument could be used as a root canal filling⁴³. Retained instruments are very difficult to remove. Among the techniques and devices offered are the Masserann Kit, wire loop method, Endo Extractor, long-shank burs, Canal Finder System, ophthalmic needle-holders, and ultrasonic devices. Due to the risk of perforation, ledging, and other complications, these treatments can only be used when the fracture section is in the coronal or middle third of the canal. With the introduction of dental operating microscopes, ultrasonic tips, and instrument removal devices, the odds of retrieving the tools have improved^{44,45}. If removal of the broken instrument is not feasible, bypassing may be performed. The Crown down technique and Hybrid technique was mostly followed by endodontists as the primary preparation process whereas the step back technique was mostly followed by postgraduates. Enlargement of early coronal two-thirds, eliminates restrictive dentin and decreases strain from any file type's more coronal cutting flutes⁴⁶. While this survey provides insight into the respondents' views and attitudes, it has some drawbacks, such as its cross-sectional existence and the possibility of response bias⁴⁷. The results of this survey indicate that the adoption of new endodontic technologies among endodontists, proper guidelines, irrigation protocols and techniques has significantly contributed to the success of endodontic treatment by enhancing the quality provided and minimizing the procedural errors.

CONCLUSION

It can be concluded that despite the instruments' limitations, endodontists were taking some steps to become acquainted with their behaviour and properties, as well as gain insight into how to reduce rotary instrumentation failure by using proper instrumentation techniques and protocols.

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Overall Consensus: Rotary Ni-Ti instruments are used widely in endodontics. Although file fracture is found to be an inadvertent feature of rotary Ni-Ti files, the use of rotary instrumentation is still continued to be beneficial for endodontists because of its superelastic property and time-saving capabilities. Adoption of proper file usage with adequate irrigation is followed to prevent rotary file breakage. Also, the survey participants were aware of the potential etiological factors as well as the management procedures employed to retrieve the detached instrument. The most generally used procedure was bypassing the separated instrument, followed by retrieving the fractured instrument.

LIMITATIONS

The results of these findings are influenced by literacy, economic standards, level of education, and the degree to which the subject under research would be publicised. As a result, it is difficult to extrapolate the findings from these investigations.

FUTURE SCOPE

Future studies should gain insight more related to factors influencing rotary Ni-Ti instruments breakages like its manufacturing process and cross-sectional designs.

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