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Original Article

Dentistry Section

# A Survey on Nickel Titanium Rotary Instruments and their Usage Techniques by Endodontists in India

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## ABSTRACT

**Introduction:** The preference and usage of nickel titanium rotary instruments varies from individual to individual based on their technique, experience with the rotary systems and the clinical situation. Very limited information is available to explain the adoption of changing concepts with respect to nickel titanium rotary instruments pertaining to the endodontists in India.

**Aim:** The aim of this study was to conduct a questionnaire survey to acquire the knowledge concerning different NiTi rotary instruments and their usage techniques by endodontists in India.

**Materials and Methods:** A Survey questionnaire was designed which consisted of 32 questions regarding designation, demographics, experience with rotary instruments, usage of different file systems, usage techniques, frequency of reuse, occurrence of file fracture, reasons and their management was distributed by hand in the national postgraduate convention and also disseminated via electronic medium to 400 and 600 endodontists respectively. Information was collected from each individual to gain insight into the experiences and beliefs of endodontists concerning the new endodontic technology of rotary NiTi instrumentation based on their clinical experience with the rotary systems. The questions were designed to ascertain the problems, patterns of use and to identify areas of perceived or potential concern regarding the rotary instruments and the data acquired was statistically evaluated using Fisher's-exact test and the Chi-Square test.

**Results:** Overall 63.8% (638) endodontists responded. ProTaper was one of the most commonly used file system followed by M two and ProTaper Next. There was a significant co relation between the years of experience and the file re use frequency, preparation technique, file separation, management of file separation.

**Conclusion:** A large number of Endodontists prefer to reuse the rotary NiTi instruments. As there was an increase in the experience, the incidence of file separation reduced with increasing number of re use frequency and with experience, the management of separated file was better.


**Keywords:** Fracture incidence, Instrumentation, Questionnaire, Re use

## INTRODUCTION

Root canal treatment is one of the most technically challenging procedures in dentistry and the success depends on the diagnostic acumen, instruments used and the technologies adopted. The adoption of endodontic nickel titanium rotary technology by endodontists in India has increased two folds in the last two decades. Although, all endodontists use rotary technology there is a significant disparity in the different systems used, frequency of the use and the methods of use [1]. A survey was conducted to understand the scenario of rotary NiTi usage by endodontists in India.

Endodontic treatment encompasses procedures that are designed to maintain the health of all or part of the pulp. When the pulp is diseased or injured, treatment is aimed at preserving normal periradicular tissues. When pulpal diseases have spread to the periradicular tissues treatment is aimed at restoring them to health. This is usually achieved by root canal treatment [2].

Cleaning and shaping of the root canal system is one of the main goals in endodontics which can be carried out using different systems and techniques [3]. Traditionally, stainless steel used in the manufacturing of the hand instruments for root canal shaping lack flexibility with increasing sizes and can lead to procedural errors [4] resulting in a decreased success rate for endodontic treatment [5].

In 1988, root canal instruments manufactured from nickel-titanium (NiTi) alloy were introduced to overcome the rigidity of stainless steel [6]. NiTi is one of several shape memory alloys, but this particular alloy of two metals has the most important particular applications in medicine and dentistry due to its biocompatibility and corrosion resistance [7]. NiTi alloy was discovered by Buehler HM et al., and named Nitinol which stands for nickel, titanium, Naval ordinance Laboratory [8]. In endodontics, NiTi was initially reported for use by Walia HM et al., [9].

Nickel titanium instruments have the advantage of instrumentation with reduced procedural errors. They are two to three times more flexible and have superior resistance to torsional fracture as compared to stainless steel [10]. Various NiTi rotary systems are being constantly released. Continuous improvements have been made to the instruments design with the implementation in the hope of achieving better and safe shaping with reduced risk of procedural accidents, such as transportation or file separation [6].

Furthermore, there is a perception among clinicians and researchers that the number of use of an instrument may be an important factor in the defect rate [11].

The introduction and development of nickel-titanium rotary instruments is undoubtedly a quantum leap for the field of endodontics. Endodontists who have gained some experience in the use of nickel-titanium rotary instruments will confirm that each file system has its own special characteristics pertaining to advantages and disadvantages and the particular rules for its usage are to be followed [12].

Very limited information is available regarding the adoption of nickel titanium rotary instruments and instrumentation by endodontists in India.

Thus, the aim of this study was to conduct a questionnaire survey to acquire the knowledge concerning different NiTi rotary instruments and their usage techniques by endodontists in India.

## MATERIALS AND METHODS

The study was conducted in the Department of Conservative Dentistry and Endodontics, PMNM. Dental College and Hospital, Bagalkot, Karnataka, India.

The questionnaire was designed and the validity was assessed by distributing to eight experienced endodontists with a minimum experience of five years after postgraduation. The questionnaire designed was validated for relevance of questions particular to the topic of the survey (Face validity) and also for the reliability of the options provided (Content validity). A pilot survey was conducted on 25 endodontists to assess the reliability and internal consistency of the questionnaire which revealed that the survey was reliable with the Cronbach's alpha internal consistency score of 0.8. The data obtained from the pilot study was used to determine the sample size, using the formula N=4PQ/D2 [13] (where N stands for sample size, P stands for highest prevalence, Q =100-P and D stands for acceptable error or lowest prevalence) thus sample size obtained yielding the average sample size of 519.6. Then the sample size obtained was rounded off to nearest hundred and the sample size for the survey to be conducted for a minimum of 500 endodontists to ascertain the results was determined. Thus 1000 endodontists were given the questionnaire in a systemic random sampling manner. Questionnaire was distributed to specialists of 29 different states to represent the entire Indian population of endodontists.

A survey questionnaire was disseminated via two methods; electronic media and on site to 1000 endodontists. The on-site questionnaire was distributed to 400 endodontists who attended 17th IACDE-IES national post graduate convention held at Bhopal in April 2016. Questionnaire was also sent through electronic media to 600 endodontists in India. The repetition of the endodontists was avoided by the demographic data collection and subsequent elimination of the particular institution. The mailing address was gathered from the souvenirs of the convention and through personnel contacts. The survey consisted of 32 questions, many of which had multiple options and every question was indicated as mandatory. A questionnaire was used for collecting information from each individual regarding designation, demographics, experience with rotary instruments, usage of file systems and methods, frequency of reuse, occurrence of file fracture during canal preparation, reasons for file fracture, management of fractured files and usage frequency of reciprocating and self adjusting file system with advantages and disadvantages.

Questions were constructed by using check boxes, multiple options and with the option for free text. Selection of more than one answer was allowed. The questions were based on information gathered from recent reviews and textbooks on root canal preparations.

The data was collected from endodontists by using the online interface during a four month period and on site questionnaire distributed were collected within a time period of two days. Questionnaire distributed through electronic media was formatted to allow single or multiple responses on the basis of the focus of the question. To ensure all questions were completed, an alert was delivered if one or more questions were left unanswered. To facilitate collecting unbiased data, respondent's personnel information regarding their name, age or sex was not included in the questionnaire. The survey was completely anonymous and identification of the participant was not linked to the individual responses.

## STATISTICAL ANALYSIS

Responses received on site and through electronic media were formatted to allow analysis by using the SPSS version 19.0 (IBM Corp, Armonk, NY, USA) with Fisher's-Exact test and the Chi-Square test. Chi-Square test was applied to determine whether there was a significant association between the two categorical variables from a single population of endodontists. Percentages were calculated based on the number of responses or respondents to each question. The correlation between the preparation technique and the file separation, experience with frequency of file separation, experience with management of file separation, experience with repeated reuse were assessed.

| | | Frequency | Percent |
|---|---|---|---|
| Which file system are you using now | Protaper next | 267 | 41.8 |
| | Protaper | 550 | 86.2 |
| | M two | 366 | 57.4 |
| | Race | 65 | 10.2 |
| | Revo S | 115 | 18.0 |
| | Neolix neo Ni Ti | 126 | 19.7 |
| | One shape | 92 | 14.4 |
| | Hyflex | 84 | 13.2 |
| | K3 | 74 | 11.6 |
| | Flexicon | 6 | 0.9 |
| | Komet F360 | 10 | 1.6 |
| | V taper | 47 | 7.4 |
| | Reciproc | 17 | 2.7 |
| | Chinese | 1 | 0.2 |
| | Hero shaper | 6 | 0.9 |
| | Heroshaper twisted | 1 | 0.2 |
| | Light speed | 3 | 0.5 |
| | Profile system | 1 | 0.2 |
| | SAF | 1 | 0.2 |
| | Silk | 1 | 0.2 |
| | TF | 1 | 0.2 |
| | Twisted files | 2 | 0.3 |
| | Wave one | 15 | 2.4 |
| | Wave One Gold | 1 | 0.2 |

**[Table/Fig-1]:** Data regarding various rotary file systems used.

| | | Frequency | Percent |
|---|---|---|---|
| Why do you use rotary file system | Follows the canal anatomy better | 378 | 59.2 |
| | Better cleaning efficiency | 363 | 56.9 |
| | Time factor | 405 | 63.5 |
| | Fracture resistance | 60 | 9.4 |
| | Ease of use | 424 | 66.5 |
| | Cost factor | 296 | 46.4 |
| | Mostly used | 1 | 0.2 |
| | Waveone has less screwing effect in canal. Hence less file breakage | 1 | 0.2 |
| | Wizard navigator | 1 | 0.2 |
| | | Frequency | Percent |
| What is your preparation technique | Crown down technique | 346 | 54.2 |
| | Hybrid preparation technique | 264 | 41.4 |
| | Sequential manner | 27 | 4.2 |
| | Step back | 1 | 0.2 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| Do you prefer rotary instrumentation in upper anterior teeth | No | 486 | 76.2 |
| | Yes | 152 | 23.8 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| Do you use glide path rotary files | Depends on the canal | 27 | 4.2 |
| | No | 360 | 56.4 |
| | Some times | 63 | 9.9 |
| | Yes | 188 | 29.5 |
| | Total | 638 | 100.0 |

**[Table/Fig-2]:** Data regarding rotary techniques.

## RESULTS

This study achieved an overall response rate of 63.8%. From 638 respondents of the current survey, 135 (21.2%) were academician and clinician, 64 (10%) were only clinicians and 439 (68.8%) were post graduate students. The experience using rotary file system for more than five years was 28.1%, from one year to five years was 35.9%, six months to one year and less than six months was 22.3% and 13.8% respectively.

| | | Frequency | Percent |
|---|---|---|---|
| Do you initially enlarge the canal before rotary instrumentation with K file | 15 no. K file | 172 | 27.0 |
| | 20 no. K file | 359 | 56.3 |
| | 25 no. K file | 46 | 7.2 |
| | Depends on the canal | 61 | 9.6 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| Do you use coronal enlarging file | Gates Glidden or large number K file | 41 | 6.4 |
| | GG drills | 1 | 0.2 |
| | No | 123 | 19.3 |
| | Orifice opener | 1 | 0.2 |
| | Orifice openers or Sx file | 1 | 0.2 |
| | Protaper Sx | 1 | 0.2 |
| | Sometimes when orifices are apart | 1 | 0.2 |
| | Sx | 1 | 0.2 |
| | Yes | 468 | 73.4 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| Have you used reciprocating file system | No | 544 | 85.3 |
| | Yes | 94 | 14.7 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| Have you used self adjusting file system | No | 579 | 90.8 |
| | Yes | 59 | 9.2 |
| | Total | 638 | 100.0 |

**[Table/Fig-3]:** Data regarding intial enlargement, coronal preparation and usage frequency of reciprocating and self adjusting file system.

| | | Frequency | Percent |
|---|---|---|---|
| How many times do you re use your rotary file system | 2 uses | 17 | 2.7 |
| | 3-5 uses | 185 | 29.0 |
| | 5-10 uses | 408 | 63.9 |
| | More than 10 uses | 22 | 3.4 |
| | Single use | 6 | 0.9 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| When do you discard rotary file system | After decrease in the cutting efficiency | 171 | 26.8 |
| | After repeated re use | 352 | 55.2 |
| | After the file separation | 76 | 11.9 |
| | After using in curved canal | 39 | 6.1 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| How do you remember the number of times the files are used | Marking on files | 366 | 57.4 |
| | Recording on paper | 195 | 30.6 |
| | Removal of petals | 41 | 6.4 |
| | Others | 36 | 5.6 |
| | Total | 638 | 100.0 |

**[Table/Fig-4]:** Data regarding re use of rotary file system.

| | | Frequency | Percent |
|---|---|---|---|
| What is the estimated frequency of file separation in the root canal ( after how many cases) | After 1 | 8 | 1.3 |
| | After 10 | 50 | 7.8 |
| | After 2 | 11 | 1.7 |
| | After 3 | 7 | 1.1 |
| | After 4 | 25 | 3.9 |
| | After 5 | 89 | 13.9 |
| | After 6 | 141 | 22.1 |
| | After 7 | 33 | 5.2 |
| | After 8 | 227 | 35.6 |
| | After 9 | 19 | 3.0 |
| | After more than 10 | 28 | 4.4 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| What is the estimated frequency of file separation in root canal | In less than a week | 14 | 2.2 |
| | Less than five times a year | 198 | 31.0 |
| | Once in 15 days | 84 | 13.2 |
| | Once in a month | 239 | 37.5 |
| | Once in a week | 33 | 5.2 |
| | Rare | 70 | 11.0 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| Do you think that the separation of file has decreased with your increasing experience on rotary file system | No | 43 | 6.7 |
| | Yes | 595 | 93.3 |
| | Total | 638 | 100.0 |

**[Table/Fig-5]:** Data regarding file separation.

The data from the responses received was categorized accordingly with the data regarding the use of various rotary files system [Table/Fig-1], data regarding the rotary usage and preparation techniques [Table/Fig-2], data regarding initial enlargement, coronal preparation and usage frequency of reciprocating and self adjusting file system [Table/Fig-3], data regarding the re use of rotary file systems [Table/Fig-4], data regarding file separation, reason for file separation and the management of separated file [Table/Fig-5-7], data regarding the advantages and disadvantages of rotary, reciprocating and self adjusting file system [Table/Fig-8,9].

There was a significant correlation between the initial enlargement with K files and the frequency of re using the file system.But when the initial enlargement was upto 25 K file showed varied correlation with least number of respondents favouring enlargement till 25 K file.The correlation between the preparation technique and re using the file systems revealed hybrid preparation technique was more efficient. With the increasing experience on the rotary file system the frequency of re using the file system increased and as well the management of separated file system [Table/Fig-10].

## DISCUSSION

This survey was conducted with an intention to collect data from Indian endodontists regarding the usage of different NiTi rotary instruments and their usage techniques. Although such survey data are available from other countries such as Australia [14], the UK [2], Denmark [15], the United States [16], Tehran [3], French dental schools [17] and Flemish [18],Wales [1,19, 20] comparatively little is known about the different NiTi rotary instruments usage and their techniques in India.

The distribution of the survey forms by hand and via electronic media was done. Collection of data via electronic media offered a unique set of strength as this method facilitated access to large groups, improved response percentages by offering the ability to send reminder messages, calls and guaranteed completion of each

| | | Frequency | Percent |
|---|---|---|---|
| Where does the majority of the file separation occurs | Lower anteriors | 3 | 0.5 |
| | Upper premolars buccal root | 3 | 0.5 |
| | Upper premolars palatal root | 4 | 0.6 |
| | Upper molars Mesiobuccal canal | 199 | 31.2 |
| | Upper molars distobuccal canal | 24 | 3.8 |
| | Lower molars Mesiobuccal canal | 371 | 58.2 |
| | Lower molars Mesio lingual canal | 464 | 72.7 |
| | Lower molars distal canal | 6 | 0.9 |
| | Lower premolars | 1 | 0.2 |
| | Upper anteriors | 1 | 0.2 |
| | | Frequency | Percent |
| Where does the separation occurs most commonly | Apical one third | 563 | 88.2 |
| | Middle one third | 75 | 11.8 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| Do you think the incidence of file separation decreases with | Hand piece with speed and torque control | 616 | 96.6 |
| | Hand piece without speed and torque control | 22 | 3.4 |
| | Total | 638 | 100.0 |
| | | Frequency | Percent |
| Does the irrigation protocol decreases the file separation | Irrigation play a minor role. I believe it's always a good glide path and extended duration of using hand files decrease the fractures. | 1 | 0.2 |
| | EDTA to be used properly | 1 | 0.2 |
| | No | 58 | 9.1 |
| | To some extent | 1 | 0.2 |
| | Yes | 577 | 90.4 |
| | Total | 638 | 100.0 |

**[Table/Fig-6]:** Data regarding file separation.

| | | Frequency | Percent |
|---|---|---|---|
| What may be the common reason for file separation in the canal | Excessive pressure on file | 507 | 79.5 |
| | Incorrect insertion angle of the file | 198 | 31.0 |
| | Non constant speed of rotation | 52 | 8.2 |
| | High R P M | 47 | 7.4 |
| | Infrequent irrigation | 328 | 51.4 |
| | Calcified canal | 135 | 21.2 |
| | Over usage | 373 | 58.5 |
| | Inappropriate torque settings | 265 | 41.5 |
| | Type of file | 23 | 3.6 |
| | Complex root canal anatomy | 180 | 28.2 |
| | Incorrect file sequence | 346 | 54.2 |
| | File design | 1 | 0.2 |
| | Unknown | 4 | 0.6 |
| | | Frequency | Percent |
| How do you manage separated instruments | Retrieve the instrument | 263 | 41.2 |
| | Bypass the separated instrument | 518 | 81.2 |
| | Obturation over the separated instrument | 351 | 55.0 |
| | Depends on preoperative infection status and level of fracture of instruments | 1 | 0.2 |
| | Depends the place of seperation and irrigation protocol | 1 | 0.2 |
| | Refer | 1 | 0.2 |
| | Retrieve if in coronal otherwise bypass.. If it doesn't happen then obturate if patient is symptom free. | 1 | 0.2 |
| | Variable for each case | 1 | 0.2 |

**[Table/Fig-7]:** Data regarding reason for file separation and management of file separation.

question by using an incomplete error message for unanswered questions during the submission process [16].

This study had an overall response rate of 63.8%, which was acceptable for dental surveys (50-70%) [6]. Purpose of this questionnaire survey was to gain insight into the experiences and beliefs of endodontists concerning the new endodontic technology of rotary NiTi instrumentation as the successful introduction of new NiTi rotary technology into daily clinical practice would require not only effective products, but also the appropriate and adequate data with quality information for the usefulness of the practitioners [1,7,19]. The questions were designed to ascertain the problems, patterns of use and to identify areas of perceived or potential concern. Furthermore, it was intended that the information so obtained would allow a better understanding of the needs within the Indian endodontic community.

Experienced operators combine instruments from different file systems and use different instrumentation techniques to achieve best biomechanical cleaning and shaping results, resulting in the fewest procedural errors [6].

It is recommended that NiTi rotary instruments be discarded after a single use. A single use is ideal for reducing the risk of file separation; however, the high operating cost of NiTi files has forced clinicians to reuse them. There are so many factors governing the safe re use of NiTi rotary file systems which mainly depends on the number of re uses, preparation technique employed, glide path preparation prior to rotary instrumentation and initial apical preparation and enlargement of the canal using hand K files, sufficient orifice enlargement or the coronal preparation and the use of adequate irrigant and lubrication with the file system [6].

The preparation technique was associated with the frequency of file separation. Operators who use the sequential total length technique tended to experience file fracture more than crown down and hybrid preparation technique. The crown down technique has been used for more effective cleaning and shaping. It minimizes coronal interference, decreases the torque load of each instrument and reduces procedural errors. The hybrid technique does not deviate from the principles of the crown down preparation [6].

Prior to use of any NiTi rotary instruments, a passive glide path for these instruments upto ISO size 20 with stainless steel K hand files is essential so that the fragile tips of small sized NiTi rotary instruments can follow the path created without exploring the canal or cutting. Even light pressure or a small amount of torque with inadequate glide path would otherwise fracture these instrument tips [12]. So, it is recommended that the use of stainless steel hand files to prepare the apical 1/3$^{rd}$ before introducing rotary files, to reduce the incidence of file breakage [21].

The frequency of reusing NiTi files differed according to experience. Experienced operators had a strong tendency of reusing the files 6-10 times. This was due to the experience based opinion that a file can be safely re used more. It seems that experienced operators do not rush through a procedure, so that it could decrease the chance of torsional failure [22,23].

Instrument fracture occurs during preparation of the root canal when the root canal still is rather narrower and not finally flared. The majority of the fractures had occurred in molars; the most frequently involved root canals were the mesial canals of mandibular molars followed by buccal canals of maxillary molars [24]. The responses obtained were comparatively similar with that of the PennEndo database study [10].

Instrument separation was 33.5 times more likely to occur in the apical one third versus the coronal one third of the tooth [10]. Similar responses were obtained according to the respondents of this survey.

| | | Frequency | Percent |
|---|---|---|---|
| What is the advantage of using rotary file system | Decreased procedural errors | 306 | 48.0 |
| | Time saving | 539 | 84.5 |
| | Ease of use | 412 | 64.6 |
| | Maintaining the canal anatomy and curvature better | 299 | 46.9 |
| | Maintains working length | 49 | 7.7 |
| | Easier canal obturation | 415 | 65.0 |
| | Patient factor | 48 | 7.5 |
| | At times being an endodontic. Rotary is expected | 1 | 0.2 |
| | | Frequency | Percent |
| What are the disadvantages of using rotary file system | Ledging of the canal | 94 | 14.7 |
| | Transportation | 73 | 11.4 |
| | Strip perforation | 36 | 5.6 |
| | Straightening of the canal | 65 | 10.2 |
| | Binding of the file | 99 | 15.5 |
| | File separation | 533 | 83.5 |
| | Excessive dentin removal | 450 | 70.5 |
| | Expensive | 1 | 0.2 |
| | | Frequency | Percent |
| What are the advantages of using reciprocating file system | Reciprocating motion | 287 | 45.0 |
| | Time factor | 75 | 11.8 |
| | Reduced incidence of file separation | 494 | 77.4 |
| | Others<br>No<br>No advantage<br>not sure<br>Not used. | 11 | 1.8 |
| | | Frequency | Percent |
| What is the disadvantages or why have you not used reciprocating file system | Cost factor | 287 | 45.0 |
| | Availability of files | 60 | 9.4 |
| | Need for reciprocating hand piece | 521 | 81.7 |
| | None | 6 | 0.9 |

**[Table/Fig-8]:** Advantages and disadvantages of rotary and reciprocating file systems.

Majority of the respondents agreed that the incidence of file separation decreases with the irrigation protocol and with hand piece having speed and torque control. The galenic form of a lubricant was the main factor to influence mechanical stresses on instruments. Aqueous solutions were superior to a gel type preparation. Furthermore, the addition of a chelating agent caused some further decrease in torque, torsional load, and force values. This effect occurred immediately [25].

The management of separated files is multifactorial, the removal of the fractured NiTi instruments is more influenced by such factors as the anatomy of tooth, degree of root canal curvature, and the location of fragment than the specific technique used [26]. There was an improvement in the management of the separated files with the increasing experience.

Although instrument breakage in some cases sharply increases the chance of case failure, it does not in general act as a particularly powerful influence toward case failure. The rather high success rate obtained in spite of instrument breakage suggests that instances a broken instrument does not have an adverse effect on the prognosis [27].

Root canal instruments should be examined before being introduced into a canal to make sure that the spiral twists are regularly aligned. If the blades are not spaced equally, it is an indication that the instrument has been strained and that the torque has caused the blades to become irregularly spaced. The spacing may be closer together or further apart than normal, depending on whether the instrument had been originally wound clockwise or counter-clockwise by the manufacturer. Instruments with irregularly spaced blades are likely to break. Instruments should also be examined as they are removed from the canal and are being cleaned on a cotton roll prior to sterilization. A quick glance is sufficient to determine whether the instrument has been under strain and should be discarded [28].

| | | Frequency | Percent |
|---|---|---|---|
| What are the advantages of using self adjusting file system | Continuous irrigation | 421 | 66.0 |
| | Time factor | 74 | 11.6 |
| | Reduced incidence of file separation | 472 | 74.0 |
| | | | |
| | Better cleaning and shaping | 1 | 0.2 |
| | canal anatomy is preserved | 1 | 0.2 |
| | Cost | 1 | 0.2 |
| | Doesn't change the original anatomy. Suitable for non circular canals | 1 | 0.2 |
| | Maintains Canal anatomy | 1 | 0.2 |
| | No advantage, rotary is equally better | 1 | 0.2 |
| | not sure | 4 | 0.6 |
| | Not used | 7 | 1.1 |
| | reduce dentin removal | 1 | 0.2 |
| | | Frequency | Percent |
| What are the disadvantages or why have you not used self adjusting file system | Cost factor | 314 | 49.2 |
| | Availability of files | 62 | 9.7 |
| | Need for specialized hand piece | 503 | 78.8 |
| | Don't know | 3 | 0.5 |
| | Need for GlidePath with rotary files | 1 | 0.2 |
| | Not used | 2 | 0.3 |
| | SAF does shape and enlarge the canal ... It only helps in cleaning the canal | 1 | 0.2 |
| | Used | 1 | 0.2 |

**[Table/Fig-9]:** Advantages and disadvantages of self adjusting file system.

The study addressed to the various instruments and instrumentation technologies of rotary NiTi which will help in understanding the clinical implications which will provide a better platform for the endodontists to carefully select and eliminate different instrument systems and methods catering to the future prospects to the endodontists in India.

## LIMITATION

The limitation of the survey was that the study did not include the questions regarding the advantages of hand over rotary systems, the time consumed by hand over rotary systems and the success rate of hand over rotary systems. It also did not include the questions regarding the sterilization technique adopted by the endodontists after each use of the file system.

## CONCLUSION

Increased success rates of root canal treatment is still not a conclusive finding with the rotary instrumentation but there is evidence in the endodontic literature which proves that rotary instruments have several advantages over traditional hand filing techniques. The dissemination of the data to the various regions of India gave an insight regarding the usage of rotary NiTi instruments and techniques by endodontists in India.

| Co-relation between initial enlargement and file re use , Chi square value(df)= 10.64(6), p=0.10(NS) | | | | |
|---|---|---|---|---|
| Initial enlargement | Re-uses | | | Total |
| | 1 - 5 | 6 – 10 | more than 10 | |
| 15 no. K file | 45 (26.2%) | 120 (69.8%) | 7 (4.1%) | 172 |
| 20 no. K file | 69 (19.2%) | 276 (76.9%) | 14 (3.9%) | 359 |
| 25 no. K file | 16 (34.8%) | 27 (58.7%) | 3 (6.5%) | 46 |
| Depends on the canal | 10 (16.4%) | 47 (77.0%) | 4 (6.6%) | 61 |
| Total | 140 (21.9%) | 470 (73.7%) | 28 (4.4%) | 638(100.0%) |
| Co-relation between biomechanical preparation technique and file separation, Fisher's exact test = 0.01* | | | | |
| Preparation technique | File separation | | | Total |
| | After 1 – 5 | After 6 – 10 | After more than 10 | |
| Crown down technique | 86 (24.9%) | 246 (71.1%) | 14 (4.0%) | 346 |
| Hybrid preparation technique | 46 (17.4%) | 208 (78.8%) | 10 (3.8%) | 264 |
| Sequential manner | 7 (25.9%) | 16 (59.3%) | 4 (14.8%) | 27 |
| Step back | 1 (100.0%) | 0 | 0 | 1 |
| Total | 140 (21.9%) | 470 (73.7%) | 28 (4.4%) | 638 (100.0%) |
| Co-relation between years of clinical experience with rotary files and file separation, Chi square value(df)= 29.34(6), p<0.001* | | | | |
| Years | File separation | | | Total |
| | After 1 – 5 times | After 6 – 10 times | After more than 10 times | |
| 1 year to 5 years | 36 (15.7%) | 181 (79.0%) | 12 (5.2%) | 229 |
| 6 months to 1 year | 44 (31.0%) | 89 (62.7%) | 9 (6.3%) | 142 |
| Less than 6 months | 31 (35.2%) | 54 (61.4%) | 3 (3.4%) | 88 |
| More than 5 years | 29 (16.2%) | 146 (81.6%) | 4 (2.2%) | 179 |
| Total | 140 (21.9%) | 470 (73.7%) | 28 (4.4%) | 638 |

| Co-relation between years of clinical experience with rotary files and method of management of separated instrument | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Years | | | | Total | Chi square test | |
| | 1 year to 5 years | 6 months to 1 year | Less than 6 months | More than 5 years | | Chi square value | p-value |
| Retrieve the instrument | 84 (36.7%) | 33 (23.2%) | 24 (27.3%) | 122 (68.2%) | 263 (41.2%) | 81.56 | <0.001* |
| Bypass the separated instrument | 182 (79.5%) | 109 (76.8%) | 67 (76.1%) | 160 (89.4%) | 518 (81.2%) | 11.61 | 0.009* |
| Obturation over the separated instrument | 141 (61.6%) | 86 (60.6%) | 33 (37.5%) | 91 (50.8%) | 351 (55.0%) | 17.92 | <0.001* |
| Others | 2 (0.8%) | 1 (0.7%) | 0 | 2 1.2%) | 5 (0.8%) | - | - |

**[Table/Fig-10]:** Co-relation data.
*p<0.05 statistically significant; p>0.05 Non significant, NS
Fishers Exact test and Chi square test used.

The adoption of new endodontic technologies among endodontists in India has significantly contributed to the enhancement of the quality of endodontic treatment. The present survey provided the qualitative and quantitative information regarding the various aspects of rotary NiTi systems. Questionnaire based studies can serve as a useful tool in successful practice.

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