



A STATE-WIDE SURVEY ON VARIOUS NI-TI ROTARY INSTRUMENTS AND THEIR USAGE TECHNIQUES EMPLOYED BY DENTISTS

Dental Science

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ABSTRACT

The science of rotary instrumentation is ever evolving with newer technologies emerging ever so often to achieve better and faster instrumentation of root canal systems. Limited information is available about the adoption of these technologies by endodontists as well as general dentists and their attitude towards the various advantages and disadvantages of these rotary systems.

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 the state of Karnataka.

Materials and methods: 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, and management of fractured files. 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 and the data acquired was statistically evaluated.

Results: This study achieved an overall response rate of 62%. From 372 respondents of the current survey, 75% were general dentists and 25% were endodontists. The experience using rotary file system for more than two years was 47%, from one year to two years was 11% - and less than one year was 35%.

Conclusion: A significant proportion of participants who require further education and training in the science of rotary instrumentation and separation.

KEYWORDS

Rotary Instrumentation, Questionnaire, File separation

I. INTRODUCTION

Root canals, with their multiple fins and ramifications, have complex morphologies thereby leading to difficulties in endodontic procedures. The success of any endodontic treatment depends on effective disinfection of the canals during chemo-mechanical preparation. Hence, this step is one of the most important aspects of root canal therapy.

Owing to development of newer techniques and innovative materials, there has been a paradigm shift in the technique used for mechanical preparation. Traditionally, stainless steel was used to manufacture instruments for root canal shaping but their rigidity and decreased flexibility in larger size files led to greater incidence of procedural errors (Porto Carvalho, 1999). Consequently, root canal instruments manufactured from nickel-titanium (NiTi) alloy were introduced to overcome the rigidity of stainless steel. These NiTi instruments, due to their unique metallurgical characteristics, have reduced the incidence of procedural errors. They are two to three times more flexible and have superior resistance to torsional fracture as compared to stainless steel (Iqbal, 2006). They also allowed the operators to switch from manual instrumentation hence significantly reducing treatment time. Various NiTi rotary systems are being constantly released and they have undergone a revolution regarding design features, mechanical properties and performance.

Iatrogenic procedural errors such as ledging, apical zipping, canal perforation and apical transportation can occur during any root canal instrumentation. In addition to these iatrogenic errors, separation of endodontic instruments is one of the most problematic events. Since NiTi files are more advanced and more flexible than stainless steel instruments; separation of the instrument is a topic of concern because these instruments can fracture within their elastic limit and without any visible signs of permanent deformation (Madarati, Watts and Qualtrough, 2008).

Contradictory results are reported in literature regarding the clinical significance of separated files remaining within the treated root canals. According to Spili in 2005, a decrease in healing of periapical lesions is seen in cases of necrotic teeth with fractured fragments.

There is an understanding among various clinicians and researchers that the frequency of usage of any instrument is a significant factor in the defect rate. There is limited availability of information regarding the use of nickel titanium rotary instruments and instrumentation by endodontists and general practitioners as well as their opinions and attitudes towards the intracanal separation of endodontic instruments in the state of Karnataka. Thus, the aim of this study was to conduct a

questionnaire survey to acquire the knowledge concerning different Ni-Ti rotary instruments and their usage techniques by endodontists in the state of Karnataka.

II. MATERIALS AND METHODOLOGY

The study was conducted in the department of Conservative Dentistry and Endodontics, Faculty of Dental Sciences, Ramaiah University, Bangalore, Karnataka. A survey questionnaire was distributed through the internet to various general dentists and endodontists in the state of Karnataka which was designed and validated by distributing it to 5 experienced dentists.

A pilot survey was conducted on 25 endodontists to assess the reliability and internal consistency of the questionnaire. A survey questionnaire was disseminated via two methods; electronic media and on site to 400 endodontists. The questionnaire was also distributed to 200 endodontists who attended the IDA Conference, Bangalore in December 2018. The repetition of the endodontists was avoided by the demographic data collection and subsequent elimination of the particular institution. 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, and management of fractured files.

Questions were constructed by using check boxes, multiple options and with same number of options given for each question. Selection of more than one answer was not 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. An introductory letter was attached to clearly explain the objectives of the survey to the participants and also ascertained on the confidentiality of the survey.

Sample size was calculated based on the following statistical analysis:

SAMPLE SIZE ESTIMATION

Where $Z = Z$ value for the confidence level chosen = 1.96 (for 90% confidence level - from standard normal distribution)

$p = 50\% = 0.50$ (percentage of samples who have positive response)
 $q = 1 - p = 50\% = 0.50$

Δ = Margin of error which is acceptable = 0.10 (or 10%)
Therefore, $SS = [(1.96)^2 * (0.50) * (0.50)] / (0.10)^2$

SS = 271 ~ 300

STATISTICAL ANALYSIS

Data was entered in the excel spread sheet. Descriptive statistics like mean, standard deviation and percentages were calculated. Inferential statistics like chi-square test or Fischer's exact test were computed using SPSS (statistical Package for Social Sciences) version 20. (IBM SPASS statistics, IBM corp. 2011] Any other necessary tests were dealt at the time of analysis based on data distribution.

RESULTS

The data from the responses received was categorized accordingly with the data regarding the education of various Ni-Ti rotary systems (Table/Fig1), data regarding the pattern of rotary usage (table/Fig 2) data regarding issues faced during rotary instrumentation (Table/Fig 3), data regarding the management of separated file (Table/Fig4).

This study achieved an overall response rate of 62%. From 372 respondents of the current survey, 75% were general dentists and 25% were endodontists (Table 1). The experience using rotary file system for more than two years was 47%, from one year to two years was 11% - and less than one year was 35%.

Table 1: Ni-ti Education

Prior to Ni-Ti usage, was any training received?	Yes	240	64%
	No	132	35.4%
If yes, the training courses were conducted by	Dental supply company	38	10.2%
	University	142	38.2%
	Dental association and societies	50	13.4%
	Other	141	37.9%
Were the training courses beneficial?	Yes	266	71.5%
	No	106	29.5%
Niti rotary usage was practiced on	Extracted teeth	183	49.2%
	Patients	56	15.1%
	Plastic blocks	133	35.8%
Category	General dentist/ non-endodontist	281	75.5%
	Endodontists	91	24.5%

Table 2: - Pattern Of Usage

Type of instrument used for cleaning and shaping of root canal	Hand stainless steel files	11	3%
	Hand NiTi files	4	1.1%
	Rotary files	70	18.8%
	All of the above	287	77.2%
The type of rotary files often used	Protaper	209	56.2%
	Mtwo	77	20.7%
	RaCe	16	4.3%
	Others	70	18.8%
Experience in use of rotary instruments	0-12 months	130	34.9%
	13-24 months	40	10.7%
	25-36 months	20	5.3%
	36-48 months	8	2.1%
	More than 48 months	174	46.7%
After how many usages do you change your rotary files	1	6	1.6%
	2	14	3.8%
	3	61	16.4%
	4	24	6.4%
	5 or more	248	66.7%
Technique used for shaping the canal	Step back	11	3%
	Crown down	135	36.3%
	Balanced force	43	11.6%
	Hybrid/Combination	181	48.7%
	Other	2	0.5%
Motors used to drive rotary instruments	X Smart	259	69.6%
	Tri Auto ZX	4	1%
	Endo Motor	50	13.4%
	Endo Mate	18	4.8%
	Other	41	11%

How many rotary instruments have you used	1-2	48	12.9%
	2-3	62	16.7%
	4-5	84	22.5%
	More than 5	178	47.9%
Reasons for discarding the instrument	Distortion	44	11.8%
	Unwinding	6	1.6%
	Decreasing cutting efficiency	40	10.8%
	Number of uses	263	70.7%
	Others	19	5%

Table 3 : Experience with rotary usage

Positive experience with rotary NiTi compared with manual instrumentation	Canal preparation is much	251	67.5%
	Canal curvature is maintained	82	22%
	Final canal obturation is easier	27	7.3%
	Working length is maintained	12	3.2%
Procedural difficulties encountered most often during treatment	Ledging of the canal	103	27.7%
	Transportation of the canal terminus	97	26.1%
	Straightening of the root canal	95	25.5%
	Canal perforation	77	20.7%
Incidence of file fracture in a year	1-5	174	46.8%
	6-10	89	23.9%
	10-15	80	21.5%
	More than 15	25	6.7%
	None	4	1.1%
Size of the separated instrument	15-20	285	76.6%
	25-30	63	16.9%
	35-40	12	3.2%
	45 or more	12	3.2%
Taper of the separated instrument	2	90	24.2%
	4	83	22.3%
	6	192	51.6%
	8	8	2.1%
Length of the separated instrument	0.5-1.5	175	47%
	2.0-3.0	135	36.3%
	3.5-4.5	62	16.7%
	5.0-6.0	0	0%
Location of the separated instrument	Apical third	270	72.6%
	Beyond apex	10	2.7%
	Coronal third	75	20.2%
	Middle third	17	4.6%
Reasons for file fracture	Complex root canal anatomy	80	21.5%
	Excessive pressure on file	113	30.4%
	Incorrect file inserton	73	19.6%
	Over usage	106	28.5%
Pattern of endodontic file examination	Before treatment	91	24.5%
	Regularly during treatment	187	50.2%
	After treatment	60	16.1%
	After sterilization	34	9.1%

Table 4: Management of separated instrument

Management of instrument at coronal third	Retrieved	274	73.6%
	Bypassed	75	20.2%
	Referred to specialist	20	5.4%
	Surgical approach	3	0.8%
Management of instrument at middle third	Retrieved	97	26.3%
	Bypassed	257	69.1%
	Referred to specialist	13	3.5%
	Surgical approach	5	1.3%
Management of instrument at apical third	Left in situ	106	28.4%
	Bypassed	190	51.0%
	Referred to specialist	56	15.1%
	Surgical approach	20	5.4%
Management of retrieval at coronal third	Ultrasonic	95	25.5%
	Masseran	19	5.1%
	File braiding	27	7.3%
	Forceps	16	4.3%
	Multitechnique	215	57.8%

Management of retrieval at middle third	Ultrasonic	156	41.9%
	Masseran	12	3.2%
	File braiding	18	4.8%
	Forceps	22	5.9%
	Multitechnique	164	44%

Table 5: Cross-tabulation of category of specialisation and incidence of file fracture in a year

		Incidence of file fracture in a year					Total
		1 to 5	10 to 15	6 to 10	More than 15	none	
Endodontist	Count	49	15	19	5	3	91
	% of Total	13.2%	4.0%	5.1%	1.3%	0.8%	24.5%
General dentist/ non-endodontist	Count	125	65	70	20	1	281
	% of Total	33.6%	17.5%	18.8%	5.4%	0.3%	75.5%
Total	Count	174	80	89	25	4	372
	% of Total	46.8%	21.5%	23.9%	6.7%	1.1%	100.0%

Table 6: Cross-tabulation of usage of Ni-Ti usage prior and incidence of file fracture in a year

		Incidence of file fracture in a year					Total
		1 to 5	10 to 15	6 to 10	More than 15	none	
NO	Count	45	40	29	17	1	132
	% of Total	12.1%	10.8%	7.8%	4.6%	0.3%	35.5%
YES	Count	129	40	60	8	3	240
	% of Total	34.7%	10.8%	16.1%	2.2%	0.8%	64.5%
Total	Count	174	80	89	25	4	372
	% of Total	46.8%	21.5%	23.9%	6.7%	1.1%	100.0%

Table 7: Cross-tabulation of technique used for shaping the canal and incidence of file fracture in a year

		Incidence of file fracture in a year					Total
		1 to 5	10 to 15	6 to 10	More than 15	none	
balanced force	Count	19	8	13	3	0	43
	% of Total	5.1%	2.2%	3.5%	0.8%	0.0%	11.6%
crown down	Count	64	39	24	7	1	135
	% of Total	17.2%	10.5%	6.5%	1.9%	0.3%	36.3%
hybrid/combination	Count	82	32	51	13	3	181
	% of Total	22.0%	8.6%	13.7%	3.5%	0.8%	48.7%
other	Count	1	1	0	0	0	2
	% of Total	0.3%	0.3%	0.0%	0.0%	0.0%	0.5%
step back	Count	8	0	1	2	0	11
	% of Total	2.2%	0.0%	0.3%	0.5%	0.0%	3.0%
Total	Count	174	80	89	25	4	372
	% of Total	46.8%	21.5%	23.9%	6.7%	1.1%	100.0%

DISCUSSION:

This survey was undertaken aiming to collect data from dentists in the state of Karnataka regarding the usage of NiTi rotary instrumentation and the incidence of file separation. Although similar data through survey is available for India (Patil *et al.*, 2017), no survey has been done exclusively for the state of Karnataka. Even with numerous advancements in the design, metallurgy and techniques of instrumentation, file separation is still encountered frequently. Thus, this survey was conducted to gather information about the nature of file separation and the general awareness, knowledge and understanding amongst practitioners regarding the same.

Distribution of survey was done both by hand and via electronic media. 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 community practicing endodontics. The overall response rate achieved by this study was 62% from 372 respondents. Literature indicates that response rate of 50-70% is acceptable for dental surveys (Hovland, 1980).

The data from the responses received was categorized accordingly regarding the education of various NiTi rotary systems, demographics of the respondents, regarding the pattern of rotary usage, regarding issues faced during rotary instrumentation and the management of separated file.

Our results revealed that out of 372 respondents 75% were general dentists and 25% were endodontists. Majority of the respondents had an experience in rotary usage of more than 48 months (47%). The percentage of respondents with prior Ni-Ti usage were 65% and they reported lesser incidence of file fracture in a year compared to those who did not receive any training, further highlighting the importance of learning curve in rotary instrumentation to prevent file separation (Table 6).

In our survey, 77% of the respondents used a combination of hand files and rotary files for the process of cleaning and shaping. Most commonly used rotary file were Protaper Universal (56%) followed by Mtwo (21%). 67% of the respondents used rotary files for more than 5 times (Table 2). This could be a major reason for the increased incidence of file fracture (Cheung, 2010). This is in accordance with Kim *et al.*, 2006 who reported a fracture rate of 0.4-23% when instruments were subjected to multiple uses. Reusing an instrument carries a potentially higher risk of separation. The resistance of an instrument to fatigue failure is jeopardized after repeated clinical use even though there may not be any visibly detectable sign of distortion. Even though in our study the most common reason provided by the respondents for discarding the instruments was the number of uses, practitioners were anyway using it for a minimum of 5 times.

The most preferred technique for instrumentation of the canal was hybrid technique (49%) followed by crown down preparation (36%). Within the hybrid group, 22% reported incidence of file separation between 1-5 in a year, 3.5% reported more than 15 and 0.8% reported no file separation. Accordingly, in the crown down group, 17% reported instrument separation between 1-5 in a year, 2% reported more than 15 and 0.3% reported no file fracture (Table 7). Hence, use of hybrid technique had a significant role in the incidence of separation according to our study. Hybrid technique could be associated with increased reuse of files with clinicians not being aware of the stress in the file. This is in accordance with Lee *et al.*, 2012 who reported that when hybrid techniques were adopted there was a stronger tendency to reuse the files i.e. more than 10 times. Other reasons for increased failure in this technique can be skipping of instruments and using combination of different systems of varying length, taper and material.

The next category of question was related to some of the issues faced during NiTi rotary instrumentation (Table 3). Most commonly encountered procedural difficulty while using rotary instruments was ledging i.e. 28%, followed by transportation of canal terminus – 26%, straightening of root canal – 25% and perforation – 21%. When questioned about size, length and taper of the separated instrument, most common responses were size – 15-20, taper- 6%, and length- 2-3mm. Our finding is similar to studies done by Gabel *et al.*, 1999 and Bortnick, Steiman and Ruskin, 2001. The reason for separation of larger instrument is mainly due to cyclic fatigue (Baek *et al.*, 2011). The length of the separated instrument in most of the cases has been recorded to be 2-3 mm, the reason could be increased chance of torsional fatigue closer to the tip mainly because of smaller surface area, thus lowering the load bearing capacity.

The most common location of separated instrument is apical third (Table 3). Our finding is similar to studies done by Wu *et al.*, 2011 and Wang *et al.*, 2014. This is because instruments that work in apical third are more predisposed to breakage because this region of canal commonly exhibits a smaller diameter, and increased curvature and diversions (Wolcott *et al.*, 2006). The next set of questions was related to the management of separated instruments in different parts of the root canal (Table 4). The responses revealed that more apical the file separated, lessen the chance of it being retrieved. Majority of the respondents would attempt to retrieve the instrument from coronal 3rd (74%) and bypassed from middle 3rd (69%) and apical 3rd (51%). These results were similar in comparison to a survey conducted by Madarati *et al.*, 2008. When questioned about retrieval of separated instrument most common method of retrieval was multi-technique used for both coronal and middle third. For management of apical 3rd, 51% of respondents reported bypassing the file whereas 28% reported leaving the file in-situ. According to a meta-analysis report by Panitvisai *et al.*,

2010, the prognosis for endodontic treatment when a fractured instrument fragment is left within a root canal is not significantly reduced. The prognosis is lower if periapical pathology is present at the time of treatment, but only to the extent that effective canal disinfection is compromised.

Separation of an instrument during endodontic therapy is a recognized complication. According to Strindberg et al, there was a 19% reduction in success rate of RCT in cases where there are separated instruments. There are various ways in which incidence of instrument separation can be prevented. The most common method is to prevent over usage of instruments. Only 2% of respondents reported that they discard file after single use (Table 2). This percentage has to increase in order to prevent the complication of file separation. Another method for prevention can be regular examination of the files both before and regularly during treatment which is an efficient strategy. In our study only 50% reported evaluation during the treatment. There are still a vast majority of practitioners who responded that they examined instrument after the treatment which should be corrected. 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.

CONCLUSION

General awareness, knowledge and understanding of most aspects related to instrument fracture was seen in the practitioners. In the current survey, most of the respondents were aware of the need of examination of instruments, management of fractured instruments, techniques used for removal of fractured instruments and importance of magnification but there are still a significant proportion of participants who require further education and training in the science of rotary instrumentation and separation.

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