

FREQUENCY OF PROCEDURAL ERRORS IN ROTARY VS CONVENTIONAL ROOT CANAL TREATED TEETH

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ABSTRACT

The contemporary approach to root canal treatment has been shifting towards engine driven filing procedures in the last decade. However, although conventional root canal procedures are slowly being phased out, it still represents the primary mode of root canal therapy in the vast majority of the developing world. The purpose of this cross sectional study was to evaluate the frequency of procedural errors in root canal treated teeth with rotary and conventional filing systems. Three hundred and forty six root canal treatment cases were assessed, out of which 173 were prepared using conventional file system and 173 were prepared using ProTaper® universal (Dentsply) rotary system. Teeth in each group were evaluated radiographically using DIGORA® optime software for presence or absence of procedural errors (i.e. overfills, underfills, ledge formation, perforations, apical transportation and / or instrument separation). Out of the 173 conventionally treated teeth 57 (32.9%) had a procedural error. While, out of 173 cases prepared using ProTaper® universal rotary system, 50 (28.9%) had procedural errors. The most common errors in both groups, by far, was overfill (22.5% in conventional and 16.2% in rotary). Chi square test showed P value > 0.05 (0.416) which shows an insignificant relationship between the system used and the frequency of errors. There was little difference between the overall incidences of procedural errors in either system, however, there was a difference in the type of error produced. It is concluded that although rotary systems are not as easy to use as previously believed.

Key Words: Conventional root canal treatment, procedural error, rotary endodontics, ProTaper.

INTRODUCTION

The conventional approach to root canal treatment involves the use of stainless steel hand files of predetermined diameters and taper. Historically, this mode of therapy has proven to be successful¹ and comparatively economical. The contemporary approach to root canal treatment has been shifting towards engine driven filing procedures in the last decade. The reason behind this dramatic change has been due to the remarkable improvement in speed², efficiency³ and predictability⁴ provided by these new devices. However, although conventional root canal procedures are slowly being phased out, it still represents the primary mode of root canal therapy in the vast majority of the developing world.

Procedural errors are found in all approaches of endodontic treatment. The prime concern among endodontists today is to reduce the incidence of such errors from occurring, while still maintaining the quality and efficiency of current treatment modalities. Conventional root canal treatment has been plagued with a relatively high possibility of numerous errors⁵ such as perforations, ledge formation, overfills, underfills, instrument separations, etc. However rotary file systems are not immune from such problems^{6,7} either but the incidence of such errors has reduced noticeably since the introduction of these modern rotary devices.^{8,9,10}

Unfortunately general dental practitioners despite the immense advantages offered by rotary endodontics choose to use conventional hand files. The aim of our study was to evaluate the incidence of procedural errors in root canal treated teeth with rotary and conventional filing systems.

METHODOLOGY

This retrospective study was conducted at Fatima Jinnah Dental Hospital. A sample size of 346 was chosen using the formula. $\{n = z^2_{1-\alpha/2} P(1-P)/d^2\}$ All permanent maxillary and mandibular teeth (except for the third molars) which were treated using both conventional stainless steel files and rotary filing systems (ProTaper® universal [Dentsply]) by postgraduate trainees from 2011 to 2014 were recruited into this study. Patients above 65 years of age and below 12 years of age were

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excluded from the study, as were teeth possessing open apices or blocked canals. Rotary systems other than ProTaper® universal (Dentsply) were also excluded.

DATA COLLECTION

All the root canal treated teeth that fulfilled the inclusion criteria were included in this study, after approval by the Institutional Ethical Review Committee. The digital periapical radiographs (taken with a paralleling technique and stored using DIGORA® Optime) of these teeth were grouped into categories:

1. Treatment with conventional files
2. Treatment with rotary files.

Teeth treated with conventional files were prepared using the crown down technique with stainless steel hand files and were obturated using lateral condensation technique. Coronal flaring was initially done using Gates-Glidden burs. K-files were used to shape the canals in the following sequence; #55, #50, #45, #40, #35, #30. Size 30 was taken as the Master apical file (MAF). Working length was deemed acceptable if it was within 0-2mm of the radiographic apex as determined by a periapical radiograph taken using a paralleling technique.

Teeth treated with rotary system were prepared using ProTaper® universal system (Dentsply). After establishing working length with a periapical radiograph (using a paralleling technique), cleaning and shaping was done using the filing sequence as mentioned by the manufacturers (i.e. SX, S1, S2, F1, F2 for posterior teeth and till F3 for anterior teeth). In both filing techniques (conventional and rotary) a patency file was used in between each successive file used and the canal was copiously irrigated with 5% sodium hypochlorite solution. All radiographs were stored and assessed using DIGORA® Optime.

Teeth in each group were evaluated for presence or absence of procedural errors (i.e. overfill, underfill, ledge formation, perforations, apical transportation and/or instrument separation). Underfill was defined as gutta percha more than 2mm short of the radiographic apex. Overfill was defined as extrusion of gutta percha beyond the radiographic apex. Instrument separation was defined as fracture of file segment in the canal which was unable to be removed. Apical transportation was defined as undesirable deviation from the normal canal path.

Based on the presence or absence of procedural errors, radiographs were divided into two categories:

1. Acceptable RCT
2. Faulty RCT.

Teeth with no procedural error were included in the "Acceptable RCT" category. Those with a procedural error were included in the "Faulty RCT" category. Incidence for individual error and percentages of acceptable and faulty RCT were calculated for both groups. The percentage of faulty treatment and types of errors in both groups were compared. Radiographs were assessed by two senior clinicians and in case of difference of opinion the relevant X-ray was shown to

the professor of the department and his opinion was taken as final.

Null hypothesis: Root canal treatment performed by rotary (ProTaper) file system produce more consistent results and significantly reduces procedural errors.
Data analysis: Data was analyzed using SPSS version 21. Chi square test was used to test the P value.

RESULTS

A total of 346 root canal treated teeth were evaluated, out of which 173 were conventional root canal treatments and 173 were done using the rotary filing system. Out of the 173 conventionally treated teeth 57 (32.9%) were found to have a procedural error (see Table 1). Out of 173 cases prepared with rotary system, 50 (28.9%) were found to contain procedural errors. The most common errors in both groups, by far, was overfill (see Table 2). Chi square test showed P value > 0.05 (0.416) which shows an insignificant relationship between the system used and the frequency of errors.

DISCUSSION

The results of the present study revealed, surprisingly, that there was no significant correlation between the filing system used and the number of procedural errors produced. Therefore showing that conventional root canal treatment is as effective as rotary based systems in avoiding procedural errors. The present study showed that procedural errors can occur irrespective of the filing system used. Although there appeared to be slightly less procedural errors when the rotary system was employed, this was not a statistically significant finding.

Amongst the procedural errors noted during the course of this study, overfill proved to be the most frequent error in both groups in the present study

TABLE 1: PROCEDURAL ERRORS IN CONVENTIONAL VS ROTARY-

	Total cases	Frequency of errors	Percentage of errors
Conventional	173	57	32.9%
Rotary	173	50	28.9%

TABLE 2: FREQUENCY OF ERRORS IN ROOT CANAL TREATMENT DONE USING CONVENTIONAL AND ROTARY FILING SYSTEMS

Procedural Error	Conventional RCT	Rotary RCT
Overfill	39 (22.5%)	28 (16.2%)
Underfill	17 (9.8%)	15 (8.7%)
Instrument separation	0 (0.0%)	6 (3.5%)
Apical transportation	2 (1.2%)	1 (0.6%)
Normal	115 (66.5%)	123 (71.1%)

(22.5% in conventional and 16.2% in rotary). An overall statistical analysis by Haji-Hassani et al also showed similar results with overfill accounting for 18.9%.¹¹ This may not be directly attributed to an error in canal preparation by either system. In fact, it is more related to incorrect working length determination, an error related to obturation or over-instrumentation and an inability to provide proper taper.¹² Therefore, it is the skill of the operator that plays the role in correct length determination and not the filing system being used. Rotary system was noted to have a significantly less frequent appearance of overfills in the present sample. This may be explained by the increased ease of use of the rotary system and less expertise required in its application.

It was also noted that incidence of instrument separation was greater in rotary systems. Conventional file system did not demonstrate a single incidence of instrument separation in the sample. This finding indicated that rotary systems are more prone to this type of procedural error. This can be attributed to cyclic fatigue experienced by rotary instruments which is a problem not readily apparent upon repeated use of NiTi systems. On the other hand stainless steel files are more resilient to fracture and provide easily identifiable clues (e.g. visible unwinding of flutes, tip distortion, roll-up of flutes, corrosion)¹³ prior to separation. This was well demonstrated in various other studies. Al Rahabi et al reported instrument separation of 5.56% in NiTi instruments corresponding only 1.1% in stainless steel instruments.¹⁴ Similar results were shown by Sonntag et al who concluded that NiTi instruments are more prone to fracture when compared with their stainless steel counterparts.²

Underfills occurred at relatively the same frequencies in both systems (i.e. 8% in rotary and 9.8% in conventional cases). The results in the present study compare favorably to a study by Haji-Hassani et al who reported an overall percentage of underfill of 12.7%.¹¹ These results showed that there is no substantial relationship of underfill with either system. Apical transportation did not occur at any significant frequency in either system (i.e. 0.5% in rotary and 1.2% in conventional cases), therefore little can be derived from these findings other than that it is a rare occurrence regardless of the system used.

We cannot recommend the use of rotary file systems over their conventional counterparts on the basis of procedural errors produced, but it is undeniable that rotary systems are faster, more convenient and comfortable for the patient as well as the dentist. It is rare for conventional root canal treatment to be completed in less than 2 or 3 appointments, whereas, if the conditions are favorable, rotary root canal treatment can

be completed within a single appointment. Therefore our recommendation is that dentists should develop the necessary skills to handle these systems more effectively to minimize the procedural errors.

CONCLUSION

There was little difference between the overall incidences of procedural errors in either system, however, there was a difference in the type of error produced. Rotary endodontics tended to produce significantly greater incidence of instrument separation whereas conventional showed a somewhat greater occurrence of overfill. It is concluded that although rotary systems are not as easy to use as previously believed.

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CONTRIBUTION BY AUTHORS

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