

Original Research

Frequency of Post-Instrumentation Symptoms Using Hand Files *Versus* Rotary Protapers

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ABSTRACT

Introduction

Controversy among dentists exists to use conventional hand files or contemporary rotary protapers for intracanal instrumentation. The controversy arose because of variable findings on post-instrumentation pain felt by the under treatment patient that acts as a deterrent to receive further endodontic treatment. This study has been planned to assess post-instrumentation pain, swelling, tenderness or redness using the hand files and rotary protapers in confined environment where rubber dam is not used for operative field isolation from oral fluids.

Material and Methods

One hundred and sixty vital and non-vital teeth were root treated. The subjects were randomly divided into two groups. "Group A" was treated using hand files with step-back technique and "Group B" with rotary protapers. All the root therapies were accomplished in two or multiple visits depending on the satisfactory disinfection of the canal. Access to pulp chambers was obtained using sterile bur without rubber dam isolation and the preparation in either group was performed under normal saline irrigation. Drying of canal was obtained using paper points followed by cotton and temporary packing to ensure tight leak proof coronal seal and the subjects were recalled on subsequent day.

Results

Results revealed that the highest symptomatic adversity was faced by n=40 subjects with non-vital pulps after hand filing. Least frequent symptomatic complaints were made by the group with vital pulps and were treated by rotary protapers. In vital teeth, pain was reported more in hand filed teeth than in teeth that were treated with protapers. Non-vital teeth showed a similar pattern with greater number of complaints about pain in both hand filed and protaper subjects.

Conclusion

Rotary protapers induced less post-instrumentation symptoms than hand files in vital as well as non-vital teeth.

Keywords

Efficacy of hand files versus rotary files; Endodontic flare-up; Protapers versus hand file.

INTRODUCTION

Dental clinicians in routine endodontic practices often encounter patients' complaint of pain, swelling and tenderness on biting or redness in buccal sulcus after root canal instrumentation which may start a few hours after treatment and is always an unpleasant and disappointing incident for both the dentist and patient.¹ The frequency of post-operative symptoms has been stated to occur in over 50% of patients undergoing root canal therapy.² This frustrating happening known as "flare-up"³ occurs due to development of acute inflammation at the periapex in reaction to increased intensity of injury from the root canal system.⁴ Multiple studies have found link between an intracanal instrumentation technique and post-operative pain.⁵⁻⁷

Intracanal instrumentation for debridement and disinfection of the canal is performed using either of the two instrumentation approaches; starting from tip of the root with fine instruments and work way back up the canal with gradually larger instrument known as the "step-back" technique. Hand "K" files are commonly used for accomplishing an endodontic procedure with step-back technique. Alternative way of canal instrumentation is starting from the canal orifice situated in the pulp chamber with larger instruments and gradually progressing toward the apex with finer instruments the "crown-down" technique. The Protaper system has been developed keeping latter technique in view with progressively variable tapers of each instrument.⁸

Regarding post-instrumentation pain following either of the two techniques, controversy exists among practicing dentists worldwide. Many clinicians prefer rotary protapers as they possess better canal cleaning efficacy than manual "K" files⁹ and create more regular root canal tapers.¹⁰ A recently published study shows that preparation with rotary instruments produces less anguish than preparation done with manual instruments.¹¹

Many investigators believe that protapers cause more post-instrumentation symptoms as they push more debris and bacteria towards periapical region.¹²⁻¹⁴ In contrast, many researchers found that hand filing poses more post-instrumentation problems for the patients. One of such studies reported that hand instrumentation in non-vital teeth results in apical extrusion of canal contents causing post-operative pain and swelling.¹⁵ In an Iranian study, researchers proved hand files superior to use for canal debridement as they found that preparation of apical and middle two-thirds was similar with the rotary and hand files but preparation of coronal third was better prepared with hand files.¹⁶ Researchers in another study used RaCe rotary system and hand K-Flexofile for canal preparation. Their findings revealed no significant difference in post operative flare-up between the two preparation techniques.¹⁷

The high variability in the findings of existing studies creates confusion in the minds of general dental practitioners who carry out regular endodontic procedures in their practices. The dentists who graduated at the time when hand instruments and step-back technique were the lone option available to them for root canal preparation remain bewildered between choosing

hand files or protapers rotary system for the purpose and widely continue using hand files.¹⁸ They probably consider hand files safer than rotary protapers and brood over many times to use latter with the fear of post-instrumentation pain and other symptoms. Keeping these senior dentists' mental perplexity in view, this study was therefore, planned to be conducted in local environment where rubber dam is uncommon with an objective to assess frequency of post-instrumentation flare-up using manual files and rotary protapers.

MATERIAL AND METHODS

After approval from ethical committee of the institution, one hundred and sixty teeth with vital and non-vital pulp were endodontically treated. Patients fulfilling the inclusion criteria were selected. The inclusion criteria included the patients of either sex of 20-50 years of age needing root canal treatment (RCT) having no radiographic periapical lesion. The list of exclusion criteria was a bit strict including; patients who refused to give written consent to participate in the study, patients taking antibiotics, patients who missed appointment on the subsequent day after chamber opening and canal instrumentation, patients with periodontally involved teeth, patients with teeth having fine curves, open apices, calcific metamorphosis or requiring endodontic retreatment and medically compromised patients.

All the participants were clinically examined and detailed medical history including history of taking any antibiotics within six weeks of the RCT procedure performed was recorded. Thermal tests were performed to categorize the vital and non-vital pulp status. Intraoral radiographs of the under treatment teeth were obtained to exclude the teeth with extra root curvatures, open apices, canal calcifications, apical radiolucencies or periodontal involvement.

The subjects of the study were randomly divided into two groups. The subjects in "Group A" were treated using NiTi "K" files (Moyco-Union Broach Co. York, PA 17402, USA) with conventional step-back technique following the method mentioned by Mullaney¹⁹ and "Group B" subjects were treated using rotary protapers (Maillefer, Dentsply, Switzerland).

All the root canal treatments were accomplished in at least two or multiple visits depending on the satisfactory disinfection of the canal. Intracanal instrumentation was performed by single operator to eliminate any procedural discrepancy. Access to pulp chambers was obtained using sterile tungsten carbide bur without rubber dam isolation. Local anesthesia was injected wherever required. Root canal preparation in either group was performed under copious irrigation with normal saline. Drying of canal was obtained using appropriate sized absorbent paper points (Maillefer, Dentsply, Switzerland) followed by cotton pack and "Cavit G" (3M ESPE, AG, Germany) packing to ensure tight leak proof coronal seal.

Each subject was recalled on the subsequent day after his/her canal preparation and was clinically examined for any pain,

swelling, tenderness or redness in the treated tooth. Need of taking any analgesic at home after the last visit was reported as “Post-Instrumentation pain”.

RESULTS

A total of 160 participants took part in this study out of which six subjects were unable to partake in the follow-up assessment. Results

revealed that the highest symptomatic adversity was faced by the n=40 subjects with non-vital pulps after hand filing was performed on them. Contrarily, least frequent symptomatic complaints were made by the group that possessed vital pulps and were treated by machine driven protapers. Table 1 shows a descriptive overview of the results that were obtained in regards to the treatment performed and the vitality of the pulp in the tooth treated.

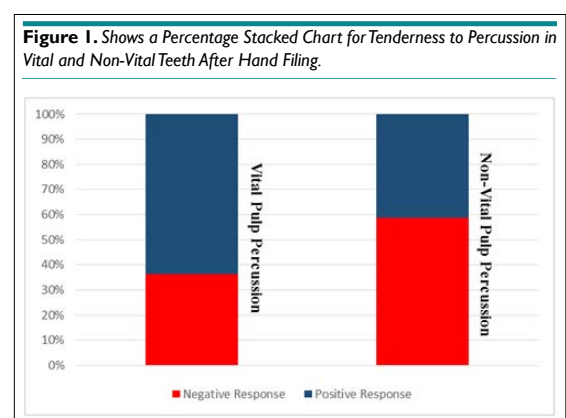
Table 1. Results in Vital and Non-Vital Teeth After Hand Filing and After Treating with Protapers				
Vital Pulp				
	Preparation with hand files n=39		Preparation with protapers n=37	
	Positive Response	Negative Response	Positive Response	Negative Response
Pain	10	29	2	35
Swelling	3	36	1	36
Tenderness to palpation	9	30	1	36
Tenderness to percussion	12	27	4	33
Redness in sulcus	4	35	1	36
Non-Vital Pulp				
	Preparation with hand files n=40		Preparation with protapers n=38	
	Positive Response	Negative Response	Positive Response	Negative Response
Pain	14	26	6	32
Swelling	18	22	8	30
Tenderness to palpation	18	22	12	26
Tenderness to percussion	21	19	14	24
Tedness in sulcus	16	24	10	28

In vital teeth, pain was reported more in hand filed teeth than in teeth that were treated with protapers. Non-vital teeth showed a similar pattern with greater number of patient complaints about pain in both hand filed and protapers subjects. The latter however, showed a significant number of participants with complaints compared to all other patients involved in the study. Furthermore, pain in non-vital teeth after protapers in comparison to pain in non-vital teeth after hand filing showed a significant difference $p=0.003$. Also, significant results were achieved ($p=0.025$) when pain in non-vital teeth was compared with pain in vital teeth after hand filing. Treatment with protapers usually yielded a lower level of pain experienced in both vital and non-vital pulps.

The presence of swelling was another clinical variable used in this study. Patients with non-vital pulps reported greatest degrees of swelling. Hand filed teeth that were non-vital showed the greatest number of complains. Swelling in vital teeth after protapers compared to swelling after hand filing showed a significance of $p=0.157$. Also, swelling in non-vital pulps after treatment with protapers in comparison to swelling in non-vital teeth after hand filing ($p=0.002$) was significantly pronounced.

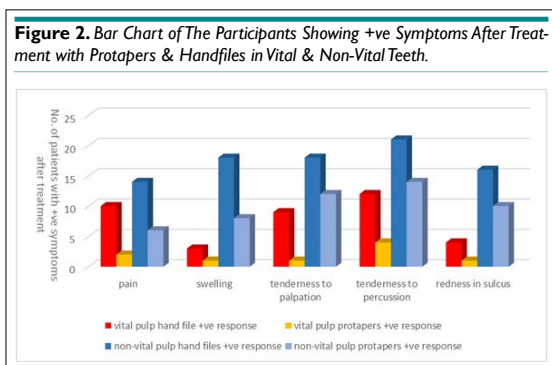
When tenderness to palpation and percussion were analyzed, the results showed a similar trend with non-vital teeth producing the most tenderness to both the mentioned entities. Tenderness to palpation was lower in all four groups under scrutiny as compared to tenderness to percussion. Hand filed cases produced the most adverse results when non-vital pulps were involved in

the treatment. So much so that when tenderness to percussion in non-vital teeth after hand filing was compared to tenderness to percussion in vital teeth after the same procedure, statistical analysis proved a high level of significance $p=0.003$. Figure 1 shows a percentage stacked chart for the results obtained in the tenderness to percussion field after hand filing was performed on them.



Redness in the sulcus was the final parameter assessed and showed a 4 times greater value between vital and non-vital teeth respectively. The greatest number of participants that experience this symptom were the ones with non-vital pulps. A significance of $p=0.014$ was produced statistically when redness in non-vital teeth after protapers usage was compared with redness in non-vital teeth after hand filing. Figure 2 shows a descriptive graphical analy-

sis of the participants who showed positive signs and symptoms after treatment with protapers and hand files.



STATISTICAL ANALYSIS

After the results were compiled, they were analyzed *via* the IBM SPSS Statistics Version 25. A Wilcoxon Signed Ranks Test was performed between the variables. There was a significant difference in reported pain levels $p=0.005$ when vital teeth were treated with Protapers in comparison with hand filing. Similarly vital teeth treated with Protapers also showed marked differences in tenderness to percussion and palpation. Table 2 shows a detailed statistical analysis of the comparison between protaper usage and hand files in non-vital teeth. The statistical analysis yielded a significant difference in reported pain levels $p=0.003$ and swelling $p=0.002$.

Table 2. Results of Wilcoxon Signed Ranks Test Comparing Protaper vs Handfiles (Non-Vital Teeth)

	Asymp. Sig. (2-tailed)
Pain in non-vital teeth after protapers vs Pain in non-vital teeth after hand filing	0.003
Swelling in non-vital after protapers vs Swelling in non-vital teeth after hand filing	0.002
Tenderness to palpation in non-vital teeth after protapers Vs Tenderness to palpation in non-vital teeth after hand filing	0.014
Tenderness to percussion in non-vital teeth after protapers Vs Tenderness to percussion in non-vital teeth after hand filing	0.008
Redness in non-vital teeth after protapers vs Redness non-vital after hand filing	0.014

DISCUSSION

Eruption of post-instrumentation symptoms including pain, swelling, redness in buccal sulcus, tenderness on percussion and palpation are the impediments associated with a RCT procedure which frequently occur during apical instrumentation of a root canal. The aim of this clinical study was to assess the effect of rotary protapers and manual filing techniques on frequency of incidence of the undesirable and annoying postoperative symptoms.

The findings of this study reveal that patients either ha-

ving vital pulp or non-vital pulp complained of post-instrumentation symptoms significantly less when rotary protapers were used for canal preparation as compared to hand files. This finding is in agreement with numerous similar previous studies.²⁰⁻²⁵ Findings of the teeth with vital pulp and non-vital pulp when compared also showed significant difference in occurrence of post-instrumentation symptoms. It might be because contemporary protapers execute excellent early cleaning of coronal and middle thirds of a canal and consequently the patients suffer less pain, swelling, tenderness or redness.²⁶ This finding matches with a study which reported that hand filing using step-back technique results in pushing of canal content in teeth with non-vital pulps into periapex and causes post-operative symptoms.¹⁵ Matching results were found in two other studies which reported that vital teeth develop less post-instrumentation symptoms than non-vital teeth.^{27,28} A Turkish study contradicts this finding with the conclusion that pulp status doesn't affect the post-instrumentation level of pain.²⁹ The reason for this contradiction may be the use of $\text{Ca}(\text{OH})_2$ as an interappointment medicament used by the investigator in that study. Many logical reasons however, may be given for superior functionality of rotary protapers over manual files. The protapers are developed to clean a canal with crown-down technique which involves early coronal flaring. The early flaring of a canal improves instrument control during apical instrumentation of the canal³⁰ and thus crown-down technique is found to extrude less debris apically compared to the step-back filing.³¹ One more reason for superiority of protapers may be linked with less apical transportation and less dentin cutting than with the manual files.³² Contrarily, one report shows that change in cross-section area at 2 and 3 mm from the apex was significantly greater with manual NiTi K-file as compared to rotary Protaper.³³

Inability of the hand files to perfectly debride apical 1/3rd of the under-preparation canal may be one reason for inferior manual file function. A study was done to assess of the apical root canal cleaning efficacy of various hand instrument techniques showed that the apical portion of the canal was less clean than the middle and coronal portions regardless of the technique employed.³⁴ Result of another such study in which five canal instrumentation techniques were employed indicated that although all of them effectively removed major chunk of debris from the canals but none could clean the entire root canal system.³⁵

Apical extrusion of debris and bacteria through the foramen is also linked to post-instrumentation symptoms. It generates periodontal inflammation with higher neuropeptide concentration which consequently promotes peripheral sensitization characterized as hyperalgesia and occurrence of impulsive pain in the tooth.³⁶ Reports of two relevant studies showed that manual "K" files apically pushed significantly greater amount of irrigating solution, bacteria and debris as compared to rotary protapers.^{37,38} The reason for more apical extrusion with hand files may be associated to their filing action which acts as a piston and tends to push the debris through the foramen as less space is available to escape coronally.³⁹ Moreover, findings of two other studies on the same issue have proved that the healing diminishes when infected dentin is pushed down to the periapical area while using hand files^{40,41} that

might be a cause of post-instrumentation pain and swelling.

Time taken for canal preparation with instruments is another key factor which may cause more discomfort after hand filing as manual preparation of canal takes longer time than rotary protapers.⁴²⁻⁴⁴

In this study, all the root canal procedures were performed under cotton roll isolation as the majority of general dental practitioners in this part of the world, carry out most of the restorative and endodontic procedures without rubber dam.^{45,46} This is not very unusual in other countries despite its known benefits. A study done on the issue of usage of rubber dam during root treatment cited many studies which found that rubber dam use by general practitioners is either not very encouragingly or disappointingly low.⁴⁷ A UK based study also found that 63% of its respondents never used a rubber dam during endodontic treatment.⁴⁸ Another survey done in Czechoslovakia, reveals that merely 8% of the general practicing dentists use rubber dam while performing RCT.⁴⁹

NaOCl in concentration of 2.6%-5.25% is considered as most effective and potent irrigant for under preparation root canals⁵⁰ but in higher concentrations above 0.5%, due to its toxicity and bad taste, its use become impracticable in situations where rubber dam isolation is not performed. As an alternate, abundant amount of normal saline was used as an irrigation solution during all the canal preparation.

CONCLUSION

The findings of this study within its limitations are indicative of better performance of rotary protapers than hand files even in situations where rubber dam is not used. For general dental practitioners, using protapers is better option as fear of inadvertent slipping of a hand file from the fingers doesn't arise and time consumed is far less.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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