Comparison of Success Rate by Evaluating Postoperative Pain Intensity After Root Canal Instrumentation with 'K' Hand Files and Rotary One Shape File

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Abstract

Introduction: The dental pulp presents with a variety of configurations and shapes throughout the dentition. Therefore, it is important that one must thoroughly know about tooth morphology, and one should carefully interpret any radiographic documentation plus one must adequately access and explore the pulp chamber and root canal system before initiating the root canal procedures, whether nonsurgical ones or surgical ones.

Background: Root canal treatment is the procedure in which infected pulp is removed to eliminate microbial invasion and to maintain tooth form and function. It includes access cavity preparation, working length determination, adequate cleaning and shaping and obturation of root canals.

Objective: To compare the success rate by assessing the level of postoperative pain following root canal instrumentation using a manual K-file against a Rotary One shape file.

Material & Methods: Using a random selection process, 112 patients were split into two groups. In group A patient, root canals will be prepared by K hand files and in group B patients, root canals will be prepared by rotary one shape file. Patients were recalled after 72 hours to evaluate postoperative pain and score was recorded according to verbal rating scale (VRS).

Results: Significant association was found regarding Success in both groups, i.e. Group A (K hand files), Group B (Rotary One shape file) with p-value = 0.036.

Conclusion: Within the confines of this study, it is possible to draw the conclusion that the hand K-file was found to have a significantly higher success rate for postoperative pain intensity after root canal instrumentation when compared to the Rotary One shape file and significant association was found between hand K- file and Rotary One shape file in terms of pain after endodontic treatment.

Keywords: Root Canal Preparation, Postoperative pain, Root canal instrumentation, 'K' hand files, Rotary one shape file

Introduction

The dental pulp presents with a variety of configurations and shapes throughout the dentition. Therefore, it is important that one must thoroughly know about tooth morphology, and one should carefully interpret any radiographic documentation plus one must adequately access and explore the pulp chamber and root canal system before initiating the root canal procedures, whether nonsurgical ones or surgical ones. The clinician encounters difficulties in achieving predictable outcomes with root canal procedures. The clinician is challenged to perform adequate enlarging, shaping, cleaning, disinfection, and obturation of the pulpal space to achieve predictable outcomes with root canal procedure.[1]

The goal remains to preserve natural teeth with optimal function and aesthetics. Despite advancements like nickel-titanium rotary instruments, outcomes haven't improved significantly. This challenges evidence-based practice, which demands better results from new methods. Still, some studies suggest certain canal preparation and disinfection techniques are more effective.[2,3]

NiTi file possesses transformational elasticity, which is also referred to as pseudoplasticity. This refers to the ability of the file to deform and then return to its original shape.[4] This feature means that usually NiTi instruments are made by milling instead of twisting; twisted instruments involve plastic deformation and are used, for example, to create stainless steel K-files. In the same way as the application of deforming forces, heat can also lead to the phase transition from austenite to martensite and vice versa.[5]

The One Shape rotary file system is a single-file, continuous rotation NiTi instrument developed to simplify and expedite root canal shaping. Designed with a unique asymmetrical cross-section and progressive pitch, it enhances flexibility,

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debris removal, and cutting efficiency while maintaining the original canal curvature. This system enables complete canal preparation with a single instrument, reducing treatment time and procedural errors.[4]

Furthermore, systems like One Shape facilitate the use of a single-cone obturation technique with a matching taper, making the canal filling process more straightforward than traditional methods. The use of a reciprocating single-file rotary system for cleaning and shaping root canals has gained popularity in endodontic therapy due to their simplicity and reduced technical sensitivity, Technical sensitivity refers to how dependent a procedure's success is on the clinician's skill and precision. Rotary systems like One Shape help minimize this sensitivity by standardizing motion, reducing the number of instrumentation steps, and maintaining canal anatomy with greater consistency. These advantages lead to fewer procedural errors such as ledging, canal transportation, or instrument separation, especially in less experienced hands.[6,7]

However, the shorter procedure time (mainly during instrumentation) obtained with a reciprocating file also can reduce the antimicrobial efficacy of solutions, which depends The lowering of microbial content in the root canal system may be jeopardized when the activity of irrigating solutions is decreased, which can consequently impede the healing process of apical periodontitis. Moreover, some research have revealed that reciprocating NiTi files are linked to more extrusion of debris than rotational NiTi files, a disadvantage that increase the possibility of postoperative complications including more incidence and severity of postoperative discomfort.[8,9]

Among these, the most significant contributor to postoperative discomfort is the accidental extrusion of dentin chips, necrotic debris, bacteria, or pulpal tissue remnants into the periapical region during the preparation process. Because this debris varies depending on the instrument and the instrumentation technique, it is preferable to use an instrument that causes less pain by extruding less material into the periapical area.[10]

For decades, research has resulted in the development of a full sequence, variable taper rotary instrument, ProTaper Universal (PTU) that was manufactured by Dentsply Maillefer. Regarding shaping abilities, this system has showed positive outcomes. Nevertheless, its drawbacks include the learning trajectory, instrument fatigue, and the increased number of instruments. The latest 5th generation of file is made in a way that the Centre of mass and/or rotation is offset. This minimizes file to the root dentin interaction by generating a mechanical wave of motion along the active length of the file.[11]

The main aim of this randomised clinical trial was to evaluate the two systems indicated above in relation to postoperative pain. This was done with the intention of achieving the highest possible level of support for evidence-based clinical practice.[12]

Materials and Methods

This Randomized Control Trial was conducted at Department of Operative Dentistry, de'Montmorency / Punjab Dental Hospital, Lahore.The duration of study was 6 months from 15th Aug 2022 to 14th Feb 2023. Ethical approval was granted from same institute having ethical number RTMC DSG22019/099/2983 It was non-probability consecutive technique. The sample size was calculated using a two-proportion test to compare the expected success rates (absence of postoperative pain) between two groups. A significance level of 5% and a power of 80% were used. Based on the expected proportions of success in each group, the formula for comparing two independent proportions was applied. This resulted in a sample size of 56 participants per group, totalling 112 participants, to detect a meaningful difference at 5% of level of significance and 80% of power of test and taking expected success rate in terms of absence of postoperative pain in each group i.e. 83.3% in K hand files and 62.50% in rotary one shape file system.

The inclusion criteria was Patients aged 15 to 30 years (both genders), and a mature single rooted tooth with closed apex as seen radio-graphically with clinical symptoms of pain and tenderness on percussion by taking history and clinical examination. While, exclusion criteria were mobile teeth with advanced periodontitis as seen clinically and radiographically, limited mouth opening less than 40 mm as measured by scale, immunocompromised patients with the history of diabetes, heart diseases or cancer etc, presence of any root canal fracture, root resorption sclerotic canals and periapical radiolucency assessed radiographically.

The study was carried out on patients who met the inclusion criteria and were visiting the Operative outpatient department of Punjab Dental Hospital/De' Montmorency College of Dentistry in Lahore. Ethical permission from the Hospital Committee was obtained. For bias elimination, entire research was completed by a single operator. The patient gave informed consent. There were no ethical concerns or risks to the patient. Demographic information like name, age, gender and address were obtained. Clinical examination 112 of patients was done after taking detailed history. Preoperatively radiograph was taken in each patient for assessment of periapical status of teeth preoperatively. Lottery method was used to divide patients in two groups of 56 each randomly in group A and B. In group A patient, root canals were prepared by K hand files and in group B patients, root canals were prepared by rotary One shape file. For group A, local anesthesia was given and rubber dam isolation was done, access cavity was made, canal orifices were identified and initial instrumentation was done with 08, 10 K-files. Working length was confirmed radiographically, instrumentation was done with K files. Canals were irrigated with 2.25% sodium hypochlorite during cleaning and shaping. Paper points were used to dry canals and obturated with gutta percha points by lateral condensation method.

For group B local anesthesia was administered and isolation was done using rubber dam. Access cavity was made; canal orifices were identified. Initial instrumentation was done using 08, 10, 15 K-files and glide path was made. Working length was determined radiographically. Shaping was done with rotary one shape single file in continuous mode of rotation. The file was gently advanced using light pressure toward the apex with a slow, controlled pecking motion. The rotational speed and torque were set to 400 rpm and 2.5 N·cm, respectively, as recommended. Canals were cleaned and shaped. Sodium hypochlorite 2.25% was used as an irrigant during instrumentation. Paper points were used to dry the canals and obturated with single cone obturation technique and permanent restoration was done with amalgam or light cure composite resin. Patients were recalled after 72 hours to evaluate postoperative pain and score was recorded according to verbal rating scale (VRS), a simple and reliable subjective tool that categorizes pain intensity based on verbal descriptors. The scale includes four levels: (1) No pain; the treated tooth felt normal, (2) Mild pain; slight discomfort without the need for analgesics, (3) Moderate pain; discomfort that was either tolerable or made tolerable with analgesics, and (4) Severe pain; pain that disturbed normal activity or sleep, with little or no relief from analgesics. For the purpose of this study, a score of 1 on the VRS (No pain) was considered a successful outcome after 72 hours post-treatment.

The analysis of the data was carried out with SPSS version 26. For qualitative as well as quantitative variables, calculations of

descriptive statistics were calculated. Standard deviation (SD) along with Mean was also calculated for quantitative variables. This was done regarding age of the patients. For qualitative data such as gender and success, researchers calculated the frequencies and percentages when postoperative pain was absent after non-surgical endodontic retreatment. Stratification controlled effect of modifiers such as gender and age. Following stratification, the Chi Square test was used to compare success rates between two groups. A P-value of 0.05 or less was regarded as significant.

Results

Table 1 and table 2 showed distribution of age, percentage of gender and success of the patients included in the sample respectively. Significant association was found regarding Success in both groups ((Group A (K hand files), Group B (Rotary One shape file)) with p-value = 0.036 (Table 2). The Success in both group ((Group A (K hand files), Group B (Rotary One shape file)) was noted concerning age (below 20 years and above 20 years), it was found that there was significant association for < 20 years age group and there was no significant association for ≥ 20 years age group (Table 3). The success of the instruments in both group ((Group A (K hand files), Group B (Rotary One shape file)) was noted concerning gender, it was found that there was no significant association for female but there was significant association regarding male patients with p-value= 0.006 (Table 3).

Table 1. Descriptive Statistics (n = 112)

Category	Frequency (n)	Percentage%
Total Patients	112	100
Males	53	47.30
Females	59	52.70
Age	**Minimum**	**Maximum**
	15	30
	Mean	**SD**
	22.26	4.878

Table 2. Stratification of Success with respect to pain in both groups (n = 112)

Group	Success		Total	P-value
	Yes	No		
Group A (K hand files)	45	11	56	0.036
Group B (Rotary One shape file)	35	21	56	
Total	80	32	112	
Percentage	71.4	28.6	100.0	

Chi-square test was applied

Table 3. Stratification of Success in both groups with regards to age and gender (n = 112)

	Group	Success (Yes)	No	Total	P-value
Age (< 20 years)	Group A (K hand files)	17	3	20	0.050
	Group B (Rotary One shape file)	12	9	21	
Age (> 20 years)	Group A (K hand files)	28	8	36	0.259
	Group B (Rotary One shape file)	23	12	35	
Gender (Male)	Group A (K hand files)	22	3	25	0.006
	Group B (Rotary One shape file)	15	13	28	
Gender (Female)	Group A (K hand files)	23	8	31	0.811
	Group B (Rotary One shape file)	20	8	28	

Discussion

In this study of 112 patients, the minimum age was 15 years and the maximum age was 30 years, with a mean age of 22.26 ± 4.878 years. (Table 1). There were 53 (47.3%) male patients and 59 (52.7%) were female patients (Table 1). The Success in both group ((Group A (K hand files), Group B (Rotary One shape file)) was noted concerning age (below 20 years and above 20 years), it was found that there was significant association for < 20 years age group and there was no significant association for ≥ 20 years age group (Table 3). This may be due to fact that patients under 20 years due to better healing capacity and less complex root canal anatomy compared to older patients. Younger teeth generally have wider canals and less calcification, facilitating more effective treatment.The success of the instruments in both group ((Group A (K hand files), Group B (Rotary One shape file)) was noted concerning gender, it was found that there was no significant association for female but there was significant association regarding male patients with p-value= 0.006 (Table 3).

Other studies found that at six hours the variations in postoperative pain between Group A (PTU) and Group B (PTN) were not statistically significant. The comparison between these two systems (PTU and PTN) is important because both are widely used rotary file systems with different design features that may influence clinical outcomes such as postoperative pain. Understanding any differences helps clinicians choose the most effective and patient-friendly system for root canal treatment. This could be related to the study's in vivo, controlled, and randomised design.[13]

A study found a pattern in the intensity of pain experienced by patients within the group. The highest intensity of pain, if any, was recorded 6 hours after therapy, and then it decreased continuously (statistically significant, P < 0.05), resulting in no pain in both groups (Group A (PTU) and B (PTN) at 72 hours.[14,15]

Our investigation yields statistically significant, P < 0.05 outcomes that match those obtained (Group A, K hand files; Group B, Rotary One shape file by Kherlakian et al[16]. and Relvas et al.[17] In addition to the Hawthorne effect, the loss of the local analgesic effect during the immediate therapy following the endodontic procedure is another potential contributor to this outcome.

Furthermore, as revealed in this study, establishing the glide path before K hand files resulted in less postoperative discomfort and faster symptom resolution[18]. Previous research has also shown that this is the case for postendodontic pain.[19]

The preparation time of each instrumentation system was also calculated because most clinicians consider canal preparation time because of its impact on patient comfort and irrigation time.[6]

The variation in the canal preparation time was clearly rather large. Group A (PTU) needed far more time than Group B (PTN), with 11.28 ± 1.72 min against 5.493 ± 1.06 min, P < 0.001.[13] The findings resemble those of a Bürklein et al. study .[20] This could be the result of the different files used—that is, five for PTU group on comparison with only three for PTN group.[21]

Pain after endodontics does not determine success. Endodontic treatment's success or failure is decided by long-term results rather than the presence or absence of short-term postoperative pain.

It should be underlined that additional such research with a larger sample size and association of greater number of variables are needed since the outcomes of one clinical study cannot be generalised to all clinical situations.

Conclusion

Within the confines of this study, it is possible to draw the conclusion that the hand K-file was found to have a significantly higher success rate for postoperative pain intensity after root canal instrumentation when compared to the Rotary One shape file. Furthermore, a significant association was discovered between the hand K-file and the Rotary One shape file in terms of pain after endodontic treatment.

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