RESEARCH ARTICLE

Comparative Evaluation of Hand K-flex Files, Pediatric Rotary Files, and Reciprocating Files on Instrumentation Time, Postoperative Pain, and Child’s Behavior in 4–8-year-old Children

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ABSTRACT

Background: A pulpectomy is regarded as the choice modality of treatment for necrotic teeth. The use of hand files, though popular traditionally as a gold standard, may be challenging due to increased chairside time. Postoperative pain is one of the most common complications of pulpectomy and may be unpleasant for a child/pedodontist. Rotary files were found to reduce instrumentation time, reduce apical extrusion, and in turn reduce pain but there is a lack of studies in primary teeth particularly for pediatric and reciprocating file systems. The increased number of options available today makes it a dilemma for the operator to choose a suitable file system.

Aim and objective: The study aimed to evaluate and compare the instrumentation time, postoperative pain, and effect on child’s behavior among three groups, i.e., hand K-flex files (group I), pediatric rotary files (group II), and reciprocating files (group III).

Materials and methods: A total of 75 primary molar teeth after meeting inclusion criteria were randomly allocated into three groups. During the procedure, step-wise instrumentation time was recorded using a stopwatch. The child’s behavior pre- and postoperatively was assessed by an evaluator. The postoperative pain (up to 1 week) was assessed by a questionnaire.

Results: The mean age of children taken for the study was 6.03 ± 1.2 years with 46 males and 29 females. The mean biomechanical preparation time was observed to be significantly shorter in the pediatric rotary and reciprocating file groups vs hand K-flex files (p < 0.001**). The postoperative pain after 6 hours had a mean value of 0.88 ± 0.9 for the hand K-flex file group which was significantly higher than both rotary file groups (p < 0.05*). The pre- and postoperative behavior revealed no significant difference.

Conclusion: The clinical performance of pediatric and reciprocating files was superior, but the choice of file system did not significantly alter behavior.

Keywords: Behavior assessment, Hand files, Instrumentation time, Pediatric rotary files, Postoperative pain, Primary dentition, Pulpectomy, Reciprocating files.

International Journal of Clinical Pediatric Dentistry (2021): 10.5005/jp-journals-10005-1919

INTRODUCTION

The loss of primary dentition prematurely is a common problem that may prevent a normal eruption of succedaneous teeth, hamper esthetics, and lead to abnormal tongue habits.¹ Pulpectomy is regarded as the choice modality of treatment for pulply involved necrotic teeth.² Hand files are used for chemomechanical preparation conventionally during the pulpectomy procedure. Although traditionally used, the use of hand files may be challenging due to narrow, curved canals in primary teeth with ongoing physiological resorption. The use of hand files may lead to difficulty in proper filling and increased time of treatment.³ The long duration of treatment time may negatively influence the child’s behavior.⁴ To overcome these challenges, Barr et al. first introduced the rotary technique for primary teeth.⁵ Rotary technique has advantages of reduced instrumentation time and superior quality fillings.⁵,⁶ However, the rotary instruments of permanent teeth may be unsuccessful in cleaning the isthmus in primary teeth⁷ and may have added disadvantages of increased cost and breakage. The introduction of pediatric rotary systems may overcome the above-mentioned disadvantage and may have improved canal centricity, conservative canal preparation with better obturation quality. There are few in vivo studies comparing instrumentation time of pediatric rotary systems with hand files in primary teeth and thereby their effect on the child’s behavior.⁸ Furthermore, the overall success of pulpectomy depends on canal disinfection, irrigation, and obturation.⁹¹⁰ Postoperative pain/swelling is one of the most common complications of pulpectomy and may be unpleasant for both patient/dental surgeon.¹¹ There is a

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How to cite this article: Tyagi R, Khatri A, Kalra N, et al. Comparative Evaluation of Hand K-flex Files, Pediatric Rotary Files, and Reciprocating Files on Instrumentation Time, Postoperative Pain, and Child’s Behavior in 4–8-year-old Children. Int J Clin Pediatr Dent 2021;14(2):201–206.

Source of support: Nil

Conflict of interest: None

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direct relation between periradicular inflammation, apical extrusion, and the presence of pain postoperatively. NiTi Rotary files were found to reduce apical extrusion of debris. As per the study by Shokraneh et al., there was significantly lower postoperative pain seen with reciprocating systems compared with conventional NiTi Rotary and hand systems. However, there is a lack of studies evaluating the intensity and duration of postoperative pain after pulpectomy in primary teeth. Upon, a perusal of literature, there was a lack of studies drawing a clinical comparison among hand, pediatric and reciprocating file systems in primary teeth.

Therefore, the study aimed to evaluate and compare the instrumentation time, postoperative pain, and effect on child’s behavior among three groups, i.e., Hand K-flex files (group I), Pediatric rotary files (group II), and Reciprocating files (group III).

Materials and Methods

Power analysis for a one-way ANOVA (Fixed Effects, Omnibus, One way) with three groups was conducted in G*Power to determine sufficient sample size using an alpha of 0.05, a power of 0.80, and an effect size ($f = 0.48$). Based on the aforementioned assumptions, the desired total sample size was 60 (i.e., 20 per group). Assuming a loss to follow-up of 20%, the final sample was 72 (24 per group). After further rounding off, the final sample size was 75, i.e., 25 in each test group.

All patients between the age-group 4 years and 8 years with primary molar teeth indicated for pulpectomy were chosen for the study. Teeth exhibiting one or more of the following with 2/3rd of the root remaining were included in the study—(a) necrotic pulp, (b) symptoms of irreversible pulpitis, and (c) radiolucencies in the periapical or furcation region. Teeth exhibiting one or more of the following were excluded from the study—(a) swelling, (b) excessive mobility, (c) cellulitis, (d) perforated pulpal floor, and (e) fistula. Children lacking cooperative ability, those having a systemic illness, mobility, (c) cellulitis, (d) perforated pulpal floor, and (e) fistula. Children lacking cooperative ability, those having a systemic illness, periapical or furcation region. Teeth exhibiting one or more of the following with 2/3rd of the root remaining were included in the study—(a) necrotic pulp, (b) symptoms of irreversible pulpitis, and (c) radiolucencies in the periapical or furcation region. Teeth exhibiting one or more of the following were excluded from the study—(a) swelling, (b) excessive mobility, (c) cellulitis, (d) perforated pulpal floor, and (e) fistula. Children lacking cooperative ability, those having a systemic illness, or special care needs were excluded from the study.

The subjects were divided into three groups using the block randomization (block of 3) technique. The randomization sequence was developed by a statistician and opaque envelopes were used for allocation concealment. The patients and parents were blinded about the treatment protocol, the evaluator recording the instrumentation time and behavior was also blinded. The principal operator performing the treatment could not be blinded as the treatment was being administered by the operator. Informed consent was obtained from each parent/guardian and ethical clearance was obtained from the Departmental Review board.

The pulpectomy procedure was performed in a single visit by the same operator. Non-pharmacological techniques of behavior management were used to alter the child’s behavior and gain cooperation. Local anesthesia infiltration was done (2% lignocaine, 1:200,000 adrenaline) followed by isolation of the tooth using the rubber dam (GDC Dental Dam Kit, Hoshiarpur, India). The instrumentation time was recorded by an evaluator blinded to the treatment modality used for access opening, biomechanical preparation, and obturation. The child’s behavior was also recorded as per the modified Frankel Scale (Table 1) preoperatively and postoperatively by the evaluator.

To assess the postoperative pain, a questionnaire was given to the parent or guardian and they were trained to use the 4-point pain scale (Flowchart 1) to record the postoperative pain felt by the child after 6 hours, 24 hours, 72 hours, and 1 week. At the end of 1 week, the parents/guardians returned with the questionnaire (Materials and Methodology step-wise illustration; Fig. 1).

Results

The data were entered into digital spreadsheets and statistical analysis was done using SPSS (Statistical Package for Social Science).

Table 1: Modified Frankel scale used in the study to assess child’s behavior

- **Rating 1:** DEFINITELY NEGATIVE (−): Refusal of treatment, crying forcefully, fearful, or any other overt evidence of extreme negativism.
- **Rating 2:** NEGATIVE (−): Reluctant to accept treatment, uncooperative, some evidence of negative attitude but not pronounced, i.e., sullen, withdrawn.
- **Rating 3:** NEGATIVE POSITIVE (−+): Fluctuation between uncooperaiveness and some evidence of unpronounced negative attitude, and cautious acceptance to treatment with reservation shifting throughout the visit.
- **Rating 4:** POSITIVE (+): Acceptance of treatment; at times cautious, willingness to comply with the dentist, at times with reservation but patient follows the dentist’s directions cooperatively.
- **Rating 5:** DEFINITELY POSITIVE (++): Good rapport with the dentist, interested in the dental procedures, laughing and enjoying the situation.
Sciences) version 16. Descriptive results were obtained in frequency (percentage) and mean ± standard deviation. The association between quantitative variables was obtained using Kruskal–Wallis non-parametric test. Level of significance was set at 5% ($p < 0.05$).

The mean age of children taken for the study was $6.03 \pm 1.2$ years with 46 males and 29 females (Table 2).

Instrumentation time showed no statistical significance in the mean time for access opening. However, the mean time for biomechanical preparation was found to differ significantly among the three groups ($p < 0.001^{**}$). The mean time (in minutes) was 40.02 ± 7.08 for group I (hand K-flex files) was significantly higher than groups II and III. The mean instrumentation time for obturation was also higher for group III which was also found to be statistically significant ($p < 0.05^*$) (Table 3).

There was no significant difference in the mean preoperative pain among the three groups. The postoperative pain after 6 hours had a mean value of 0.88 ± 0.9 for the hand K-flex files (group I), 0.44 ± 0.71 for pediatric rotary files (group II), and 0.31 ± 0.61 for the reciprocating files (group III) proving to be statistically significant.

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**Flowchart 1:** Flow diagram of study methodology

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**Table 2:** Demographic details of the study sample

| Demographic parameter | Overall (mean ± SD) | Group I (mean ± SD) | Group II (mean ± SD) | Group III (mean ± SD) |
|-----------------------|---------------------|---------------------|----------------------|-----------------------|
| Age                   | 6.04 ± 1.1          | 6.34 ± 1.27         | 5.76 ± 1.1           | 5.92 ± 1.02           |
| Gender                |                     |                     |                      |                       |
| Male                  | 46                  | 18                  | 17                   | 11                    |
| Female                | 29                  | 6                   | 9                    | 14                    |
The mean postoperative pain after 24 hours, 72 hours, and 1 week showed no statistically significant difference among all the three groups (Table 4 and Fig. 2).

The preoperative and postoperative behavioral comparison revealed no statistically significant difference among the three groups (Fig. 3).

**Discussion**

The study intended to compare the instrumentation time of the hand and rotary systems (pediatric, reciprocating) in primary molar teeth. A statistically significant reduction was found in the time required for biomechanical preparation for both rotary systems. These findings are consistent with a study by Panchal et al., which compared K-files, H-files, and rotary Kedo-S files.

A study by Morankar et al. compared instrumentation time between hand files (SS K-files) and Hyflex rotary files and found a significant reduction in instrumentation time using rotary files in primary molar teeth.

Other studies which support the above-mentioned findings include Crespo et al., Govindaraju et al., and Makarem et al. Rotary systems are efficient for cleaning and shaping with better debris and tissue removal and less chairside time.

On the contrary, Katge et al. reveal more instrumentation time using rotary Mtwo files vs hand H-files in an in vitro study on primary molars. Similar findings by Madan et al. attributed the increased time to the experience of the operator.

The study also reveals a statistically significant reduction in the time taken for obturation for both rotary groups, i.e., pediatric and reciprocating file systems. This was consistent as per the study by Babaji et al. where the mean obturation time of rotary files...
factors, the randomization ensured no significant variation of preoperative pain, age, and sex among the three groups. All procedures were performed by a single operator to ensure technique standardization and a single evaluator explained the questionnaire and recorded the time values.

Finn states a positive correlation between the short appointment duration with cooperative behavior of the child in the dental clinic.\textsuperscript{31} Rotary files due to their short instrumentation time may influence behavior positively.\textsuperscript{22} However, a study by Morankar et al.\textsuperscript{21} showed greater patient acceptability by the manual group (83.3\%) than the rotary group (66.7\%) which was attributed to the fear of the rotary handpiece and increased visibility of the files to the patient. A study by Krishna et al. comparing H files with Mtwo rotary files showed that 66.7\% of children preferred H-files which was attributed to the air-rotor-like appearance of the motor which may provoke fear/ anxiety.\textsuperscript{32} The operator’s comfort was more for the Mtwo file group, though not statistically significant possibly due to less fatigue and improved cutting efficacy of the rotary files.\textsuperscript{33}

In the present study, no statistically significant variations were observed in the child’s behavior among the three groups. The author attributed this to the initial non-pharmacological strategies used with each child to ensure patient comfort before starting the procedure. Due to the variation of findings in different studies, this aspect should be focused upon in the years to come.

**CONCLUSION**

The study aimed to evaluate and compare the effect of hand, pediatric, and reciprocating file systems on instrumentation time, postoperative pain, and child behavior. The overall performance of the rotary groups was found to be better than the hand file group.

- There is shorter instrumentation and obturation time for rotary (both pediatric and reciprocating) over manual files.
- The study also shows lower postoperative pain (6 hours) for rotary files vs manual files, whereas the pain values at 24 hours, 72 hours, and 1 week showed no significant intergroup variations.
- No significant differences in the child’s behavior among the three groups.

A limitation to the present study could be the lack of a cross-over type study design where all three groups could be compared in a single child, which could not be done due to its impending sensitivity in sample selection.

The future scope of the studies could be analysis of segregated instrumentation time along with an inter-arch comparison of the same, the effect on the child’s behavior could also be evaluated by the child’s preference/feedback form in place of the operator’s perception of the same and operator’s experience could also be taken into account.

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