

Comparing the Influence of Conventional and Rotary Instrumentation Techniques on the Behavior of the Children: A Randomized Clinical Trial

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ABSTRACT

Background: Pulpectomy has gained popularity in the pediatric dental practice for preserving the primary teeth in its position until exfoliation. There has been a paradigm shift from using manual instrumentation to rotary instrumentation for canal preparation in primary teeth. While studies show that there is a reduction in the instrumentation time with the use of rotary instruments which in turn influences the behavior of the child, its direct effect on the behavior of the children has not been evaluated.

Aim: To compare the behavior of the children during manual and rotary instrumentation for pulpectomy in the primary molars.

Materials and methods: A single-blinded randomized clinical trial was conducted in 88 children in any one of the mandibular primary molars indicated for pulpectomy. The canal preparation was done using manual K files and rotary ProTaper (44 children in each group). The influence of these instrumentation techniques on the children was assessed with three different scales- Frankl Behavior Rating Scale; Venham Interval Rating Scale; Wong Baker FACES Pain Scale for evaluating the behavior, anxiety, and the pain experienced by the children, respectively during canal preparation.

Results: A total of 88 participants, comprising 50 females and 38 males, participated in the study. An equal distribution of the participants with respect to age ($p = 0.064$), gender ($p = 0.389$), and teeth ($p = 0.877$) was observed between the groups. More cooperative behavior ($p < 0.001$); lesser anxiety levels ($p < 0.001$); lower intensity of pain ($p < 0.001$) were recorded in the children instrumented using Rotary files.

Conclusion: The present study concludes that it is preferable to use rotary instrumentation for primary canal preparation in pediatric practice as it has a more positive influence on the behavior of the children, which eventually determines the success of the treatment.

Clinical significance: With rise in the use of rotary files for pulpectomy in primary teeth, the present paper demonstrates the influence of rotary instrumentation technique for canal preparation during pulpectomy on the behavior of the children in a dental chair. This paper throws light for the pedodontists to effectively perform pulpectomy in children with ease without leaving a psychological impact on the children.

Keywords: Behavior, Primary teeth, Pulpectomy, Rotary files.

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INTRODUCTION

Early childhood caries is a globally existing oral health condition possessing a strong risk of primary teeth getting lost at an earlier age. Early loss of primary teeth endures to be a major concern in the field of pediatric dentistry. The role of a pedodontist is to maintain the primary teeth in its position until exfoliation without signs of infection, thus preserving the integrity of the dental arches.¹ Hence, endodontic management of primary teeth with infected pulp became the growing field in pediatric dentistry.

Pulpectomy is the only choice of treating symptomatic primary teeth in children to retain the primary teeth in its natural position as a fully functional component in the dental arch. The procedure of pulpectomy involves complete pulpal removal followed by debridement of the canal space for adequate obturation with a resorbable root filling material.² Haapasalo et al. have reported that bio-mechanical preparation is the most important step that determines the success of the pulp therapy.³ The primal intent of root canal preparation in primary teeth is to completely eliminate the organic debris in relatively shorter time.⁴

Hand files were used for canal debridement of the primary teeth traditionally and extensively but have also been reported to be more time consuming and result in iatrogenic errors.⁵ To overcome the detriments of the hand instrumentation in primary roots canals

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and to preserve the torturous root canal path of the primary teeth, NiTi instrumentation was introduced into pediatric dentistry.⁶ Besides the limitation in the procedural errors and reduction of the operator's fatigue, the major advantages of using rotary instruments over hand instrumentation in pediatric dentistry is the reduction in the instrumentation time and its positive influence on the child's behavior towards dental treatment. The length of the appointment is strongly associated with the child's behavior.^{7,8}

The behavior of children plays an integral component and is the primary requisite of the pediatric dental practice.^{9,10} Assessment of child's behavior during a dental procedure is one

of the most important skills of a pediatric dentist for successful completion of the dental treatment.¹¹ The child's behavior on a dental visit is influenced by various factors, of which the procedural technique followed by the dentist is an at most factor to be taken into account.¹² A technique will be considered to be completely successful only if it has a positive impact on the child's behavior. A lot of scales for assessing the behavior have been declared, of which Frankl behavior rating scale is considered to be the most reliable tool for assessing the behavior of the children in a dental setup.¹³

Dental anxiety and dental pain are two other important factors that influence the behavior of the child in a dental sitting. In a pediatric dental practice, management of dental fear and anxiety which influences the behavior of the child for the dental procedure is an at most factor to be taken into consideration. It has been well-documented that the difficulties associated with behavior management are not only related to the technical procedures involved but also to the emotional constituents such as the fear and anxiety.¹⁴ Anxiety is an unpleasant emotional state arising without any objective source of danger. Anxiety in children during a dental procedure will not only have an impact on the child's dental attitude but will also affect the quality of the treatment.

Pain is another factor that has an impact on the child's behavior for the dental procedure. Pain is defined as an unpleasant sensory or emotional experience associated with actual or potential tissue damage. In pediatric patients, effective pain management is the cornerstone for successful behavior management.¹⁵

Various studies have been conducted using different rotary instrumentation for canal preparation in primary teeth and have concluded that there is a significant reduction in the chair side time which indirectly improves the cooperation of the child for the dental treatment.^{8,16,17} However the direct association of the use of rotary instrumentation on the child's behavior and the anxiety levels has not been assessed. Determining the behavior of the children, their anxiety level, and the pain experienced by them on using rotary instruments is elemental to completely accept the use of NiTi files in routine pediatric dental practice. Hence, the aim of the present study was to compare and evaluate the child's behavior, anxiety level and the pain perception on using Manual and Rotary instrumentation for cleaning and debridement of the primary root canals.

MATERIALS AND METHODOLOGY

Study Design and Ethical Approval

The study was a single-blinded randomized controlled trial conducted at Saveetha Dental College and Hospitals, Chennai, Tamil Nadu, India. Ethical approval was obtained from the institutional ethical committee of Saveetha Institute of Medical and Technical Sciences prior to the start of the study (SRB/SDMDS15PED12) and was conducted in accordance with the Declaration of Helsinki.

The target population was children attending Saveetha Dental College for routine dental treatment. Children between the ages of 4 and 7 years showing cooperative behavior for the dental treatment in their first dental visit were invited to participate in the study. Children lacking cooperative ability, children with physical and psychological disabilities and with underlying systemic diseases requiring special health care needs were not invited to participate in the study. Also, children requiring pulpectomy in an abscessed or nonvital tooth, teeth showing signs of internal/pathological resorption, teeth with inadequate coronal tooth structure to receive

Stainless Steel Crown and parents who were not willing and those who refused to sign the informed consent were also excluded from the study.

The participants' parents were explained about the treatment required for their children and the participation of their children into the study was voluntary. Informed consent was obtained from the parents of all the participants prior to the commencement of the treatment.

Sample Size Calculation

Sample size was calculated from a pilot study that was conducted with a total of 20 children (10 per group) meeting the above said inclusion and exclusion criteria. Sample size was calculated at 95% power with alpha error set 5% using G power and arrived to a total sample size of 88 (44 per group).

Randomization and Allocation Concealment

The participants were randomly allocated into two groups using a computer-generated randomization sequence. The sequence was numbered in advance and was sealed in an envelope to ensure adequate concealment. As the participant was recruited into the trial, the investigator opened the sequentially arranged envelopes to determine the type of instrumentation that has to be used for pulpectomy in that particular participant.

Study Procedure

Pulpectomies for all the included teeth were carried out by a single pediatric dentist in single visit. Topical local anesthetic agent (Precaine B, Pascal International, USA) was applied and the teeth were anesthetized with local anesthetic solution containing 2% lignocaine with 1:200,000 adrenaline (LOX* 2% ADRENALINE, Neon Laboratories limited, India). Rubber dam isolation was done (GDC Marketing, India). The superficial caries was removed using high speed sterile No. 330 round carbide burs (Mani, Inc., Japan). A standard access opening and coronal pulp tissue removal was done. The overlying dentinal shelf was reduced until all the canals were completely visible. The vitality of the tooth was confirmed by the presence of hemorrhage in the canal upon de-roofing. No.10 size K file (Mani, Inc., Japan) was used to explore and determine the patency of the canal. Working length determination was done with the help of pre-operative radiograph and was kept 1 mm short of the apex.

In group I, the canals were prepared using K files (Mani, Inc., Japan) till size 30 in quarter pull turn method. The canals were irrigated with saline between each file size.

In group II, a simplified protocol for the use of ProTaper rotary files (Dentsply India Pvt. Ltd, India) in primary teeth were followed as suggested by Kuo C et al.⁴ SX and S2 ProTaperfiles were used for the canal preparation of the primary teeth sequentially using an X-Smart motor (Dentsply India Pvt. Ltd., Delhi, India) at a rotational speed of 300 r.p.m. with torque set at the lowest level.

SX file was inserted into the canals in bucco-lingual brushing motion to remove the over-lying dentin and gain straight line access. This was followed by insertion of the S2 file till the determined working length. On removal of the file from the canal, the pulp tissue was commonly seen wrapped to it. The primary root canals were thoroughly irrigated using saline. The files were discarded after use in five teeth and no attempt was made to force the files beyond the point of resistance if felt to prevent the fracture of the instrument within the canal.

During canal preparation, the operator assessed the behavior of the child using Frankl's behavior rating scale. The criteria used to categorize the participants as definitely positive, positive, negative, and definitely negative. The anxiety level of the children on instrumentation was recorded using Venham's Interval Rating Scale. This scale scores from 0 to 5 describing the anxiety level of the children in the increasing order. Behavior and anxiety scores were recorded by the dentist who performed the treatment. Tell Show and Do technique and use of euphemisms were commonly employed for management of the children of both the groups. In cases where the child showed negative behavior voice control, HOME, and physical restraints were used for managing the children.

After canal preparation, the child was assessed for the pain experienced during instrumentation using Wong Baker FACES Pain Scale (Fig. 1). This self-reported scale was explained to the children and they were asked to point out the face that depicts their pain level during the canal instrumentation.

The canals were then dried thoroughly using sterile paper points. A premixed paste of calcium hydroxide and iodoform was used to obturate the root canals (Metapex, Meta Biomed Co., Ltd., Korea). The obturated canals were given Glass Ionomer Cement entrance filling (Shofu, Shofuinc. Japan) and was restored with Stainless Steel crowns (3M ESPE).

Statistical Analysis

The collected data was analyzed using SPSS software version 17.0 (Chicago. SPSS Inc.) with statistical significance set at $p < 0.05$. Independent t-test and Chi-square test were used to compare the distribution of the participants with respect to age; sex and the distribution of the teeth between the groups, respectively. Mann-Whitney test was used for analyses of the behavior; anxiety and the pain scores of the children between the two groups. Spearman-correlation test was used to establish the relationship between the behavior of the children, the anxiety levels, and the pain.

RESULTS

Eighty eight participants, comprising of 50 females and 38 males, participated in the study. The mean ages of the participants were 4.95 ± 0.987 years in K file group and 5.43 ± 1.371 years in the ProTaper group. 28.4 and 27.3% of primary left first and second molars were included in the study. A total of 15.9% of primary first

molars and 28.4% of primary second molars on the right side were included for the study. Comparative analyses of the distribution of the participants and the teeth between the groups was evaluated using Independent t-test and Chi-square test with p -value set at the significance of 0.05. An equal distribution of the participants with respect to age ($p = 0.064$), gender ($p = 0.389$), and teeth ($p = 0.877$) was observed between the groups eliminating the chances of bias (Table 1).

The mean behavior of the children was significantly more cooperative and positive in the group where rotary files were used for primary canal instrumentation ($p < 0.001$). The children on whom rotary files were used for canal instrumentation were less anxious when compared to those children on whom hand instrumentation was done. This difference in the anxiety level expressed by the children was highly statistically significant ($p < 0.001$). On comparing the pain experienced by the children on instrumentation with hand and rotary files, it was observed that the pain perception was much lesser with rotary instrumentation than hand instrumentation with a statistically significant difference ($p < 0.001$). The parameters evaluated in this study are summarized in Figure 2.

A positive correlation was observed between the pain and the anxiety levels of the children, showing that with increase in pain the anxiety levels in the children also increased. In other words, with increase in the anxiety level, the intensity of pain experienced by the children also increases.

A negative correlation was seen between the pain and the behavior of the children in the present study in both hand and rotary instrumentation. That is with increase in the intensity of pain, the children exhibited more negative behavior.

A negative correlation was also reported between the anxiety levels and behavior of the children, which depicts that with increase in the anxiety level the children exhibited more negative behavior. These results portray the relationship of pain, anxiety and behavior in children with a statistically significant difference ($p < 0.005$) (Fig. 3).

DISCUSSION

A paradigm shift from extracting the pulpally involved tooth to preserving the decayed tooth in the dental arch until its exfoliation was first reported by Sweet CA.¹⁸ Pulpectomy treated teeth that exfoliated were statistically more successful when compared to

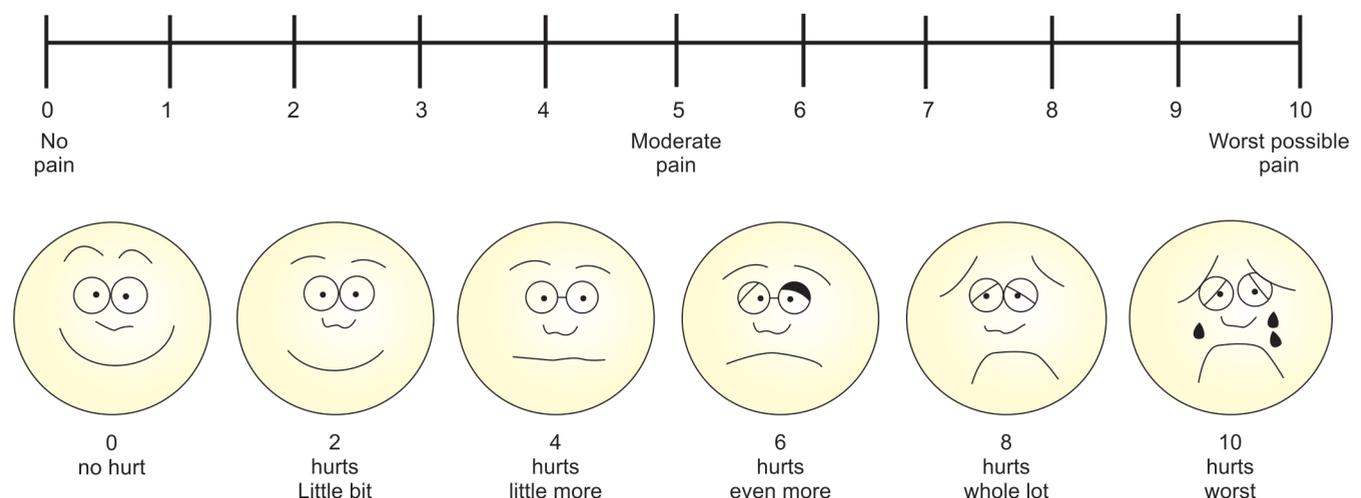
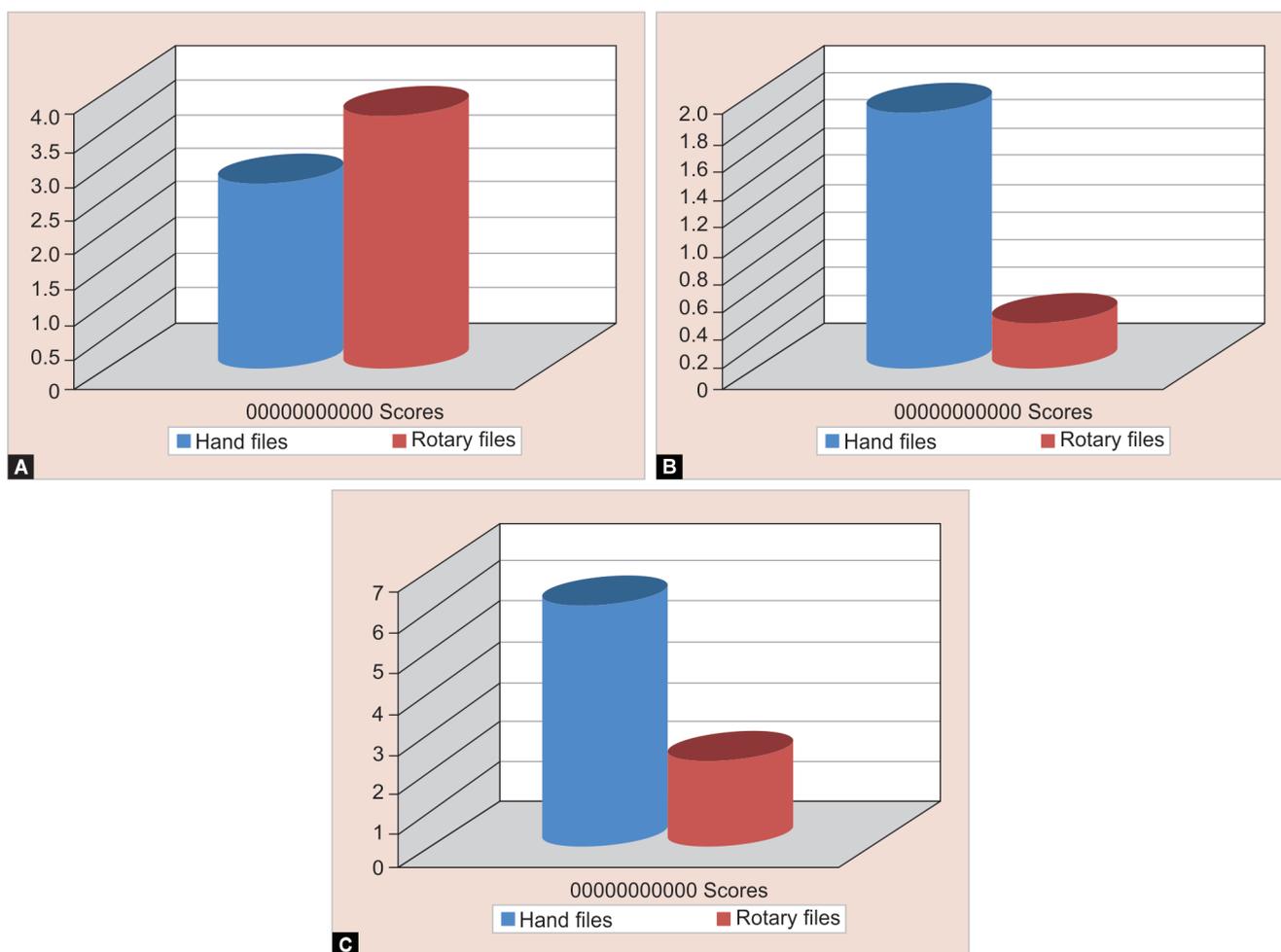


Fig. 1: Wong Bakers FACES pain scale

Table 1: General characteristics of the participants and the teeth

Parameters	Hand file	Rotary file	p-value
Age	4.95 + 0.987	5.43 + 1.371	0.064*
Sex			0.389*
Male	47.7% (n = 21)	38.6% (n = 17)	
Female	52.3% (n = 23)	61.4% (n = 27)	
Teeth			0.877*
74	29.5% (n = 13)	27.3% (n = 12)	
75	27.3% (n = 12)	27.3% (n = 12)	
84	18.2% (n = 8)	13.6% (n = 6)	
85	25.0% (n = 11)	31.8% (n = 14)	

*p > 0.05, statistically not significant

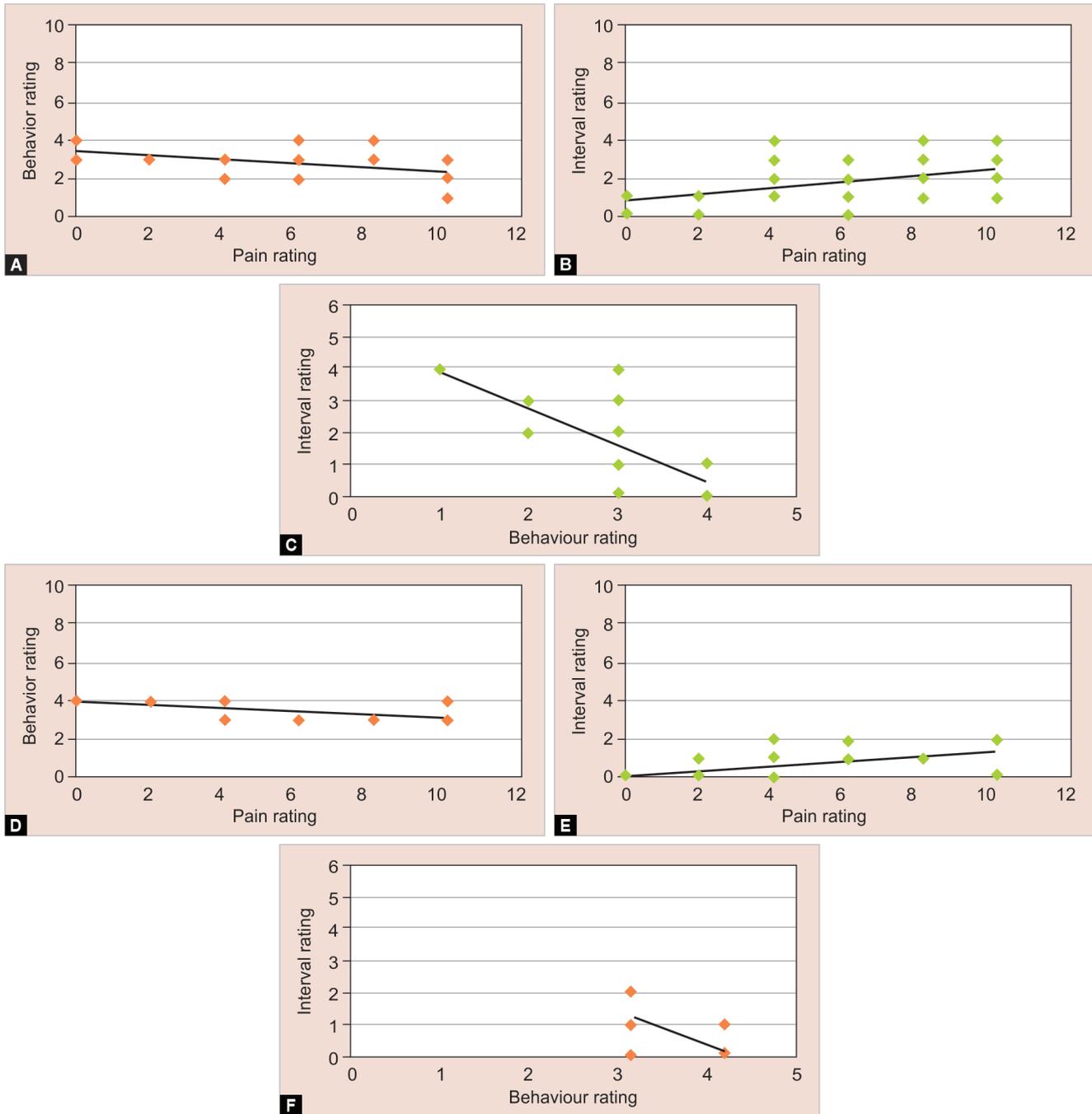


Figs 2A to C: (A) Comparison of the behavior; (B) Anxiety; and (C) Pain, experienced by children during instrumentation with hand and rotary files

the extracted teeth.¹⁹ Pulpectomy is considered as the choice of treating symptomatic primary teeth. The prime factor determining the success of the pulpectomy procedure is the canal preparation, which was conventionally prepared using hand files is now shifting towards preparation with rotary files.

Dental treatment, in general, is a stressful act for children, their parents and also the pediatric dentist. In particular, it has a greater influence on the children resulting in long-term consequences associated with psychologically rooted issues. In pediatric dentistry management of these psychological entities which includes the behavior, anxiety, and pain is as

important as providing a complete qualitative dental treatment. Thus, behavioral science is an indispensable aspect of pediatric dentistry which would quantify the behavior of the children towards the dental technique used. Pinkham JR stated that behavior management is the fundamental key for the success of a dental treatment in children.⁹ Dental treatment for children is centered on their management of fear, anxiety, and pain and hence recording the same is an important aspect.²⁰ Children showing temper tantrums interferes with the quality of the dental care provided and can also result in the risk of injury to the children. Thus, the child's behavioral response on the dental



Figs 3A to F: Co-relation between behavior, pain, and anxiety of the children in hand file groups (A to C) and rotary file groups D to F

chair towards various techniques is a major concern for the practitioners in pedodontic field.

A lot of studies existing in the literature had evaluated the effectiveness of rotary files for canal preparation in primary tooth with respect to the instrumentation time, canal cleaning efficiency, quality of obturation and the success rates.^{4-8,16-17,21,22} However, there is still a paucity existing in the literature to evaluate the influence of different instrumentation techniques on the behavior of the children, which ultimately decides the success of a particular instrumentation technique especially in pediatric practice.

Hence, the present *in vivo* study was conducted to compare the behavior of the children on using manual (K files) and rotary instrumentation (ProTaper) for canal preparation in primary molars.

A lot of studies existing in the literature have used ProTaper files for canal preparation in primary teeth.^{4,23,24} Pinheiro et al. showed that the cleaning efficiency of the primary canals with ProTaper rotary files is significantly better.²³ Also a recent survey conducted by Govindaraju et al. showed that about 34% of the practitioners use ProTaper rotary file for canal instrumentation in primary teeth.²² Hence, in the present study ProTaper rotary files were chosen to represent the test group.

In the present study, a simplified protocol advocated by Kuo et al. for the use of ProTaper files in primary teeth were adopted as the primary teeth have a softer dentin with long, slender, and curved roots.⁴ In case of application of the original protocol proposed for the use of ProTaper files in permanent teeth,

application of the same in primary root canals can result in lateral perforation of the ribbon-shaped primary root canals.⁴ Hand instrumentation of the primary canals using K files represents the control group as it is considered to be the gold standard.

Children cooperative in their first dental visits were selected for participation in the present study as the change in their behavior with the use of various instrumentation techniques can be well appreciated.

Nonvital or abscessed primary molars were not included in the present study as instrumentation in these teeth can act as a potential bias to the pain perception which would, in turn, affect the behavior of the child during treatment.

Mandibular molars alone were included in order to maintain the uniformity and also for the ease of access.

The study population was equally distributed between the two groups with respect to the age, thus do not contribute to the bias. Also, there was an equal distribution of the involved teeth and the participants with respect to the gender in the present study.

A study conducted by Coll JA showed 77.8% of success rates at the end of 90.8 months follow-up in primary teeth treated with single visit pulpectomy.¹⁹ Bharuka SP compared the single and two-visit pulpectomy treatment in primary teeth with apical periodontitis and concluded that there is no statistically significant difference in the clinical and radiographical success rates at the end of 6 months follow up. Also, one-visit pulpectomy procedure saves time; reduces the cost of the treatment; minimizes the distress to the children by eliminating the need for an additional anesthetic injection, rubber dam placement, and removal in the second visit.²⁵ Hence, in the present study single visit pulpectomy was performed on the participants.

All the pulpectomy procedures were done by single operator in order to prevent any sort of bias that can occur with respect to the way of explaining to the children, treating, and also assessing the behavior and anxiety scores. Thus, operative bias is not a consideration in the present study.

Topical anesthetic agent was applied prior to the administration of local anesthesia in order to eliminate the influence of pain during injection to interfere with the pain perception during canal instrumentation.

The positive behavior of a child for a dental procedure is an important criterion to determine the success of the treatment. Though many behavior rating scales are available for assessing the child's behavior, Frankl behavior rating scale is the most reliable tool for rating the behavior of the children in dental sittings. Hence, in the present study, Frankl behavior rating scale was used to compare the behavior of the children upon instrumentation with manual and rotary files. In the present study, it was seen that about 75% of the children in rotary instrumentation group showed definitely positive behavior and 25% of the children showed positive behavior. Whereas, in manual instrumentation group only 9.1 and 61.4% of the children showed definitely positive and positive behavior, respectively. No negative behavior was exhibited by the children on using rotary files for canal preparation, while about 22.7 and 6.8% of the children in manual instrumentation showed negative and definitely negative behavior, respectively. The results of the present study show that on using rotary files for canal preparation of the primary molars, the children show more cooperative behavior towards the treatment. This could be attributed to the reduced time taken for instrumentation of the primary canals with rotary files.^{4,5,8,16,17,21,22}

The major aspect of child management in a dental care is managing the dental anxiety of the child which could be a potential barrier for performing the treatment. The complications of dental anxiety include prolonged chair side time, behavior management issues, and dental care neglect.²⁶ Dental anxiety is considered to be the main reason for behavior management problems.²⁷ Measurement of dental anxiety in children is important for delivering a quality oral care. Understanding the anxiety levels of the children towards different techniques will allow the clinician to provide a positive dental experience. Hence in the present study, the anxiety levels of the children were recorded during canal preparation of the primary molars to evaluate which type of instrumentation has a better psychological effect on the children. Venham's Interval Rating Scale was used in the current study as it was proved to be potentially a better standard tool for assessment. Statistically decreased anxiety scores were expressed by the children on using rotary files for canal preparation in primary molars in the current study. The decrease in the anxiety levels in the children of rotary group could be due to the appearance of the X-smart motor which resembles a video game player and also the children imagined the rotary files as tiny vibrating brush that pulls the germs out of the tooth as in most of the cases the pulp tissue (referred to as germs to the child) was seen wrapped around the ProTaper file. However, Tell- Show- Do technique and euphemisms were used in children of both the groups.

Pain assessment is absolutely vital for gauging the discomfort and response to any therapy. Pain perception in children is highly variable and hence self-report of the pain is the best method of assessing pain in children. Wong Baker FACES Pain scale was selected in the study as it was reported to be more sensitive and easier for the children to understand compared to other pain scales. In the present study, the pain evaluation in children showed that 13.6% of the children from manual instrumentation group and 52.2% of the children from rotary instrumentation group reported with mild pain during canal preparation. 40.9 and 36.4% of the children reported moderate amount of pain experienced during canal preparation with Manual and Rotary files, respectively. While, 45.5 and 11.4% of the children from manual and rotary instrumentation group reported with severe pain on canal preparation, respectively. The intensity of pain perceived by the children on instrumentation with rotary files was significantly less when compared to primary canal instrumentation with conventional hand files in the present study. The results of the present study strongly encourage the use of rotary files for canal instrumentation in primary teeth as any pain free or less painful new treatment technique scores higher over the traditional existing technique.

The behavior of the child becomes negative with an increase in the intensity of pain which in turn increases the anxiety of the child towards the dental procedure. No studies in the literature have statistically proved the above statement. Hence, in the present study relationship between anxiety, pain, and the behavior of the children on instrumentation during canal preparation was evaluated. In both the groups, it was seen that as the pain intensity increases the uncooperative behavior and the anxiety of the child also increase.

The obtained results of the present study throw light on the practitioners to manage the pain and anxiety of the children appropriately in the dental chair to elicit a cooperative behavior from the children for providing a qualitative and successful dental treatment. In the current study, the anxiety levels and the pain intensity were much lesser on instrumentation with rotary files, which in-turn reflected as a more positive and cooperative behavior of the children for canal preparation of the primary molars with rotary files.

CONCLUSION

The results of the present study draw to the following conclusions:

- The behavior of the children during canal preparation with rotary files is more positive when compared to those children in whom manual files were used.
- The anxiety level of the children was comparatively lesser on instrumenting with rotary files when compared to the manual files.
- The intensity of pain experienced by the children during canal preparation with rotary files was much lower than manual instrumentation.
- It is preferable to use rotary instrumentation for primary canal preparation in pediatric practice as it has a more positive influence on the behavior of the children, which eventually determines the success of the treatment.

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