



Quantitative assessment of the efficacy of three different file systems in reducing the bacterial load in primary canals

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ABSTRACT

Aim: To quantitatively assess the efficacy of reducing the bacterial load in the root canals of primary molars using K hand files and two NiTi rotary filing systems- Kedo S Square and Kedo S Plus.

Methodology: This study was a randomized clinical trial which comprised of 60 children with primary mandibular first and second molars requiring pulpectomy treatment. The samples were randomly allocated into three groups with 20 samples each; Group 1: K hand files, Group 2: Kedo S Square NiTi Rotary files, Group 3: Kedo S plus NiTi Rotary files. Mechanical preparation was done and samples were obtained before and after cleaning and shaping using absorbent paper points and transferred to a suitable agar media. The cultures were counted and the data was subjected to statistical analysis using the SPSS system (IBMSPSS Statistics, Version 20.0, Armonk, NY: IBM Corp). Kruskal wallis test was used to compare the mean microbial load of before and after filing values (Pre and Post) between the groups. The test used to compare the mean microbial load of pre and post values within the groups was done using Wilcoxon sign rank test. Results: In all the groups there was a statistical significant reduction of micro flora following mechanical instrumentation but Kedo S plus had a better potential of reducing the microflora in the canals when compared to Kedo Square and K hand files.

Conclusion: Rotary filing systems are as efficient as conventional hand files in reducing bacterial load in primary canals.

Keywords: *mechanical preparation, Rotary NiTi, microflora, K files*

INTRODUCTION

The prime importance of rotary endodontics in pediatric dentistry is to reduce the bacterial load and its byproducts which causes pain and infections leading to abscess and extra oral swellings (Figdor and Sundqvist 2007). Pulpectomy is the removal of the coronal and radicular infected pulp tissue and obturating

with a suitable material thereby reducing the microbial load and achieving good healing of the surrounding tissue (Karamifar, Tondari, and Saghiri 2020). An effect of biomechanical debridement with a proper irrigant will enhance the success of the treatment as it needs to remove the infected remnants of pulp tissue and debris from the infected dentin

(Jayachandar, Gurunathan, and Jeevanandan 2019; Jeevanandan and Thomas 2018). This will create a clear pathway for irrigants to reach the apical third of the roots and help provide required space for the obturating material to flow (Marsh and Largent 1967).

Decades ago hand instrumentation was done using K files and pulp tissue was extirpated using barbed broaches (Bertrand et al., n.d.). It has been found to be very time-consuming which was a big pitfall for pediatric dentists as children could not cooperate for an extended period of time (Asif et al. 2019; Panchal, Jeevanandan, and Subramanian 2019). The rigidity of the files also led to the formation of ledges and lateral perforation which increased the chances for iatrogenic damage (Punathil et al. 2014). Advancements have been made to overcome these shortcomings with the introduction of rotary endodontics with the usage of nickel titanium file systems, which have the advantage of greater flexibility, shape memory and faster preparation of root canals. Barr et al was the first to use NiTi files in pediatric endodontics in 2000.

Due to the advancements in science and technology, diversified brands have introduced various file systems into the market. Kedo files have been a brand specifically designed for primary teeth which have a total of 5 generations of file systems. The 4th (Kedo S Square) and 5th (Kedo S Plus) generations have single file systems. There have not been any studies on Kedo S Plus files and no studies comparing the two file systems in quantitatively reducing the bacterial load in primary canals, which is the aim of this study.

MATERIALS AND METHOD

This randomized clinical study was conducted to compare the effectiveness of three different file systems- K Files, Kedo S square and Kedo S plus in reducing the bacterial load in primary canals. The Institutional Review Board approved the study protocol and gave ethical clearance for the same. Informed consent was obtained from the guardians of the participants prior to the treatment and after providing complete information of the study protocol.

The sample size was derived from priorly published literature (Sankar and Jeevanandan 2021). G power was taken as 95% probability. The sample size was arrived to 60 children.

Study Design

The participants were selected based on examinations both clinically and radiographically until the sample size was met. The samples were randomly allocated into three groups using allocation concealment with a sealed envelope. 60 patients within the age of 4-8 years, devoid of any systemic diseases with no previous history of antibiotic medication in the past two weeks having radiographic evidence of pulp involvement in any primary mandibular molars with more than two third of the radicular structure with an intact crown structure were taken. Exclusion criteria included children with special needs, illnesses of systemic origin, teeth having internal or external resorption, dentoalveolar abscess and furcal radiolucencies.

Clinical Procedure

Local anesthesia was administered locally containing 2% lignocaine 1:200,000 adrenaline (Xicaine). This was followed by rubber dam isolation. Access opening was performed using a handpiece with a no.8 round bur and deroofting was done using a non end cutting bur. Pulp was extirpated using a 15 size H file (Mani). The distal canals were taken for samples, while the mesial canals were temporarily covered using an intermediate restorative material (3 M Cavit G) to avoid any contamination. Samples were taken before and after cleaning and shaping with a sterile absorbent paper point that was placed till the working length of the distal canal for one minute. The collected sample was then placed in an Eppendorf tube with a transport media of distilled water.

Sample Processing

These samples were given to the microbiology lab for culture. The samples were placed on culture plates consisting of blood agar and incubated for a time frame of 48 hours for aerobic culture. The quantitative antibacterial

effectiveness of the files were assessed by counting the colony forming units using a digital colony counter.

The groups consisted of - Group 1: K files(Mani) 15 till size 35 using quarter turn and pull motion, Group2: Kedo S Square rotary Ni-Ti file and Group 3: Kedo-S Plus rotary Ni-Ti files were used in a pecking and brushing motion until the working length was reached..

Irrigation was carried out using saline and EDTA before the post preparation samples were taken using a similar protocol as mentioned above. The remaining canals were then prepared and dried using sterile paper points before obturation with Metapex obturating (Meta Biomed Co. Ltd. Chungbuk, Korea) material and coronal sealing was done with GIC and restored using stainless steel crowns. Mean values between pre and post instrumentation sample was compared by using

SPSS version 21.0 and statistical significance was set at $P < 0.05$

Statistical Analysis

The data were entered in Microsoft Excel spreadsheet and analyzed using SPSS software (IBM SPSS Statistics, Version 20.0, Armonk, NY: IBM Corp.).Descriptive statistics were used for data summarization and presentation.A p value of 0.05 were considered to be statistically significant. Shapiro wilks normality test was used to determine the normal distribution of data. Kruskal wallis test was used to compare the mean microbial load of +/-before and after filing values (Pre and Post) between the groups. Wilcoxon signed rank test was used to compare the mean microbial load of pre and post values with in the groups

TABLE 1: Comparison of mean microbial load before filing (Pre) between the groups

GROUPS	Pre instrumentation CFU/ml SD (10 ³)	Post instrumentation CFU/ml +/- SD (10 ³)	Mean difference CFU/ml (10 ³)	% of Microbial reduction	pValue
K FILE	380.70	88.60	292.1	76.8	0.001
KEDO S PLUS	507.00	45.80	461.2	90.9	0.001
KEDO SQUARE	418.65	63.45	355.2	84.8	0.001

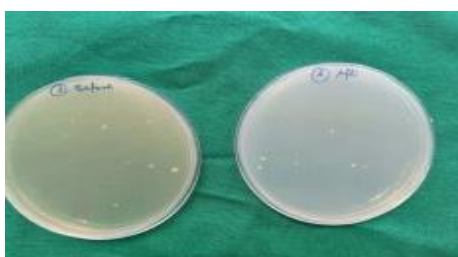


FIG 1: Agar plates showing pre and post instrumentation using K hand files



FIG 2: Agar plates showing pre and post instrumentation using Kedo S Square



FIG 3: Agar plates showing pre and post instrumentation using Kedo S Plus

RESULTS

Of the children included in this study, 58% were males and 42% were females. The mean microbial count difference was the least in Kedo S plus files. It was observed 78% microbial reduction was seen in K hand files whereas 84.8% and 90.9% microbial reduction was seen in the rotary Kedo S square and S plus respectively. Table 1 showed a statistically significant difference in the reduction of microbial load post filing in all three groups as the pvalue was <0.05 . It can be observed that biomechanical preparation irrespective of the type of file used significantly reduced the bacterial load but Kedo S plus files were comparatively better than K files and rotary Kedo S square NiTi files.

DISCUSSION

Bacteria and their by-products are the most common causative agent for pulpitis and pain (Haapasalo et al. 2005). Pulpectomy as defined by the American Academy of Pediatric dentistry is a procedure by which access of the root canals are gained which are then debrided, enlarged, disinfected and filled with a resorbable material (of Pediatric Dentistry and Others 2008). Improper biomechanical preparation leads to a poor prognosis of root canal or pulpectomy treatment as remnants of viable microorganisms are present in the apical portion of the root. The usage of rotary files can improve the sterility of the canals by the removal of bacteria effectively and efficiently.

The rotary files have a clockwise motion which facilitates in the ease of removal of pulpal tissue and dentin from the canal which is more effective when compared to hand files. The pecking in and

out motion is performed with slight pressure resulting in cleaner canals. Mechanical instrumentation resulted in reducing the flora present in the root canals by hundred to thousand folds. Instrumentation using rotary leads to production of a large amount of smear layer on the canal walls. Proper irrigation is necessary to rinse and remove the debris created by the rotary files and to act as an antimicrobial agent in breaking down pulpal remnants. Saline was used in this study to properly analyze the efficiency of the three filing systems instead of the use of sodium hypochlorite or any other antimicrobial irrigating solution to remove any bias (Alves et al. 2018). It is an inert irrigant as it has no influence on the root canal and the objective of this study was merely to evaluate the efficacy of three filing systems alone. Similar studies conducted compared the efficiency of manual versus rotary techniques and found similar results where rotary filing systems significantly reduced the microbial load (Subramanyam, Jeevanandan, and Subramanyam, n.d.). Mechanical preparation is the most important step in the reduction of bacterial load in infected canals (Lakshmanan and Jeevanandan 2020; Govindaraju, Jeevanandan, and Subramanian 2017). Paper points were used for collection of samples as they are cost effective and flexible when placed in the narrow canals.

There are currently 5 generations of Kedo file in the market, the files used in the present study are the single file systems; Kedo S Square which is a heat treated NiTi file with titanium oxide coating which allows better flexibility with minimal taper which requires minimal preparation but effective in pulp removal (Pitchiah and Shivashankarappa 2020). Kedo S plus is a heat treated NiTi file which has Titanium oxide coating in apical $\frac{1}{3}$ rd of the file increasing its flexibility in the apical

portion. This allows better preparation and cleaning in the curved canals which allows better flow of the irrigant and obturating materials. This increases the success of the treatment.

A study conducted by Byström & Sundqvist studied that there was a significant reduction in the bacterial counts in canals which had only been cleaned and shaped with hand files in 5 sittings which just saline irrigation and no antimicrobial dressing (Byström and Sundqvist 1981; Sjögren et al. 1991). Another study conducted compared Kedo S Plus Niti files to K hand files and found that Niti files systems had a higher potential in decreasing the microbial load when compared to the hand file group (Priyadarshini et al. 2020). An invitro study to assess the dentin removal and taper of the preparation was conducted by Thakur and evaluated using a CBCT and results showed that rotary files had a slightly better outcome compared to hand files (Seema et al. 2020). (Oz et al. 2023) Conducted a study and compared hand files, protaper and kedo files and found that rotatry files showed a significant reduction in the bacterial load.

The advantage of this study is that there are no studies done on single file systems. This was an invivo evaluation which gave more clinically oriented results.

LIMITATIONS

One brand of rotary files were used in this study. Culturing using agar plates was done instead of advanced techniques. The usage of different irrigants might have given better outcomes.

CONCLUSION

Mechanical instrumentation significantly reduced the bacterial load after cleaning and shaping irrespective of the type of filing system used. Kedo S plus had a better potential of reducing the microflora in the canals when compared to Kedo Square and K hand files. It is important to supplement the use of an irrigating solution that has a good antimicrobial action to further increase the success of treatment.

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