Comparison Between Rotary and Manual Techniques on Duration of Instrumentation and Obturation Times in Primary Teeth

Tania Ochoa-Romero * / Veronica Mendez-Gonzalez ** / Hector Flores-Reyes *** / Amaury J Pozos-Guillen

Objective: *The aim of this study was to compare the duration of instrumentation and obturation times and quality of root canal filling between rotary and manual instrumentation techniques in primary teeth.* ***Study design:*** *A randomized, controlled clinical trial was performed that included deciduous teeth with pulp necrotic. Forty necrotic teeth were included; 20 were instrumented with a rotary technique (experimental group) and 20 with a manual technique (control group). The time taken for instrumentation and for obturation were recorded in minutes, and the quality of the root canal filling was recorded as optimal, underfilled, or overfilled.* ***Results:*** *The use of the rotary technique diminished the time of instrumentation to 63% and time of obturation to 68%, and it improved the quality of the root canal filling.* ***Conclusion:*** *The use of rotary instruments in the pulpectomy of primary molars represents a promising technique; the time is significantly reduced.*

Keywords: *Pulpectomy, primary molars, rotary instrumentation.*
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INTRODUCTION

In cases of advanced pulpal degeneration that affects radicular pulp tissue, two treatment options are available: extraction and pulpectomy. Various consequences are associated with premature extraction of primary teeth caused by dental caries and root canal infection, having a deleterious effect on growth of the facial-skeletal complex, particularly for full development of the dental complex, its occlusion, aesthetic qualities, and soft tissue support. Thus, the ideal treatment in these cases is to remove the etiologic agent and perform endodontic therapy (pulpectomy). This technique is considered to be preventive since the successfully treated teeth can be retained in a non-pathologic state until they exfoliate. Pulpectomy is indicated in primary teeth with chronic inflammation or necrosis beyond the coronal pulp.[1] The ultimate goals of pulpectomy are to (1) maintain arch length, (2) preserve occlusal function, and (3) promote eruption of the permanent teeth.[2] Pulp management of primary teeth requires effective techniques that consume reasonably little chair time, having as their final goal maintenance of the teeth in a functional state until time for their natural exfoliation.

Endodontists have recently seen great advances in the field of pulp therapy, including diagnostic procedures, improvement of biomaterials, instrumentation, and obturation techniques. Endodontic treatment is performed to control the infection in the root canal(s) to allow healing of the periradicular tissues.[3] This goal is achieved by mechanical instrumentation, coupled with irrigation of the canal(s).[4] Cleaning and shaping of the root canal(s) is an essential part of endodontic therapy. The biologic objective of this procedure is to remove all pulp tissue, bacteria, and bacterial toxins from the root canal system.

Traditionally, cleaning and shaping have been done with stainless steel hand files. Use of these files is associated with undesirable curvatures of the root canal morphology that make proper filling of the canals difficult, although a number of techniques have been developed in recent years to

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overcome this problem. Rotary nickel-titanium (Ni-Ti) systems have been developed to maintain original canal shape. They have been used widely in permanent teeth with decreased instrumentation time in curved molar root canals, increased patient comfort, and lower risk of flare-up.[5-7] Ni-Ti endodontic instruments were introduced to facilitate instrumentation of curved canals, and they not only provide greater flexibility, but also raise the possibility of automated instrumentation.[8-9] However, as it is a recent development, few *in vivo* or *in vitro* studies on primary teeth have been reported.[10-14]

The aim of this study was to compare the instrumentation time, obturation time, and quality of the root canal filling between rotary and manual instrumentation techniques in primary teeth.

MATERIALS AND METHOD

This investigation consisted of a double-blinded, randomized, clinical trial. Patients were assigned sequential numbers in the order in which they were enrolled, and they received their allocated treatment according to a computer-generated randomization schedule prepared before start of the study. The different steps of the study followed the guidelines suggested by the CONSORT group[15] for planning and reporting clinical trials in pediatric endodontics with the highest levels of evidence (Figure 1). Patients were randomized into 2 groups of treatment; sample size was 20 subjects per group. Forty canal treatments were performed in primary posterior teeth: 20 belonged to the experimental group, which were instrumented with the rotary technique, and 20 to the control group, instrumented with the manual technique. The study was approved by the university ethics committee. The clinical procedure was explained to either the parents or legal guardians, and written informed consent was obtained. This controlled, randomized clinical trial included 40 patients of both sexes between 5 and 9 years old. Inclusion criteria were as follows: Patient in good general health having (1) primary posterior teeth containing at least 1 necrotic pulp canal, abscess, or sinus tract; (2) radiolucent area(s) in furcation or periapical region; (3) at least two thirds of root remaining; and (4) sufficient tooth structure to support a rubber dam. Patients with any systemic illness, nonrestorable teeth, perforated pulpal floor, excessive mobility, or pathological root resorption were excluded. All treatments were performed in a single visit by the same operator. Likewise, consistency and reliability tests for the diagnostic and results evaluator were carried out in an independent manner by means of an unweighted kappa test, which resulted in a score of 0.90 (excellent).[16] Sampling of patients was realized non-probabilistically (consecutive cases), and the instrumentation technique selected for each case was made from a list of random numbers. In this study the participants, assessing observer, and analyst were blind in regard to technique group assignation. Because the rotary and manual techniques each has recognizable characteristics, they could not be blinded to the operator.

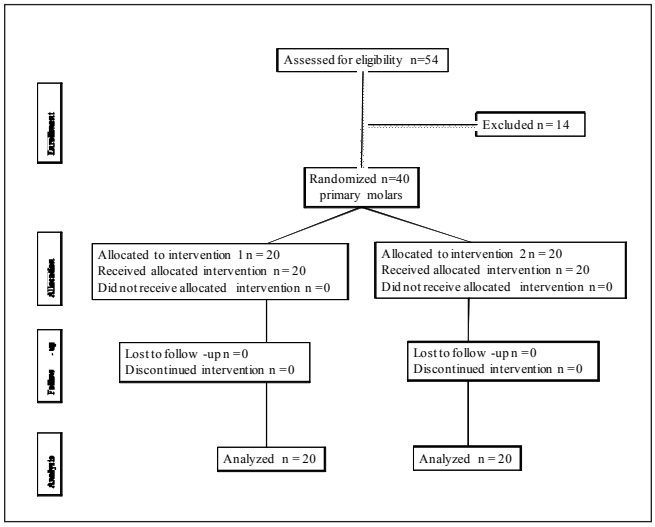

Figure 1. CONSORT flow chart of subject progress through the phases of a randomized trial.

Pulpectomy was performed on the selected molar using the following technique: Under local anesthesia and rubber dam isolation, the decayed tissue was removed and an access opening was made using a No. 4 round carbide bur (Indeco/plus, Mexico City, Mexico) at high speed. The canals were located using a DG16 instrument (Hu-Friedy, IL, USA). Canal length was determined by placing No. 15 files (Dentsply-Maillefer, OK, USA) into each canal; working length was determined to be 1 mm short of the apex. For the manual technique, teeth were prepared using the conventional method with stainless steel K files (Dentsply-Maillefer, OK, USA) and the quarter-turn-pull technique. For the rotary group, we used a K3 rotary Ni-Ti instrument system (Sybron Endo, West Collins, CA, USA); the working length was established by placing the first adjusting file to radiographic working length; instrumentation started with the 0.06 taper file. The canals were cleansed and shaped with 3 progressively larger tapered files, using the "crown down" technique; each instrument was changed according to the manufacturer´s recommendation. After use of each file, the root canals were irrigated with 1 mL of 1% NaOCl. The rotator files were used with an X-Smart motor (Dentsply-Maillefer, OK, USA) at 350 rpm and slow torque. For both groups, after final irrigation, the canals were dried with paper points and filled with iodoform paste (Ultrapex, META Biomed Co, PA, USA) by means of a pressure syringe and hand file to push the paste to just short of the apex. The excess coronal filling material was removed, and the coronal space was covered with glass ionomer (Vitrebond, 3M ESPE, St Paul, MN, USA), which was light cured for 40 seconds. Finally, a preformed metallic crown (3M ESPE) was adapted and cemented (PCA, SS White, Gloucester, UK). The time taken for instrumentation and for obturation were recorded in minutes and the quality of the root canal filling was recorded as optimal, underfilled, or overfilled.[17]

Data are expressed as frequencies, percentages, medians, and ranges. Results were analyzed by the Mann-Whitney *U* test to compare the differences among groups for continuous

variables. For categorical variables we used χ^2 and Fisher exact tests. A difference was considered significant if the probability that it occurred by chance alone was <5% ($P < 0.05$) in a 2-tailed test. The JMP IN v. 4.0.1(SAS Institute Inc, Cary, NC, USA) statistical program was used to analyze the data.[18]

RESULTS

Demographic characteristics of the sample were similar between groups for age and gender. Variable that describe the distribution of treated teeth was also similar between groups (Table 1).

Instrumentation time elicited in the manual technique group (17.7; 10.3–30.6 min) was significantly longer than that in the rotary technique group (13.3; 2.2–17.5 min). Similarly, obturation time in the manual technique group (2.1; 1.1–5.7 min) was significantly longer than that in the rotary technique group (1.5; 0.4–3.2 min), with differences statistically significant in both cases ($P = 0.002$ and 0.009, respectively; Mann-Whitney *U* test). These results are shown in Tables 2 and 3.

For the manual technique, 10 of 20 teeth (50%) were optimally filled, 8 (40%) were underfilled, and 2 (10%) were overfilled. For the rotary technique, 16 of 20 teeth (80%) were optimally filled, 2 (10%) were underfilled, and 2 (10%) were overfilled. There were statistically significant differences ($P < 0.05$, Fisher exact test) (Table 4).

DISCUSSION

This study was a randomized clinical trial that compared manual and rotary techniques of root canal instrumentation in primary teeth. The objective of root canal treatment is to completely seal a cleaned and disinfected root canal system. A thorough debridement of the canals is an essential step toward this goal.[19] In order to preserve function and esthetics, pulpectomy for restorable primary teeth with infected pulpal tissue is the preferred treatment over extraction for single-rooted teeth and for molars with signs of furcation and/or radicular involvement.[14,20,21] Premature extraction may create, orthodontic, masticatory, or functional sequelae.

Before placing filling material for pulpectomy, the root canals of primary teeth have been traditionally shaped and cleansed with endodontic broaches and hand files. However, rotary instruments have been shown to be faster and to produce well-filled canals and uniform results.[10,12,22,23] Reducing instrumentation time directly correlates with less chair time, thus causing a positive impact on child cooperation. Also, it has been suggested that rotary instrumentation allows for greater apical enlargement, reducing apical transportation and improving canal shape over traditional hand filling.[24]

Rotary Ni-Ti instruments have been investigated in numerous studies. Nevertheless, few comparative studies have reported on use of rotary instrumentation in primary teeth. Also, employment of experimental designs varies greatly. This study was performed according to the guidelines suggested by the consort group.[15] This clinical trial permitted collecting data and subsequently comparing results between comparative groups. Barr *et al* described the advantages and disadvantages of using rotary files in primary teeth. These authors consider this technique a more effective way to debride the uneven walls of primary teeth and to facilitate a consistently dense fill.[10] Silva *et al* did not find differences in cleaning capacity when comparing rotary and manual instrumentation techniques, but they reported the reduction of instrumentation time by using the latter technique.[12] Guelmann *et al* concluded that the NaviTip system provided a more reliable filling quality than either the lentulo or Vitapex syringe techniques.[25] An *in vitro* study by Crespo *et al* demonstrated that the use of rotary files in primary teeth were efficient in terms of both preparation time and root canal shape, favoring a higher quality of root canal filling.[11]

In this study we found that the use of the rotary technique diminished instrumentation time in 63% of cases and obturation time in 68%, and it improved the quality of the filling.

Table 1. Summary of demographic variables and teeth treated per group of treatment

Groups of treatment	Sample size	Age, Median (range)	Gender Male/Female	Teeth (FDI system) 54-55-64-65-74-75-84-85
Rotary technique	20	6.0 (5.0-9.0)	11/9	0-3-0-3-4-4-5-1
Manual technique	20	5.5 (5.0-9.0)	12/8	2-1-3-1-2-5-3-3

Table 2. Instrumentation time per group of treatment (minutes)

Groups of treatment	n	Mean ± Standard Deviation	Median (range)
Rotary technique	20	11.9 ± 4.6	13.3 (2.2-17.5)
Manual technique	20	18.8 ± 6.6	17.7 (10.3-30.6)

$P = 0.002$, Mann-Whitney *U* test.

Table 3. Filling time per group of treatment (minutes)

Groups of treatment	n	Mean ± Standard Deviation	Median (range)
Rotary technique	20	1.7 ± 0.5	1.5 (0.4-3.2)
Manual technique	20	2.5 ± 0.8	2.1 (1.1-5.7)

$P = 0.009$, Mann-Whitney *U* test.

Table 4. Quality of root canal filling per group of treatment

Groups of treatment	n	Optimal	Underfilled	Overfilled
Rotary technique	20	16 (80%)	2 (10%)	2 (10%)
Manual technique	20	10 (50%)	8 (40%)	2 (10%)

$P < 0.05$, Fisher exact test.

This result is a relevant clinical factor for pediatric endodontic treatment. The use of rotary files in primary teeth has several advantages when compared with manual K files:

Promotes efficiency in both preparation time and root canal shaping, decreases working time, helps maintain patient cooperation by diminishing fatigue, improves conical shaping of the root canal and promotes a higher quality of filling, increasing clinical success.[11]

Ni-Ti endodontic instruments facilitate instrumentation of curved canals and minimize transportation. They have 2 to 3 times the flexibility of stainless steel files owing to their very low modulus of elasticity, and they show superior resistance to torsional fracture because of their ductility.[26] The flexibility of Ni-Ti instruments permits easy access to all duct systems with greater confidence, since it reduces the possibility of fracturing instruments. In this study, we used a K3 rotary system, which, due to its design, facilitates efficient and safe root canal preparation, with few limitations. Instruments can be moved smoothly down the canal without threading themselves into it; they cut well and resist torsional and cyclic fatigue.[27] This rotary system has been studied in terms of its mechanical properties, deformation, flexural fatigue, torsional overloading, fracture, number of uses, and corrosion.[28-36] Results of these studies suggest that rotary systems can be used under clinical conditions.

CONCLUSIONS

The use of rotary instruments in the pulpectomy of primary molars represents a promising technique; Ni-Ti rotary instruments have been shown to be advantageous for the pediatric patient, as chair time is significantly reduced. The positive results of our study emphasize the need for further clinical investigation. Such studies should be randomized, blinded clinical assays, so that the clinical and radiographic effects of rotary instrumentation used in pulpectomies of primary molars can be compared with a control group, and they should have adequate follow-up.

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