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EFFICACY OF TWO ROTARY SYSTEMS IN REDUCTION OF INTRACANAL BACTERIA: AN IN VITRO STUDY.

Dental Science

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ABSTRACT

Aim: The present study aimed to assess the antibacterial efficiency promoted by Protaper gold (PG) and NeoNiTi (NN) files against Enterococcus faecalis.

Methods and Material: Forty human mandibular premolars with single roots were collected and decoronated to standardize the lengths. Then specimens were mounted in resin blocks and E. faecalis suspension was used to contaminate the specimens and they were incubated for three weeks. All the specimens were divided randomly into four groups amongst which one served as the control. Instrumentation was done using NeoNiTi files (NN): Group I, ProTaper Gold (PG): Group II & Manual Crown Down technique (CD) using gates glidden drills and hand files: Group III, with sterile distilled water as irrrigant. Microbial samples were collected using paper points without instrumentation of the samples and after instrumentation from intracanal environment, which were diluted and later plated on BHI agar.

Statistical Analysis: Paired t-test and ANOVA with Tukey test were performed for intragroup and intergroup analysis respectively, in order to compare the reduction in bacterial load. $P<0.05$ was taken as the significance.

Results: Significant difference was seen amongst the experimental groups ($P<0.05$). PG and NN resulted in more bacterial reduction than CD technique ($P<0.05$) whereas PG and NN were similar in their efficacy ($P>0.05$).

Conclusion: PG and NN promoted higher bacterial reduction than CD technique, with PG demonstrating the highest antibacterial efficacy.

KEYWORDS

Protaper Gold, NeoNiTi, Enterococcus Feacalis

I. INTRODUCTION

Microorganisms that develop pulp and periapical diseases need to be eliminated during endodontic treatment [1]. These microbes especially Enterococcus faecalis may penetrate 1100µm deep into the dentinal tubules [2]. Hence there is a possibility that greater taper files could reduce more bacteria relative to smaller taper files [3].

ProTaper gold (Dentsply, Tulsa Dental Specialties, Tulsa, OK, USA) with progressive taper [4] and NeoNiTi (Neolix, Châtres-la-Forêt, France) with multiple taper [5] are two new endodontic rotary systems used in this study to compare their bacterial reduction ability with the commonly used manual Crown-Down technique (CD).

II. MATERIALS AND METHODS

A. Study Protocol:

An in-vitro observational study was conducted on 40 extracted teeth.

B. Methodology:

Forty human teeth with single roots were collected and stored in sterile physiological solution until use. The specimens were decoronated by diamond disk and root lengths were standardized to thirteen millimetres. The working length was determined by a #15 K-file (Dentsply, Maillefer, Ballaigues, Switzerland) one millimetre short of apex. Irrigation was performed with five millilitres of distilled water. Cyanoacrylate resin was used to seal the apical foramen. Nail varnish was used to cover the root surface and the specimens were fixed individually in acrylic resin blocks. Autoclaving of specimens was done at 1210C and 15 psi pressure for 15 min.

All the specimens were filled with sterile BHI broth. 10µl of Enterococcus faecalis (ATCC 29212) suspension standardized to #4McFarland scale was inoculated and incubated at 370C for three weeks. Then, the samples were divided randomly into four groups of ten teeth each. First, sterile BHI broth was filled in the canals and 15 size paper points (Dentsply Maillefer, Ballaigues, Switzerland) were inserted into the canals for one minute. The initial samples were stored in sterile BHI broth tubes with for ten minutes. Serial dilutions were prepared and plated on BHI agar medium. It is followed by incubation of plates at 370C for 48 hr and bacterial colonies (CFU/ml) were measured.

Experimental group specimens were instrumented in the following manner. In group 1, NN files were used. C1 file was used in circumferential brushing motion for coronal enlarging and A1 files (#20 & 25) were used with circumferential brushing motion till middle thirds and later pecking motion till the apex. The designed speed and torque were 300rpm and 1.5N/cm respectively.

In group 2, instrumentation with PG system was initiated with brushing movements of S1, S2 and then followed by F1, F2. The speed and torque were adjusted to 300rpm and 3N/cm, respectively.

In group 3, CD technique was used where coronal shaping was done using Gates Glidden drills (#1, 2, 3) and apical shaping was done with K-files till #25. Control group specimens were left un-instrumented. During instrumentation, 5ml distilled water was used as irrigant. 25 size paper points were used for sample collection and bacterial colonies (CFU/ml) were counted.

III. OBSERVATIONS AND RESULTS

A significant reduction in pre-instrumentation and post-instrumentation bacterial colonies was demonstrated (Table 1) in all the experimental groups ($P<0.05$) and the highest bacterial reduction was assigned to PG, followed by NN and CD respectively (Table 2). The comparison between groups showed that PG and NN demonstrated a statistically significant bacterial reduction ($P<0.05$) when compared with manual technique (Table 3). However, PG and NN did not reveal any statistically significant difference when individually compared.

Table 1: Pre-instrumentation And Post-instrumentation Colonies

Groups		Mean ± S.D (in log)
Group 1(NeoNiTi)	Pre-instrumentation	7.40 ± 0.02
	Post-instrumentation	5.60 ± 0.02
Group 2(Protaper Gold)	Pre-instrumentation	7.40 ± 0.01
	Post-instrumentation	5.39 ± 0.01
Group 3(Manual Crown-Down method)	Pre-instrumentation	7.38 ± 0.01
	Post-instrumentation	6.16 ± 0.01

Table 2: Percentage Bacterial Reduction

Group	% Bacterial reduction
Group 1	97.7
Group 2	98.3
Group 3	93.2

Table 3: Level Of Significance Between Groups

Groups	*P* value
Group 1vs 2	>0.05
Group 1vs 3	<0.05
Group 2vs 3	<0.05

IV. DISCUSSION

Microorganisms can gain access into the dentinal tubules via dentinal cracks, dental caries or due to microleakage around restoration margins which lead to coronal and radicular pulpal infections [11,12].

Therefore, endodontic treatment mainly focuses on reducing intracanal bacteria which inturn influences the treatment outcome [13]. Hence, it is necessary to achieve a low bacterial load which further enhances healing of peri-radicular tissues [14]. During treatment, chemo-mechanical debridement using endodontic instruments and chemicals (irrigants) is done to eliminate most of the microbes to create a sterile environment required prior to o bturation [15].

The present invitro study focused on the bacterial reduction efficacy of two different rotary systems used in the root canals. PG system consists of three shaping files (SX- #19, S1- #18, S2- #20) and five finishing files (F- #20, F2- #25, F3- #30, F4- #40 and F5- #50) with varying tapers [4]. NN system consists of one C1 and three A1 (with #20, #25 and #40 tip sizes) files. Wirecut electrical discharge machining (WEDM) process, a newly developed fabrication method was used to manufacture these files [5].

The plate culture method because of its efficiency and simplicity was used in this study [7-10]. And also a similarity was demonstrated between the plate culture and quantitative Polymerase Chain Reaction method [6]. *E. faecalis* shows higher resistance to antibacterial agents and penetrates deeper into dentinal tubules [16-18]. Literature also shows that, often the bacteria from the genera *Enterococcus* and *Streptococcus* initially invade the dentinal tubules [11]. Hence *E. faecalis* was selected as the experimental organism.

Both rotary systems PG and NN promoted a higher bacterial reduction when compared to the manual crown-down technique using G.G drills and hand files. The convex triangular cross-section progressively changing helical angle and pitch may be responsible for greater (98.3%) reduction of bacteria. NN accounted for 97.7% bacterial reduction, which may be attributed to its non-homothetical rectangular cross-section and varying taper. The obtained results, demonstrated that the difference was not statistically significant between the two compared rotary systems. But both the systems showed a statistically significant difference when compared to manual technique (93.2%). The results obtained for CD technique are in accordance with study conducted by Machado et al. 2017 [19].

Significant bacterial reduction was achieved with the mechanical action of instruments alone without even using any antibacterial irrigants [20-22]. Previous studies showed that the root canal microbes were reduced due to antibacterial activity of irrigants [23,24]. Instrumentation was performed without using EDTA to avoid its additive antibacterial action. Furthermore, distilled water which has no antibacterial efficacy was used as irrigant in the present study [19]. Some other studies have showed that irrigants such as chlorhexidine and sodium hypochlorite reduced the bacterial count to almost zero in the immediately collected samples [25-27]. Furthermore, in debriding the root canal, activated irrigation may play an important role [28,29]. Hence, different irrigation protocols using various chemical substances should be considered for further studies.

V. CONCLUSION

It can be concluded that in infected canal roots, rotary systems promoted a higher bacterial reduction than the manual technique. Mechanical instrumentation during root canal cleaning and shaping plays a major role in reducing the pathogens that harboured the root canal system. But it does not necessitate the elimination of active use of irrigants which provides additional benefits.

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