

# Comparison of Two Rotary Systems in Root Canal Preparation Regarding Disinfection

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## Abstract

**Introduction:** The aim of the present study was to determine the disinfection of preparations carried out by using the Protaper or Mtwo system in canals infected with *Enterococcus faecalis*. **Methods:** Twenty-eight distobuccal canals of upper molars were used, in which the canals were sterilized after being enlarged to #20 file and then contaminated with an inoculation of a culture of *E. faecalis*. After the incubation period, bacterial samples were collected and were seeded on plates for analysis of colony-forming units (CFU)/mL. The teeth were divided into 2 groups according to the rotary system used for instrumentation; 2 noninstrumented teeth served as the control group. Then bacterial samples were collected and were seeded on plates for analysis of CFU/mL again. The data obtained were evaluated by the Wilcoxon and Mann-Whitney *U* tests. **Results:** Bacterial reduction was 81.94% and 84.29%, respectively, in ProTaper and Mtwo systems, and there was no statistically significant difference ( $P > .05$ ). **Conclusions:** Both systems, ProTaper and Mtwo, reduced the amount of bacteria in the mechanical disinfection of the root canal system, demonstrating that they are suitable for this purpose. (*J Endod* 2010;36:1238–1240)

## Key Words

Disinfection, endodontics, *Enterococcus faecalis*

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During the last decades, endodontics has seen innumerable advances and applications of technological resources with the aim of improving the prognosis of treatment, increasingly contributing to the preservation of teeth. One of the new resources that stand out is rotary instrumentation made of nickel-titanium components, featuring the ability to afford a uniform preparation and in less time, consequently reducing work fatigue and stress imposed on the patient.

Among the various rotary systems developed, the ProTaper system stands out; consisting of progressively tapered files in the same instrument, it has been widely popularized and used (1). Compared with other rotary systems, it is significantly faster in instrumentation (2), resulting in more tapered preparations, mainly in the cervical and middle thirds (3, 4).

Another prominent system is Mtwo, which differs from ProTaper because of its fixed conicity. Comparison with other rotary systems also showed more agility in the surgical procedure, resulting in preparations following more closely the original curvature of the canal (5, 6), and a capacity for penetration and cutting superior to the others (7).

Studies comparing the preparations produced by ProTaper and Mtwo systems versus other systems have shown that there are no significant differences (8), but both ProTaper and Mtwo produce more tapered preparations, clean and free of debris, mainly in the cervical and middle thirds, in relation to the other systems compared (9, 10).

However, there are concerns as to the effectiveness of these instruments, principally with respect to providing an adequate disinfection, because although showing interesting clinical performance, they are maneuvers that need to be checked.

There have been previous studies on bacterial disinfection, in which older systems were compared with the manual technique, showing no significant difference (11–14). However, a comparative study between manual and rotary instrumentation has shown that stainless steel file sizes #35 and #40 caused significant apical transportation, and rotary instrumentation proved safe for apical preparation, with little deviation (15). However, there have been few such studies in relation to newer systems.

Because of infection of the root canal system and the microbiotic diversity present, studies have called attention to *Enterococcus faecalis* as a result of its high degree of resistance; in many cases, this microorganism is not eradicated by traditional methods of instrumentation and disinfection (16), appearing to be one of the most common factors accounting for persistent lesions in the periapical region in unsuccessful endodontics (17).

Therefore, the aim of the present study was to determine the disinfection of preparations carried out by using the Protaper or Mtwo system in canals infected with *E. faecalis*.

## Material and Methods

For analysis of the distobuccal canal of upper molars, 28 upper molars were used, in which the root was sectioned and the distobuccal canals were instrumented 1 mm from the apical foramen, beginning with a #8 K file up to a #20 K file (Dentsply-Maillefer, Ballaigues, Switzerland), irrigating with only water. The apical foramen was sealed with cyanacrylate (Henkel, São Paulo, Brazil), and later the teeth were mounted in

plaster (Aster, São Caetano do Sul, Brazil) and placed in 50-mL Falcon plastic tubes with buffer to be sterilized in an autoclave.

The tubes containing the sterilized samples were opened in a laminar flow hood and then contaminated by an inoculation with a culture of *E. faecalis* (ATCC 29212) by using a sterile #15 K file to transfer the bacterial suspension throughout the canal.

The specimens were placed in their respective tubes and incubated at 37°C for 72 hours in an incubator; 24 hours later, the canals were filled again with TSB culture broth to determine bacterial survival.

After the incubation period and again in a laminar flow hood, the teeth were removed from the tubes, and the canals were filled with sterile peptonated water. Samples were then collected by using 3 sterilized #20 paper points (Dentsply-Maillefer, Petropolis, Brazil) for 10 seconds each, where they were stored in Eppendorf tubes containing 1 mL of peptonated water for serial dilutions.

For quantitative bacterial assessment, each dilution was seeded on plates containing m-*Enterococcus* agar medium (Difco, BD, Franklin Lakes, NJ), which were incubated at 37°C for 48 hours, at which time the CFUs were counted.

The teeth were divided into 2 groups (n = 13), according to the rotary system used for instrumentation. ProTaper group represented the ProTaper system (Dentsply-Maillefer, Ballaigues, Switzerland) and Mtwo group the Mtwo system (VDW, Munich, Germany); 2 teeth were not instrumented and served as the control group until the final experiment for the purpose of demonstrating the sterility of the canals.

All procedures were carried out by a single investigator, and each rotary kit, always sterilized, was used for the preparation of no more than 4 canals.

Thus, the canals were shaped by using sterile distilled water that was renewed with every change of instrument and irrigated with 5 mL of the same water at the end of the preparation.

Instrumentation with ProTaper system was carried out according to Machado (1). The cervical third was previously straightened with Gates-Glidden 1, 2, and 3 drills. The instrument sequence SX and S2 was used, with the motor activated by brushing movements; and the sequence S1, S2, F1, F2 was used to instrument the middle and apical thirds, where the files are first introduced manually to eliminate tension points and then introduced by activation with passive pressure movement (1).

Mtwo was carried out according to the manufacturer's instructions in the sequence 10/.04, 15/.05, 20/.06, 25/.06, 30/.05 introduced directly into the working length with slight movements back and forth, gradually increasing the pressure in the apical direction. The canal was again filled with peptonated water, and new samples were collected with sterile paper cones for later plating and CFU counting.

The data obtained for the samples were evaluated before and after instrumentation and submitted to statistical evaluation by the Wilcoxon and Mann-Whitney U tests at a 5% level of significance.

### Results

Analysis of the results showed that the 2 groups, ProTaper and Mtwo, did not differ significantly ( $P > .05$ ). In the comparison of the

quantitative reduction of *E. faecalis*, both demonstrated a significant mean reduction, in which the ProTaper system produced a 81.94% decrease in CFUs and the Mtwo system 84.29% (Table 1).

With regard to the positive control group, there was no detectable bacterial growth, thereby demonstrating the sterile condition of the root canal system before contamination with *E. faecalis*.

### Discussion

There is currently much discussion about how much the apical region should be enlarged to achieve the expectations of this step in endodontic therapy. Some investigators have found similar results in relation to the amount of surgical preparation of the root canal, showing no significant differences between a more conservative preparation and one with greater enlargement (18).

However, the precariousness of studies related to rotary systems that are more recent and of different configurations have stimulated studies to determine whether the aims are in fact achieved with regard to the performance, safety, and viability of these new materials and resources.

ProTaper and Mtwo are rotary systems that have different characteristics with respect to their conicity; the former is progressive and the latter is constant. Both have shown excellent results with respect to preparation and amount of time required (2, 5, 6, 9, 10), which has prompted the comparison of the two in relation to the extent of disinfection of the root canal system.

In the present study, the distobuccal canals of upper molars that were chosen for study are of particular interest, because they make up part of the tooth group with a high incidence of endodontic treatments. Furthermore, the anatomic conditions facilitate the standardization of the samples because they have a single root canal, which in most cases is circular, and at the same time, the difficulties in therapy can also be observed, such as access, curvature, and other incidental factors that are typical in molars.

The apical preparation size is very important, because a smaller diameter leaves more canal surface untouched, which might affect the ability to disinfect root canals (19). Although instrumenting canals to larger sizes might not be prudent in every case, minimal apical preparations based on clinical opinions are far more detrimental to the success of root canal therapy (20).

The technique of Machado (1) used here is justified because it shows lower rates of fractures of instruments; previous utilization of Gates-Glidden drills in the preparation of the cervical third of canals alleviates the tensions exerted by the walls of the canals on the instruments, which is encountered in the preparation of the apical region (1).

After the advent of rotary instrumentation, the torque used by motors on the instruments and the number of rotations completed for each instrument changed the interpretation of wear in apical region. With manual instrumentation, the quality of disinfection is associated with the number of instruments used in the preparation of the canal, and the choice of main cone is related to the caliber of the last instrument. However, rotary instrumentation such as ProTaper, when combined with Gates-Glidden drills, shows some particular

**TABLE 1.** *Enterococcus faecalis* Reduction before and after Instrumentation

Group	n	Before instrumentation (CFU/mL)	After instrumentation (CFU/mL)	Percent reduction
		Mean ± SD	Mean ± SD	Mean ± SD
ProTaper*	13	$7.05 \times 10^5 \pm 12 \times 10^5$	$5.2 \times 10^4 \pm 1 \times 10^4$	$81.94 \pm 21.47$
Mtwo*	13	$1.0 \times 10^6 \pm 1.6 \times 10^6$	$1.2 \times 10^4 \pm 2.4 \times 10^4$	$84.29 \pm 21.61$

SD, standard deviation.

\*Significant difference ( $P < .05$ ).

characteristics. For example, when the preparation of the apical region is concluded with an F2, a #30.06 cone can easily be introduced, and to achieve this with the Mtwo system, the preparation should be carried out with an additional instrument, #30. The verification of the apical enlargement is then no longer related to the caliber of the last instrument, but rather to the apical diameter of the gutta-percha cone that fits this region. Therefore, the finalization with F2 makes it possible to obtain apical enlargement corresponding to a #30 point, and the fitting of the 30.06 cone has shown better results in preparations with F2 (1).

The use of *E. faecalis* is justified because this bacterium is present in persistent endodontic infections and is very resistant to protocols for the treatment of the root canal (16, 17, 21). This bacterium significantly penetrates the interior of dentin tubules as a consequence of the collagen's attraction for this microorganism. Besides a greater dentin penetration, this bacterium can develop better conditions for survival in the root canal system, where it has been observed to persist for periods of 4 weeks to as long as 12 months inside the tubules, even in obturated canals (22–25). Moreover, this model is important because one of the difficulties found in carrying out an investigation involving endodontic microbiota is its polymicrobial nature, where half of the microorganisms present in this ecosystem are unculturable (17).

Substantial reductions in bacterial counts were seen here in canals prepared by using rotary instruments, as found in the literature involving rotary systems (11–14, 26, 27), demonstrating outstanding performance of the instruments evaluated. However, it should be pointed out that none of the samples were found to be totally free of microorganisms, which corroborates the existing literature and reaffirms the necessity of the combination of surgical preparation and chemical disinfectants (18, 28).

Thus, it is concluded that both systems, ProTaper and Mtwo, significantly reduce the amount of bacteria in the mechanical disinfection of the root canal system, demonstrating that they are suitable for this purpose.

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