Evaluation of the level of safety of three instrumentation systems to prepare curved canals

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ABSTRACT

The issue of security in three systems of instrumentation for the preparation of curved canals is analyzed by presenting a study about apical deviation and instrumental fracture in the preparation of curved canal. The authors wished to compare the Quantec, Profile 04 Maillefer and Profile 04 series 29 Tulsa systems for safety. Thirty inferior molar mesio-vestibular canals were divided into three groups of ten as follows: Group I (the Profile 04 Maillefer system), Group II (The Quantec system), Group III (the Profile 04 series 29 system). Superposition of pre and post-operatory X-rays, drawings and projections, measurements of distance from the tip of the instrument before and after preparation were used to provide an analysis of this topic. Results showed that the Quantec system was the one with a lesser degree of deviation followed by the Profile 04 Maillefer system. The worst results came from the Profile 04 series 29, although the difference was considered statistically insignificant. Five fractures were spotted: two in the Profile series 29 and there in the Profile 04 Maillefer.

Key Words: Endodontics, root canal, therapy, dental instrumental.

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INTRODUCTION

In endodontic therapy, instrumentation is a very important phase since it cleans and molds the root canal aiming to favor the next step, i.e., the obturation, or filling.

During molding, a fundamental requisite for the instrument and for the technique of instrumentation is not to alter the original path of the root canal. This objective is particularly difficult when the dentist is facing a canal with curved roots where a tendency for deviation and perforation is marked. Therefore, it is important to develop more flexible instruments and also to seek for safer techniques which reduce accidents in this step of the procedure.

The introduction of nickel and titanium instruments (Walia et al., 1988) has launched a new perspective in the solution of this problem. Due to the fact that these instruments show a "plastic memory" and high flexibility, that is, do not undergo alteration and adapt well to the root canal with less tendency to deformation, these instruments have demonstrated to be safer, besides being more resistant to corrosion and to stress (Serene et al., 1995).

These characteristics of nickel-titanium have also promoted the development of rotator systems such as the Quantec system and the Profile (Maillefer and Series 29 from Tulsa).

However, it is important to note that it is not only the steel that is responsible for the success of an instrument in preparing curved root canals, but also its intrinsic characteristics regarding the penetration guidance, the orientation of its cutting blades and its design.

Therefore, rotatory instruments, as the one mentioned, the Quantec and Profile systems show different characteristics regarding their engines and assigned rotation.

Taking this into consideration, one may question if there is a difference in terms of safety, that is, which system is safer to the clinical practice. Therefore, the aim of this study is to compare the systems (Quantec, Profile Maillefer and Profile Series 29 from Tulsa) regarding the safety while preparing curved root canals, evaluating deviations and cases of fractures of the instrument.

MATERIAL AND METHOD

It was developed a special device to maintain the tooth included in a resin block and the film in a same position to be x-rayed. Thirty mesial curved roots (curvature of 30º as measured by the method of Schneider) of inferior molars were included in resin blocks and afterwards x-rayed with a file K #10 (Maillefer, Baillanges, Switzerland) in the length of the working area. Afterwards, roots were separated in three groups of ten teeth each according to the system used, as follows:

Group I: Profile Maillefer system (Maillefer, Baillanges, Switzerland). In the instrumentation of this group it was used the Novvage motor at 250 rpm, with the crown-down technique according to the instruction of the manufacturers and determining, as term of memory, the instrument # 25 and conicity 04;

Group II: Quantec system (Tycom, California, USA). In this group the motor was the NT matic II (Nt Company, California, USA) at 300rpm, being the cervical preparation established with the instrument number 1 with conicity 06 and extremity 25. The memory instrument was the number 6 that has extremity 25 and conicity 04 and stepbacking the other instruments (from 7 to 10).

Group III: Profile system series 29 (Tulsa Dental Products, USA). In the motor used was the same as for group I and with the same rotation. For cervical preparation it was used Orifice Shaper 30/06 e 40/06. Afterwards it was used the instruments 2(D0-0.129), 3(D0-0.167), 4(D0-0.216) e 5(D0-0.279) in the actual length of the working area and regressive stepback was proceeded.

During all the instrumentation phase the canals were irrigated with saline solution.

After instrumentation the teeth were x-rayed in the mentioned device with a file K-flexofile (Maillefer, Baillanges, Switzerland) inside the canal. The pre and post instrumentation x-rays were overlapped, mounted in frames and projected in a wall with a magnification of 20 x. Drawings and deviations were obtained with the aid of a rule. Results were divided by 20 to conversion in millimeters. Data were statistically analyzed by test of variance to a criterion of global comparison and the test of Tukey-Kramer to the confrontation of two by two. It was also determined the number of fractured instruments.

RESULTS

TABLE I shows the average in millimeters and standard deviation of the studied groups. In the statistical analysis there was no significant statistical difference.

TABLE II shows the number of canals where instrument fracture has occurred in each studied group.

TABLE 1 – Average in mm and standard deviation of studied groups

Group	Average	Standard deviation
Profile 04 Maillefer	0.32mm	0.2
Quantec	0.27mm	0.17
Profile 04 série 29	0.45mm	0.30

TABLE 2 – Number of canals showing fracture of the instrument according to the group

Group	Canal with fractured instrument	Number of instrumented canals
Profile 04 Maillefer	3	10
Quantec	0	10
Profile 04 serie 29	2	10

DISCUSSION

Nickel-titanium instruments showed to be safe and resistant in comparison to stainless steel instruments and, additionally, safer in the preparation of curved canals (Bishop; Dummer 1997, Duarte et al. 1998a). Since these instruments are safe, resistant to rotation, endure stress and show greater resistance to corrosion, nickel-titanium motor powdered instruments were developed such as the Profile Maillefer and the Tulsa series 29, Quantec, Pow-R, Light-speed systems. They vary according to the diameter, conicity and size of the active part, shape of the penetration guidance and design. There is scarce information in the literature regarding the comparison of these three methods although there are papers discussing each one individually.

In this study, the Maillefer Profile, the Profile series 29 from Tulsa and the Quantec system were compared. Both Maillefer and Tulsa Profile systems have similar design with blades of radial cutting edge and null cutting angle and both with conicity 04 and 06, although in this study only the 04 was used. On the other hand, the Quantec system has a different design with cutting angle slightly positive, a heavier mass in the periphery of the blades and a conicity ranging from 02 to 06.

Contrary to a study by Thompson & Dummer (1997a) it was found two cases of instrument fracture with the Profile series 29 system. Those authors had not a single case of instrument fracture in a series of 40 canals simulated in resin block. It is important to note that in the present study natural teeth were used which dentin shows a marked difference in hardness if compared to resin. This difference could be the cause of such variation in fractured instruments. For the Maillefer Profile systems, the fracture index was 3. Bryant et al. (1998a), while making instrumentation of 40 simulated blocks, had three cases of instrument fracture and deformation of three, despite the small number if compared with the present study, the cause could be the same, that is, the difference in hardness between dentin and resin is the main factor.

Regarding the Quantec system, there was no instrument fracture in 10 instrumented teeth. Thompson & Dummer (1998a) have instrumented forty resin blocks and have observed fracture in one instrument and deformation in three, demonstrating therefore a low index of fracture and greater safety in this regard.

Reason for low incidence of instrument fracture with Quantec system, in comparison to both Profile systems, may be attributed to the different design of the instruments. While the Profile systems have a radial blade and small metallic mass to bear these blades, the Quantec has a cutting angle slightly positive which may favor the cutting process and produce less tension in the instrument, and greater metallic mass to support the blade (Korzen 1996). Another factor that favors a lower fracture index is the instrument's exchange system that is simpler in the Quantec than the others, diminishing the risk for fracture.

Concerning apical deviation, it was noted a smaller incidence with Quantec, followed by Maillefer´s Profile and the worst results were shown with Profile series 29, although no significant statistical difference was found among the three systems. Bonetti Filho & Tanomaru Filho (1999) while studying the Quantec system have observed adequate safety. On the other hand, Thompson & Dummer (1998b) observed a significant number of transport and four perforations while using Quantec in resin blocks. These authors have suggested the guidance design as the cause for this greater index of deviation. Another reason could be the fact that the authors used file # 9 as memory instrument, which has a diameter 40 while in the present study it was used the file #6 with diameter 25.

For the Profile systems, Maillefer and series 29, the deviation was greater if compared to Quantec system. Although there is no significant difference. This fact may be attributed to the simplicity for changing instruments in the Quantec system, and its design that has a smaller metallic mass in its central axis favoring a smaller tension against the external wall. Thompson & Dummer (1997b), evaluating the Profile series 29 system, have observed a low index of deviation that is contrary to the findings of the present study. Bryant et al. (1998b) have observed an important number of deviation with the Maillefer Profile system but with low values for deviation, around 0.1mm, which differ from the values of the present study (0.32mm).

Comparing both Profile systems, in terms of deviation, the Maillefer one was slightly safer as related the series 29. This fact could be explained by alterations in the quality of the steel used in its manufacture.

Regarding to speed, for the Profile systems it was used the one recommended by manufacturers (250rpm). For the Quantec systems, the speed was lesser than the recommended (300 rpm). Concerning the influence of velocity, Gabel et al. (1999) have observed a smaller index of fracture in lower rotations with the Profile system.

As per the methodology, the use of teeth and X-rays for such analysis has been widely recommended (Esposito; Cunningham 1995; Duarte et al 1997a 1997b) and this was the reason for using such methodology in this study. The use of resin block would favor standardization but is far from the clinical reality, since the resin has different hardness. Thus, results should be interpreted with caution.

CONCLUSIONS

a) There was no fractured instrument in the Quantec system, whereas it has occurred in the Profile systems;

b) Quantec system favored a minor deviation index regarding the Profile systems, although no significant difference was recorded;

c) Deviation was slightly inferior with Maillefer Profile than with Series 29 Profile system.

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