

The advantage of mechanical root canal preparation using Ni - Ti rotary instruments for smoothing the third apical wall

Badi Soerachman, Endang Sukartini, Dudi Aripin

Department of Conservation Faculty of Dentistry Universitas Padjadjaran

ABSTRACT

Canal wall preparation achieved by smoothness. Objective of this study was to determine smoothness differences of nickel titanium manual instruments compared with nickel titanium rotary instruments in apical third region canal wall. This study was a quasi experimental research conducted by in vitro method on 30 single rooted upper permanent incisive that have been extracted. They were randomly divided into two group (n=15) and each group root canal teeth were cleaned and shaped with manual rotary nickel titanium instruments. Roughness analyzed used with Mitutoyo roughness surface instruments. Every sample analyzed in apical third region canal wall. Data have been analyzed with t test. The result of study showed that different smoothness for every sample after preparation by manual and rotary. In conclusion, from this study showed those instrumentations with rotary nickel titanium will give the best smoothness than manual nickel titanium instruments.

Key words: Smoothness, nickel titanium, preparation

ABSTRAK

Preparasi saluran akar yang baik menghasilkan dinding saluran akar yang halus. Tujuan penelitian ini adalah untuk mengetahui perbedaan kehalusan dinding saluran akar pada sepertiga apikal hasil preparasi secara manual dan rotari menggunakan instrumen nikel titanium. Jenis penelitian ini adalah eksperimental semu yang dilakukan secara invitro. Penelitian dilakukan dengan membagi sampel menjadi dua kelompok, masing-masing terdiri dari 15 sampel. Setiap kelompok diberi perlakuan yang berbeda kelompok pertama sebanyak 15 buah sampel gigi insisif dilakukan preparasi secara manual. Kelompok kedua yang terdiri dari 15 buah sampel gigi insisif dilakukan preparasi secara manual. Kemudian dilakukan uji kehalusan dengan menggunakan alat uji Mitutoyo Roughness Surfaces Instruments. Setiap sampel diuji pada sepertiga apikal. Data dianalisis secara statistik menggunakan t test. Hasil penelitian menunjukkan terdapat perbedaan kehalusan tiap kelompok hasil preparasi secara manual dan rotari. Simpulan dari penelitian ini adalah preparasi secara rotari mendapatkan permukaan dinding saluran akar yang lebih halus.

Kata kunci: Kehalusan, Nikel Titanium, preparasi

INTRODUCTION

Root canal treatment is a procedure aiming in maintaining tooth function whilst keeping the tooth to remain sterile. Stages of root canal treatment is preparation that includes shaping the root canal, cleaning and disinfection, and filling the root canal.¹ Root canal treatment outcome is moreover depends on the quality of the canal preparation, copious use of irrigation solutions, and root canal filling seals, especially on the apical third.²⁻⁴

One way to prevent failures in endodontic treatment is to make a good preparation and instrumentation. Thompson et al.⁶ reported that a new generation of endodontic instruments made from nickel titanium, either manually or by a rotary, have much higher flexibility compared to stainless steel and can produce a smooth wall of the root canal and are able to maintain its original canal curvature. Smoothness of the root canal walls need to be considered to facilitate the flow of irrigation material, removing dirt from the root canal, as well as to get a better adaptation of root canal filling material.^{5,6}

Nickel-titanium instruments are designed with standard taper and a different length of files, such as the form of a positive cutting angle, without radial land, progressive blade on the apical and coronal with non cutting tip. This design provides ease of preparation and enables to follow the shape of the root canals with various diameter file ends. Files can perform a more specific cutting action in the canal, resulting in a clean and smooth root canal walls.^{7,8}

Root canal preparation can be done manually using hand instruments or by using rotary instruments. According to Mayers⁹, rotary nickel-titanium instruments produce smooth surface of the root canal walls and are able to maintain root canal curvature in accordance to the original even if used in a curved root canal. Another opinion stated that the preparation of root canals manually produce a more cleaner and smoother surface than using rotary instruments.^{10,11}

Based on some of the above reasons, the author is interested to compare the difference in

smoothness of the root canal walls in the apical third of the preparation with nickel-titanium instruments manually and rotary.

MATERIAL AND METHODS

Criteria of the population in this study were: single-rooted teeth; tooth root curvature ≤ 200 ; fully formed apices; There was no fracture line at the root; There is no root resorption; no root canal obstruction; There is no root caries; had never been treated endodontically; were able to be entered file # 10 to the root end. 30 samples were taken randomly and were divided into 2 groups, according to two kinds of treatment: manual root canal preparation and rotary.

Controlled variables in this study were: File SS # 10 to open a root canal, one file was used to open 5 root canals according the manufacturer's instructions; root canal preparation was performed using a crown down technique. Irrigation solution used was 2.5% NaOCl as much as 2 ml after each file used; Lubricants EDTA pasta was used 1 drop for each file; Paper point for drying the roots according to the last file number in all samples of teeth; irrigation needle used was maxi probes 28G; instrument used to cut the crown was the carborundum separating disks, one disk was used to cut two teeth; tool for splitting the root of the tooth were chisel and mallet; round file for manual and file for rotary motion; and manual and rotary lap time.

Thirty extracted teeth were immersed in 2.5% NaCl physiologic solution. The remaining soft tissue and tartar attached to root and crown surface were cleaned using ultrasonic scaler. Teeth were then reimmersed in physiologic solution soon after cleaning, until the time when they were used as the study sample as to prevent dehydration that might damage the dental tissue structures. Teeth were marked at the cement enamel junction (Figure 1).

Crowns were then cut at the CEJ line with a diamond disk (Intensive SA, the Swiss Dental Products) using high-speed handpiece (NSK). Cutting the coronal enabled easier access for preparation.

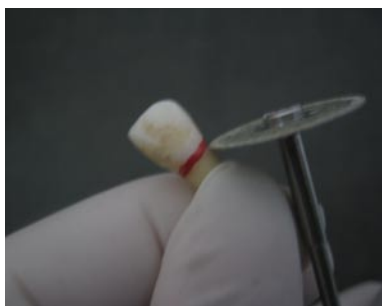


Figure 1. Marked tooth at the cemento-enamel junction boundary with coronal cuts with a corborundum separating disk.

Manual and rotary root canal preparation

Prior to root canal preparation, working length was determined. File SS # 10 (Dentsply, Maillefer, Tulsa Okla.) was used to trace the root canal to the apex, and a rubber stop is placed at the reference point. Length between the tips of the file to the stop was measured. The working length was 1mm short to the the length. Teeth were molded in a wax and plaster blocks. Preparation began with a file manually S1 (Dentsply, Maillefer, Tulsa Okla.) that were previously lubricated with EDTA paste along 2/3 the working length with a circular motion clockwise until the root canal

feels loose. Followed by file S1, S2, F1, F2, F3, F4, F5 at working length; every turn of the file, 2.5% NaOCl solution as much as 2 ml were used to irrigate the canal after each file; canals dried with sterile paper points size F5. Orifice was sealed with wax to prevent contamination of dirt. Rotary preparation were performed using X-smart Electric Motor (Dentsply, Maillefer, Tulsa Okla.) set in 250 rpm, with 5 Nm torque as stated according to the manufacturer's instructions. S1 file preparation that was initially used along 2/3 of the working length followed S1, S2, F1, F2, F3, F4, F5 files according to the length of work to the working length; every turn of the file, 2.5% NaOCl solution as much as 2 ml were used to irrigate the canal after each file; canals dried with sterile paper points size F5. Orifice was sealed with wax to prevent contamination of dirt.

All samples were marked buccopalatally using markers and grooves were made on the line with a diamond fissure bur (Dentsply, Maillefer, Tulsa Okla.). The teeth were split into two equal part using chisel and mallet. Each part of tooth was selected and prepared for image examination using Mitutoyo SJ 301 Instrumens Roughness Surfaces.

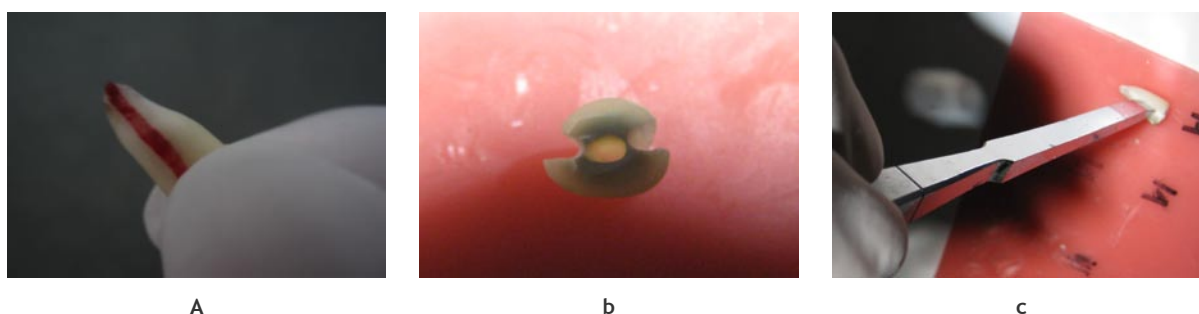


Figure 2 A. Root of the tooth marked at the mid-buccal and palatal with a red marker; B. Grooves was made a on the buccal and palata part; C. Teeth splited into two parts.

Root canal smoothness evaluation

Edge of the teeth samples that have been split were flattened with a corborundum disk using low-speed hand piece, and then were placed on the tool-flops with a height position parallel to the motor probe. The position of the sample must be aligned with the direction of transverse movement of the probe. Press the start button to run the motor with probe so that it can move

back and forth one-time along the sample size to be measured and their length of work had been predetermined. Graphs appear in the form of the surface roughness value of the surface roughness (Ra) measured. Statistical test used was t test statistical analysis. The study was conducted at the Faculty of Dentistry Dental Clinic Unpad Conservation. Research on the smoothness of the root canal walls was conducted in the Metrology Laboratory ITB No. Jl Ganesha 10.

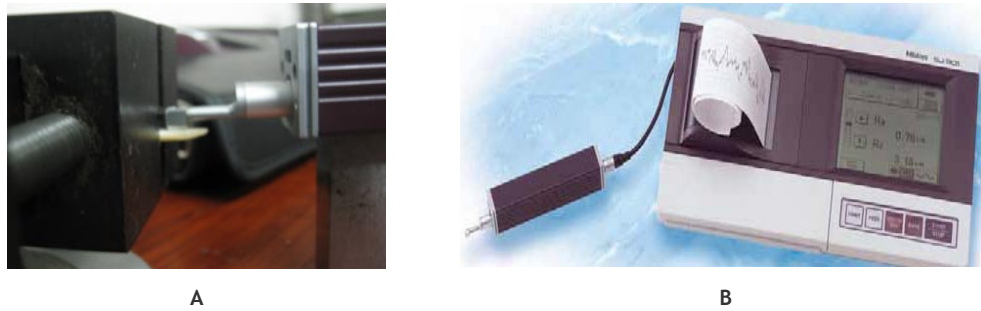


Figure 3. A. Teeth fixed on tool-flops B. Mitutoyo SJ 301 roughness surfaces instrument.

RESULT

Study on differences in surface smoothness of the root canal walls in the apical third after prepared using nickel-titanium instruments manually and rotary was carried out on 30 samples of randomly selected teeth and divided into two treatment groups (n = 15). Each group of samples was prepared, using nickel-titanium instruments manually on the first group, and rotary instruments in the other. Prepared samples were split vertically in the buccal palatal direction using a chisel and mallet. Smoothness values were calculated along the canal wall 4 mm of apical root canal. The smoothness observation was conducted using surface roughness Mitutoyo instrument.

The average value of smoothness in the preparation of manually and rotary were as follows: The average value of smoothness of the Manual preparation was 1.57, and Rotary was 2.48. From the results of statistical calculations, the value t count was -7.44, smaller than t table; in conclusion, there is a statistically highly significant difference in smoothness / means that there are

significant differences in the smoothness the walls of the apical third of root canal preparation results manually and with rotary use of nickel titanium instruments. In the diagram, both of root canal preparation were shown in Figure 4. as follows:

DISCUSSION

The results of this study showed there is significant difference in the smoothness of the root canal walls in the apical third between manual and rotary preparation. The average value of smoothness of the Manual preparation was 1.57, and rotary was 2.48. Smoothness the root canal walls in rotary preparation gave better average value.

Factors that determine the success of root canal treatment include root canal walls smoothness. Cleanliness of debris and vital or necrotic pulp tissues will eliminates microorganisms and the canal walls become smooth, therefore, hermetic obturation could be achieved.¹²

Mechanical and chemical preparations are the most important stage during root canal treatment. There are inter-related factors, namely mechanical action of the instruments and chemical action of the irrigation solution. In order to obtain a smooth and clean root canal surface free from organic and inorganic debris, and mechanical action required irrigation solution by using 2.5% NaOCl.¹¹

The results of this study showed average value smoothness of the root canal manual walls is greater. Preparation of manual movements is performed clockwise and counter-clockwise and requires sensitive hand motions. Apical pressure requires simultaneous pressure and cracks the rotation in opposite directions to balance the

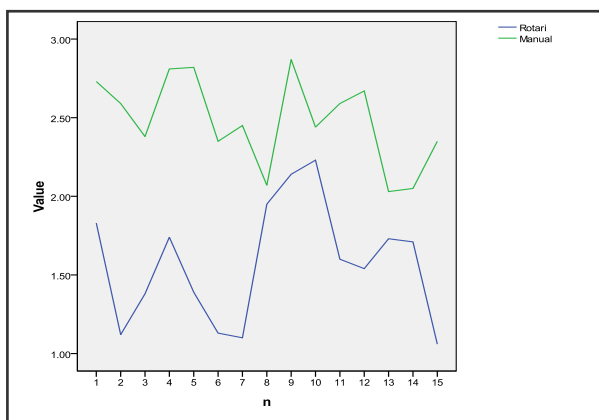


Figure 4. Smoothness value line diagram of root canal walls preparation result manually and rotary.

tool tip in the root canal. Root canal manual preparation has a weakness; caused the erosion of the hard canal wall and limited motion so that the root canal preparation become common long ledge / perforation, canal wall surfaces become rough and less efficient cleaning.¹³

Manual preparation techniques require much time and can lead to iatrogenic factors. In that situation, more dentists prefer to use a rotary. Several studies have reported that nickel-titanium rotary instruments are effective to create ideal smoothness and shape with minimal risk of root canal ledge and transport.¹⁴

The average value of the rotary smoothness was smaller due to the work system which has a rotary motion of 360°, resulting in a way that simultaneously form part of the canal wall. Continuous rotational movement (continuous rotating movement) is very influential in the root canal preparation. Rotary preparation directly centered on the area to be prepared so that the instrument can move quickly and safely, thus increase root canal cleaning and shaping¹¹ rotary tool is quicker and easier to erode, causing maintenance procedures become more efficient and effective and can shape and clean the root canal so that a shorter treatment time is needed.¹⁵

A rotary nickel titanium instruments have two kinds of movements that occur at the time of preparation of the movement back and forth movement with light pressure on the apical and lateral movement without putting pressure on the instrument tip which is centered in the middle of the root canal that will produce clean root canal wall.¹⁶

This study used teeth that have met the criteria incisive of samples with a single and straight root, to avoid difficulties or obstacles in performing root canal preparation and expected to get the preparation that is really clean and smooth, and reduce differences in treatment between the instrument rotary and manual. Prepared and splitted incisives were examined under surface roughnes MITUTOYO instrument. This has limited movement as there are apical foramens in the lateroapical and curved root canal.

CONCLUSION

This study showed that there is a significant difference between the use of manual files and rotary files in the smoothness of the apical third of root canal. Root canal preparation using rotary files showed a smoother root canal wall surface than the manual preparation.

REFERENCES

1. Grossman LI. Ilmu endodontik dalam praktek. 11th ed. (Rafiah Abyono). Jakarta: EGC.; 1995. p. 220-45.
2. Hedriyanto W. Apikal leakage akibat teknik kondensasi vertical dan lateral pada pengisian saluran akar dengan gutta point. Yogyakarta: Lustrum V UGM;1995. p. 109.
3. Weine FS. Endodontic therapy. 4th ed. St.Louis: Mosby Co; 2004. p. 195-7,209-12,445-69.
4. Tasdemir T, Aydemir H, Inan U. Canal preparations with hero 642 rotary Ni-Ti instrument compared with stainless steel hand K-file assessed using computed tomography. Internat Endod J. 2005;38:402-8.
5. Cohen S, Hargraves KM. Pathways of the pulp 9th ed. 2008. p. 67-73,231-89,323-24.
6. Thompson SA, Dummer PMH. Shaping ability of Hero 642 rotary nickel titanium instrument in simulated root canals: Part 1. Internat Endod J 2000;33:248-54.
7. Ahlquist M, Henningsson O, Hultemby K. The effectiveness of manual and rotary in cleaning of root canals: ascaning electron microscopy study. Internat Endod J 2001;34:533-7.
8. Bertrand MF, Pizzardini P, Muller M. The Removal of smear layer using the quantec system. A study using the scanning electron microscope. Int Endod J 1999;32:217-24.
9. Mayers B, Barbakov F. Effect of rotary instruments and ultrasonic irrigation on debris and smear layer scores. A scanning electron microscopic study. Internat Endod J 2002;582-9.
10. Wu MK, Wessenlink PR. Efficacy of three techniques in cleaning the apical portion of curved root canals. Oral Surgery, Oral med, Oral pathol Endod 1995;79(4):492-6.

11. Lalit CB, Bhuyan, Katak R. Histological evaluation of the effectiveness of four instrumentation techniques for cleaning the apical third of root canal An invitro study. *J Conservat Dentis* 2006;9(4):134-9.
12. Walton, Torabinejad. Prinsip dan Praktik ilmu endodonsia. 3th ed. 2008. p. 3,230-61.
13. Garg N, Garg A. Textbook of endodontics. Unipress Pub : 2008. p. 164-71,180-3.
14. Ruddle CJ. The potaper advantage: shaping the future endodontics. *Dent Today* 2001;3:1-9.
15. Chen JL, Messer HH, A comparation of stainless steel hand and rotary nickel titanium instrumentation using a silicone impression technique. 2002.
16. Kandaswanny D, Venkateshabu N. Root canal irrigants. *J Conservat Dentis* 2010;13:256-64.