ÖZGÜN ARAŞTIRMA ORIGINAL RESEARCH

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SHAPING ABILITY OF RECIPROCATING SINGLE-FILE SYSTEMS IN SIMULATED CANALS: RECIPROC VERSUS RECIPROC BLUE

SİMÜLE EDİLMİŞ KANALLARDA RESİPROKAL TEK EĞE SİSTEMLERİN ŞEKİLLENDİRME YETENEKLERİ: RECİPROC VE RECİPROC BLUE

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Öz

Amaç
Simüle edilmiş rezin L-şekilli kurvatüre sahip kök kanallarında M-wire [Reciproc (VDW, Münih, Almanya)] ve mavi ısıl işlem görmüş [Reciproc Blue (VDW) aletlerin kanal düzleştirmesini karşılaştırmaktı.

Gereç ve Yöntem
45 ° kavisli ve 17 mm uzunluğunda (# 15-0.02 konik) toplam 26 simüle edilmiş L-şekilli kök kanalını taklit eden endo eğitim blokları iki gruba ayrıldı (n = 13). Tüm kanallar, üreticinin talimatlarına göre 25 nolu apikal boyutta hazırlandı. Enstrümantasyon öncesi ve sonrası dijital fotoğraflar üst üste çakıştırılarak kanal kurvatüründeki düzleşme bir bilgisayar görüntüleme programı kullanılarak analiz edildi. Verilerin normal dağılımını belirlemek için Shapiro-Wilk testi kullanıldı. Kanal kurvatüründeki düzleşmeye göre iki grubu karşılaştırmak için bağımsız t-testi kullanıldı.

Bulgular
Şekillendirme sırasında hiçbir alette kırık gözlenmedi. Orijinal kanal kurvaürü iki grup arasında önemli bir farklılık olmaksızın iyi korudu. Şekillendirme süresi ile ilgili olarak, iki sistem arasında önemli bir fark elde edilmedi (P> 0.05).

Sonuç
Bu çalışmanın koşulları altında, aletlerin kullanımı güvenliydi ve tüm aletler orijinal kanal kurvatürünü çok iyi uyarak şekillendirmelerini sağladı. Mavi ısıl işlem görmüş veya görmemiş resiprokal hareket yapan eğelerin benzer hazırlık süresine ve kanal içi sıcaklıkta benzer şekillendirme yeteneklerine sahip olduğu ve kök kanal eğrilerini eşit derecede iyi koruduğu sonucuna varıldı.

Anahtar Kelimeler: Kanal kurvatürü, reciprokal hareket, simule kanal

Abstract

Objective
The aim was to compare the canal straightening of M-wire [Reciproc (VDW, Munich, Germany)] and blue-wire heat-treated [Reciproc Blue (VDW)] instruments in simulated resin L-shaped curved root canals.

Materials and Methods
A total of 26 simulated L-shaped root canals with curvature of 45° and length of 17 mm (#15-0.02 taper) endo training blocks were divided into two groups (n

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= 13). All canals were prepared to an apical size 25 according to the manufacturers' instructions. Pre- and post-instrumentation digital photography were superimposed and canal straightening was analysed using a computer imaging programme. Shapiro-Wilk test was used to determine the normal distribution of the data. For comparing two groups according to canal straightening independent t-test was used.

Results
During preparation no instrument fractured. All instruments maintained the original canal curvature well with no significant differences between the instruments. Regarding preparation time, no significant differences between the two instruments were obtained ($P > 0.05$).

Conclusion
Under the conditions of this study, instruments were safe to use and all instruments respected the original canal curvature well. It was concluded that reciprocal motion files with or without blue-heat treated had similar preparation time and similar shaping abilities at intracanal temperature and maintained root canal curves equally well.

Keywords: Canal curvature, reciprocal motion, simulated canal

Introduction

The main goal of root canal treatment is chemomechanical preparation of the canal system while preserving the original shape of the root canal (a tapered conical shape with the narrowest diameter at the apex and the largest diameter at the canal orifice) (1).

Since the usage of engine driven nickel titanium (NiTi) files in clinical endodontic treatment, mechanical improvement of the instruments and new instrument design and heat treatment methods are being developed to provide faster and safer treatment (2) by reducing torsional or flexural stress and decreasing procedural errors associated with root canal preparation (3).

With the developing technology, reciprocating single file systems used with reciprocating motion were designed to facilitate root preparation (4). For reciprocating single file systems used with reciprocating motion to speed and simplify canal preparation. The files used clockwise and counterclockwise cause less torsional stress, (5, 6) and extending the life of the instrument and reduce the possibility of fracture (2, 7) and reducing the shaping time (8)

The first reciprocating instruments systems were made of NiTi alloy with M-wire consisting of R phase and austenite at mouth temperature, which was made of 55.8% nickel and 44.2% titanium (9, 10). The studies had proven that M-wire is more flexible and having higher cyclic fatigue resistance than conventional NiTi alloys (11, 12). According to the studies, although it was used by clinicians with different clinical skills, it had been reported that M-wire with reciprocal motion is successful in shaping curved canals (6, 10) and reducing intracanal microorganisms (11).

The Reciproc system (VDW GmbH, Munich, Germany) is an instrument used with reciprocating motion in root canal shaping. Many studies had reported that these files had the superior shaping ability during root canal preparation (13) and retreatments (14). In order to enhance the flexibility and shaping ability of the reciprocal motion files, it has been proposed to apply different thermal processes to the instruments (15).

Reciproc blue (VDW GmbH) is produced by a special treatment with heat that results in changing the molecular structure of the alloy (1) and the depositon of a blue-colored titanium oxide layer on the file (15). The according to the manufacturer, Reciproc blue has the same design features as Reciproc classical system, but has superior flexibility and higher fatigue resistance thanks to the heat treatment applied (16).

The aim of our study was to compare the shaping abilities of the classical Reciproc with Reciproc Blue, which is a different heat-treated instrument, in an environment that simulates the intracanal temperature in curved simulated canals.

Materials and Methods

The study was designed with experimental pre/post test study design. Sample size was measured with GPower 3 program (17). Power of the study was calculated based on comparing two groups, with the effect size of 1 and α err prob of 0,15 and the study came out to 85% at a confidence interval of 95% with the sample size of 13 in each group.

In the study, 13 standardized transparent resin blocks with simulated L-shaped root canals with curvature of 45° and length of 17 mm (#15-0.02 taper) endo training blocks (Dentsply Maillefer, Sweden) were

assigned to two groups for a total of 26. Root canal shaping procedures were maintained by the same and one operator who was expert in endodontics in both groups in water bath at 35°C.

In both groups, the working length (WL) was assessed by a #10 K-file (Dentsply Maillefer, Sweden). Glide path was achieved with #15 K-file (Dentsply Maillefer, Sweden). Simulated canals were shaped according to the manufacturer recommendation's in two group (R and Rb) up to the apical size 25 with irrigation using 2 ml 2.5% sodium hypochlorite solution after preparation completed. Each instrument usage was limited only three canals. Canal aberration, instrument separation and the time of shaping were also recorded.

Prior to any instrumentation procedure, the simulated canals were filled with black-ink (Pelikan) and images were recorded with a digital camera Nikon D3500 DSLR at a fixed position and magnification. A stable support for digital camera and a platform with the reference point for specimens were used. After instrumentation root canals were filled with red-ink and post instrumented images were taken with the constant procedure. The angles of the curvature were determined in accordance with Schneider method (Figure A-B) (18). AutoCAD (Autodesk Inc, San Rafael, CA) software was used for determination the pre and post curvatures of the canals (Figure A-B) .

Statistical evaluations were performed by using the SPSS 21.0 software. Shapiro-Wilk test was used to determine the normal distribution of the data. For comparing two groups according to canal straightening independent t-test was used. A significance level of 0.05 was set for all statistical analysis.

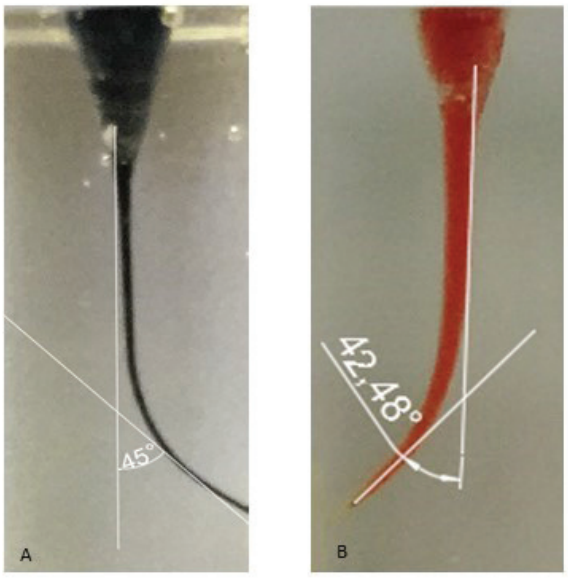

Figure A-B
Pre/Post images and determination of canal curvatures

Results

No canal transportation or canal aberration were occurred during the shaping procedures. And also during canal shaping, no overextension or loss of working length were occurred.

The Shapiro-Wilk test showed that all data performed normal distribution (P > 0,05). The mean straightening of the curved canals and the mean time taken to prepare the canals shown in Table-1. No significant differences were found according to canal straightening or time to taken to prepare the canals (Table-1).

Table 1 The mean straightening and preparation time and comparison of the two groups

	Mean ± SD	Min-Max	P value
Straightening			
Group 1	4,82 ± 3,60	2,80 – 5,10	0,707*
Group 2	4,81 ± 3,30	2,82 – 5,15	
Preparation time			
Group 1	71,47 ± 2,18	66,54 - 74,63	0,908*
Group 2	72,80 ± 2,30	67,38 - 76,11	

* Independent- t test

Discussion

The aim of our study was to evaluate and compare the shaping ability of two systems with reciprocating motion. The present study concluded that there was no difference between two different single file systems regarding straightening of canal and preparation time. During root canal shaping procedures, it is important to preserve the original shape of the canal by shaping that removes dentin in equal amounts from the inner and outer sides of the root canals (19). Shaping abilities of the files was evaluated by their centering ability (18) and preserving the curvature of the canal (20). The files with good shaping ability to stay in the center protect the canal curvature by preventing apical transport and dentin removal from one direction in root canal shaping (21). The excessive curvature of canals causes increased difficulty level of root canal preparation (18).

The curvature of root canals was evaluated in several studies (17, 19). Schneider initially introduced the concept of canal curvature angle, specifically to describe curvature angle of L-shaped curved canals (18). The degree of canal curvature was defined as the angle between the long axis of the canal and a line from the first curvature point to the apical foramen. Schneider method was the first determined root canal curvatures (18).

There are two parameters determining curvature; angle of curvature and radius of curvature. The limitation of this method is that it uses only one of the two parameters that determine curvature (19). But it is still incomplex and generally used method for measuring root canal curvatures (18, 21).

In our study, two different reciprocal files systems were compared with each other. Reciprocating with clockwise and counteclockwise motion was reducing stress on file and to increase torsional fatigue resistance (22). In addition, reciprocating motion had achieved more successful results than rotary motion in maintaining original canal curvature (23). In 2007, M-wire technology was developed in an special thermal process (24) providing cyclic fatigue resistance and flexibility to the instrument, since especially preparation curved root canals (16, 19).

Although there was no difference in canal curvature straightening between M-wires and heat-treated instruments in our study. The no difference in the study may be due to the superior centering and shaping ability of reciprocal files respect the original canal anatomy as in previous studies (25-27). Although severe curved artificial root canals were used in our study, the canal anatomies selected were not complex enough to reveal the difference between the two file systems. A study that will be planned using S-shaped root canals with smaller radii curvature or narrower canals will give us more information about the clinical significance of heat-treated files. The studies with teeths have complex canal anatomy will provide us with more information about the clinical success of the new heat-treated files.

In the study, resin simulated L-shaped root canals were preferred because the simulated resin canals are widely used in shaping studies all over the world, and almost every finding obtained with simulated resin blocks is equivalent to studies using human teeth (26, 28, 29). According to the literaure, simulated resin canals might present limitations in the study once hardness of root canal dentin and acrylic resin are not same (30-32) and second natural human teeth have different anatomic variations (33). In the other hand, the study used resin blocks ensures reproducibility and standardization of the experimental design (26) and standartized root canal dimentions such as taper, length, radius and curvaure of angle, hardness of canals (30, 33, 34). In addition, it allows comparison of canal anatomy before and after preparation, superposition them by using digital high resolution photographs, and they can be evaluated deviations at each milimeters of the root canals (26).

In our study, the curvature straightening was evaluated using digital overlapping method by digital high resolution photography. In the literature, it is recommended to use imaging as an alternative method to evaluate the shaping ability (31). But in a study to examine the shaping abilities of root canal instruments, least 20-40 µm of dentin should be removed from canal walls when using micro-computed tomography (32). In previous study, mean curvature straightening was expected to be in the range of 0.04 mm under similar experimental conditions and whether the micro-computed tomography would provide a benefit to curvature flattening if they were not in this resolution range (35). The superposition of image is the method accepted widely used to estimate the shaping ability of NiTi files in simulated acrylic resin transparent canals (36, 37) which allows two dimentional quantitative measurement (19).

In our study, the mean preparation time was recorded in seconds with the chronometer. The preparation time included active shaping and irrigation of the canals with a single file system and it only included active instrumentation time. The time required to create

the glide path up to size 15 was not included. There was no statistically significant difference between the preparation times between groups like similar studies (10, 11, 38). In our study, preparation times were found to be less compared to multiple file systems. The reason for this difference is that no more time is need changing files, as they are single file systems (39). The preparation time varies depending on many factors; such as operator experience, the number of files used to shape a root canals and the preparation technique used (40). In our study, an operator finished shaping of all canals to eliminate these differences.

Conclusions

Within the limitations of the present study, it was concluded that reciprocal motion files with or without blue-heat treated had similar preparation time and similar shaping abilities at intracanal temperature and maintained root canal curves equally well.

Due to differences in resin material and human dentin, it is recommended to plan further studies using human teeth to evaluate the shaping capabilities of different NiTi files.

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