A STUDY ON THE SHAPE OF A CANAL PREPARED WITH 'THREE-FILE' TECHNIQUE IN A CURVED CANAL

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ABSTRACT

'Three-File' 방식에 의한 만곡 근관 형성시 근관의 형태에 관한 연구

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이 연구의 목적은 'Three-File' 방식에 의한 근관형성시 근관의 형태변화 및 전이정도를 분석하고 이를 기존의 근관형성방법과 비교하고자 하는 것이다. 만곡된 근관을 가진 투명한 레진블럭 상에서 'Three-File' 방식, crown-down방식 및 스테인레스강 화일에 의한 수동방식으로 근관형성을 시행하고 이를 똑같은 위치가 재현가능한 고정틀에 위치시킨 후 사진의 이중노출 기법을 이용하여 근관형성 전후의 근관의 형태변화 및 전이정도를 분석한 결과 다음과 같은 결과를 얻었다.

1. 스테인레스강 화일의 경우 근관확대가 가장 컸고 근관의 전이정도도 심하였으며, 형성된 근관이 taper하지 못하고 불규칙한 형태를 보였다.
2. Profile로 crown-donw방식에 의해 형성한 경우 taper한 근관형태를 보였고, 근관의 전이 정도도 스테인레스강 화일의 경우보다 작았다($p<0.01$).
3. Profile로 'Three-File' 방식에 의해 형성한 경우 taper한 근관형태를 보였고 근관의 전이정도도 스테인레스강 화일의 경우보다 유의하게 작았으나($p<0.01$), crown-down방식에 의해 형성한 경우와 유의할 만한 차이는 없었다($p>0.01$).

주요어 : 근관형성, 전이, 'Three-File' 방식, crown-down방식, 이중노출 기법

I. Introduction

A continuously tapering, conical, funnel-shaped canal with the smallest diameter at the end-point and the largest at the orifice is perceived to be the most appropriate for filling with gutta-percha[1]. Unfortunately, stainless steel hand files tend to create a number of aberrations during preparation, particularly in curved canals, including zips[2,3] and danger zones[4,5]. These undoubtedly occur as a result of the inherent stiffness of the metal which is confounded by instrument design and canal shape[5-7]. Thus, in most circumstances, the use of stainless steel files in narrow curved canals is difficult and limits apical enlargement to relatively small sizes[6,8], so hindering proper obturation.

Nickel-titanium files have two to three times the elastic flexibility of stainless steel files, due to their very low values of modulus of elasticity, and show superior resistance to torsional fracture, due to the ductility of the nickel-titanium[9]. The new generation of nickel-titanium endodontic instruments therefore have the potential to shape narrow and curved root canals more effectively[10].

Mechanical methods of root canal preparation using nickel-titanium instruments have evolved in recent years. In general, the results of most studies have concluded that canal shape was maintained by rotary nickel-titanium instruments and was significantly faster than hand preparation[11,12]. A number of reports have also demonstrated that these instruments, when used in simulated canals, produce few aberrations[13-15].

Many of the new nickel-titanium instruments have increased taper in the hope that the greater flare along the active element of the instrument shaft will create automatically the flare required in the canal shape. And a technique which uses as few files as possible is preferred because exchanging a file to another file is a tedious procedure. We developed 'Three-File' technique, in which we only use three .06 Profiles to complete the preparation of most canals.

The aim of this study was to assess the ability of a new 'Three-File' technique to shape simulated curved canals in clear resin blocks.

Ⅱ. MATERIALS and METHODS

Thirth-six clear casting resin blocks(Maillefer, Ballaigues, Switzerland) containing simulated root canals were used. Their apical and coronal diameters were 0.15 and 0.35mm(±0.02mm), respectively, and the degree of curvature was 40°. A mounting device was developed and used to accurately locate the camera and the resin blocks at the same position. All root canals were stained and photographed before and after instrumentation.

For visual comparisions a double exposure of the same frame of the film was obtained by first photographing the stained original canal, blocking the film winder and then re-exposing the same frame with the widened canal after repositioning in the mounting device.

The blocks were divided into three groups of 12: Group1 for instrumentation with K-flexofiles, Group2 and Group3 was with Profile .06 taper with ISO sized tips. The working length(WL) was established with a size 10 instrument.

Group1

The K-flexofiles(Maillefer, Ballaigues, Switzerland) were precurved and used with a push-pull motion until the instruments fitted loosely in the canal, before using the next larger size. The apical preparation was completed with a size 25 file, followed by a step-back to a size 80, increasing one instrument size for each 1 mm step-back. Copious irrigation using water ensured that the canal was free of resin debris.

Group2(crown-down technique)

Group2 was instrumented using the Profile .06 taper in ISO sizes 15, 20, 25, and 30(Maillefer, Ballaigues, Switzerland) in a crown-down manner at a constant rpm of 250. A size 25 Profile was used one-half to two-thirds of the canal length. This was followed by a size 30 Profile used to approximately the same depth. A size 20 Profile was used to two-thirds to three-quarters of length, followed by a size 15 Profile placed to full length. Finally size 20, 25, and 30 Profiles were sequentially used at full length. Preparation was then completed by using a size 25 Profile at the WL.

Group3('Three-File' technique)

Group3 was instrumented using the Profile .06 taper in ISO sizes 15, 25, and 35(Maillefer, Ballaigues, Switzerland) at a constant rpm of 250. A size 15 Profile was used to resistance, followed by a size .25 Profilee and a size 35 Profile used to the same manner. These procedures were sequentially repeated. Preparation was then completed by using a size 25 Profile at the WL.

A 1:20 scale was established by projecting the resulting slides over a fixed distance onto a hard projection screen. Measurements were made at seven different levels: 1, 2, 3, 4, 5, 6 and 7 mm from the apical foramen. At each level, four measurements were made: outer canal width, inner canal width, total canal width, and amount of transportation from the original axis. The central axis of the original canal served as a reference point for all measurements. The ANOVA test was used for statistical analysis.

Ⅲ. RESULTS

Change in Outer Canal Width

Profiles in group 2 and group 3 caused a taper widening of the canal space to the outer side of the curvature, which is the finest at the apical side, and being wider to the coronal side(Fig. 1). The outer curvature of the prepared canal in Profiles was a graceful curve. But K-flexofile rather caused a greater widening at apical 1~4mm than Profiles ($p<0.01$), and maximum widening at apical 2mm to the outer side of the curvature(Table 1). The outer curvature of the prepared canal in K-flexofiles was not a graceful curve, but an irregular curve. There was not significant difference between group 2 and group 3($p>0.01$).

Change in Inner Canal Width

Profiles in group 2 and group 3 caused a taper widening of the canal space to the inner side of the curvature. K-flexofiles caused generally greater and nontapered widening of canal space than Profiles to the inner side of the curvature. It caused significantly greater widening than Profiles at apical 4~5 mm($p<0.01$), and maximum widening at apical 6 mm(Table 1). There was not significant difference between group 2 and group 3 ($p>0.01$).

Change in Total Canal Width

Profiles in group 2 and group 3 caused a generally taper widening in total canal width. But K-flexofile caused generally greater and nontapered widening of canal space than Profiles, significantly wider change at apical 1~3mm($p<0.01$), and the widest change at apical 4~5mm(Table 1). There was not significant difference between group 2 and group 3 ($p>0.01$).

Amount of Transportation From the Original Axis

Profiles in group 2 and group 3 hardly transported the canal from the original axis slightly to the outer side of the curvature at the apical part, but the amount was insigificant. K-flexofiles severely transport the canal to the outer side of the curvature at the apical part, maximally at apical 1 mm. It severely transported the canal to the inner side of the curvature at the coronal part, maximally at apical 6 mm(Table 1). There was not significant difference between group 2 and group 3 ($p>0.01$).

Ⅳ. DISCUSSION

The use of clear casting resin blocks appears to be not only valid substitution for root canals in natural teeth[16], but it is of great help for improving our understanding of the behaviour of endodontic instruments in root canals. The double exposure method provided enlarged images of root canals which could be clearly elucidated and accurately quantified. The method provided a clear view of the areas that were

Table1. Mean values of outer canal width, inner canal width, total canal width, and amount of transportation(mm).

		Distance from the apex						
		1mm	2mm	3mm	4mm	5mm	6mm	7mm
Outer canal width	group 1(n=12)	0.32	0.34	0.32	0.34	0.27	0.20	0.24
	group 2(n=12)	0.16	0.22	0.28	0.32	0.32	0.29	0.24
	group 3(n=12)	0.15	0.19	0.24	0.27	0.25	0.23	0.28
Inner canal width	group 1	0.15	0.21	0.30	0.42	0.50	0.52	0.48
	group 2	0.11	0.13	0.14	0.17	0.24	0.33	0.34
	group 3	0.12	0.12	0.14	0.18	0.25	0.34	0.36
Total canal width	group 1	0.47	0.55	0.62	0.76	0.77	0.72	0.72
	group 2	0.27	0.35	0.42	0.49	0.56	0.62	0.68
	group 3	0.25	0.31	0.39	0.45	0.50	0.57	0.64
Amount of Transportation	group 1	0.16	0.13	0.02	-0.08	-0.23	-0.32	-0.22
	group 2	0.07	0.09	0.14	0.16	0.19	-0.03	-0.01
	group 3	0.05	0.08	0.10	0.10	0.00	-0.11	-0.07

enlarged or remained unchanged after the instrumentation.

As a result of this study, Profiles with conventional and 'Three-File' techniques caused taper widening of canal space to the inner side of the curvature, generally taper but somewhat more widening at apical 4-5mm to the outer side of the curvature, and generally taper widening in total canal width. The inner and outer outline of the curved canal was a graceful curve. The original axis of the curved canal was transported somewhat to the outer side of the curvature at the apical area, but the amount was not severe. There was not significant difference between the results by conventional and 'Three-File' techniques.

K-flexofile, in general, caused taper effect but somewhat more widening at apical 5~6mm to the inner side of the curvature. It caused more widening at the apical area than at the coronal area and maximum widening at apical 2mm to the outer side of the curvature. It caused nontapered shape on the whole total canal width, generally greater widening than Profiles, and maximum widening at apical 4~5mm. The inner and outer outline of the prepared canal was not a graceful curve. The original axis of a curved canal was severely transported to the outer side of the curvature at the apical area and to the inner side of the curvature at the coronal area.

Bryant[17] found that the use of Profile instruments was effective and produced good canal shapes. Other studies[12,18] partly supported the observations of Bryant. The results of the present study were consistent and support these previous findings since Profile instruments used in a rotary fashion performed significantly better than hand instruments. In this study 'Three-File' technique also showed results as good as crown-down technique. In 'Three-File' technique, we only use three .06 Profiles to complete the preparation of most canals. The technique may be preferred because exchanging a file to another file is a tedious procedure.

Further research is needed to evaluate 'Three-File' technique to determine whether they can be safely and effectively used.

V. CONCLUSION

The purpose of our study is to assess the ability of a new 'Three-File' technique to shape simulated curved canals in clear resin blocks. Curved canals on translucent resin blocks were prepared with stainless steel hand instruments, with Profiles by the conventional technique, and with Profiles by 'Three-File' technique. And they were placed at the platform which can reproduce the same position. The unprepared and prepared canal forms were accurately compared by double exposure technique of photography.

The results were as follows :

1. Canal preparations with stainless steel files were not tapered and provided the significantly larger transportation than those with Profiles($p<0.01$).
2. Canals preparations with Profiles by the crown-down technique made a canal taper and the degree of canal transportation was significantly smaller than that with stainless steel files ($p<0.01$).
3. Canals prepared by 'Three-File' technique were excellent in taperness and in maintaining the original curvature, but the degree of canal transportation was not significantly different from that of the crown-down technique($p>0.01$).

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