

# COMPARATIVE EVALUATION OF PROGRESSIVE CHANGES IN CANAL SHAPE AFTER USING RECIPROCATORY AND ROTARY SINGLE FILE SYSTEMS WITH PROTAPER NEXT IN MESIAL ROOT CANAL OF MANDIBULAR FIRST MOLAR BY USING CONE BEAM COMPUTED TOMOGRAPHY

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## ABSTRACT

**Aim:** The purpose of this study was to Compare Progressive changes in canal shape after using Reciprocatory – WaveOne and Reciproc and Rotary- One Shape Single File Systems with Protaper Next Multiple File System in mesial mandibular first molar by using cone beam computed tomography with and without glide path preparation.

**Methodology:** One hundred twenty freshly extracted mandibular first molar human teeth severely curved mesial root with two separate canals i.e. mesiobuccal and mesiolingual and apices with a curvature angles ranging within 20-30 degrees were divided into two groups [ n = 60 each] Group I: With Glide Path; Group II: Without Glide Path. The two groups were then subgrouped into four subgroups [ n=15 each] and the mesial canals were then prepared with four different file systems using WaveOne, Reciproc, One Shape and Protaper Next file instrumentation systems in strict accordance with each manufacturer's recommendations. CBCT images were obtained before and after instrumentation with glide path at 90° high resolution dental mode. The technical outcomes were then compared at 0, 1, 2, 3, 4, 5, 6 and 7mm intervals to evaluate the progressive changes in canal shape after using reciprocatory and rotary single file systems with Protaper Next multiple file system. The obtained results were statistically analyzed using t-test and Chi-square.

**Results:** Using t-test and Chi-square test there was a statistical difference between the root canal curvatures and working time between the two groups (P < 0.05). Glide path is necessary for both multiple and single file systems and for rotary and reciprocatory

motion in order to achieve a path so that files can enter from the orifice and follow the smooth canal walls uninterrupted to the terminus. Protaper Next Multiple File System showed the better cleaning and shaping ability with respect to all the parameters evaluated in this study both with and without glide path followed by Reciprocating-WaveOne, Reciproc and the Rotary- One Shape – Single File Systems.

**Conclusion:** Within the limits of this study Protaper Next appeared to be suitable instrument used both with and without creation of glide path.

**Keywords:** Glide Path, Nickel Titanium, One Shape, Path files, Protaper Next, Reciprocating Motion, Rotary Motion, WaveOne.

## INTRODUCTION

Canal shaping is a critical aspect of endodontic treatment because it influences the outcome of the subsequent phases of canal irrigation and filling and the success of the treatment itself. Once the canal is prepared, it should have a uniformly tapered funnel shape, increasing in diameter from the end point to the orifice (1). This "ideal" preparation can be a difficult task to achieve in severely curved root canals or S-shaped canals, especially with traditional stainless steel hand instruments. Nickel – titanium (NiTi) rotary instruments were introduced to improve root canal preparation (3, 4).

Therefore, it is recommended to preflare the root canal manually or mechanically to create a glide path before using Nickel titanium rotary instrumentation to increase the root canal diameter to at least one size larger than the tip of the first rotary instru-

ment induced in the root canal (5). According to West (2010) a GLIDE PATH is defined as "A smooth radicular tunnel from the canal orifice of the canal to the physiologic terminus of the root canal."

Over the following decades there has been the emergence of a staggering number of file brands, sequences and hybrid techniques advocated for shaping canals. However, recent advances for endodontic canal preparation have focused on the concept "Less is more" (4).

The WaveOne concept provides a single-file shaping technique, regardless of the length, diameter or curvature of any canal (4). It is a single-use, single-file system to shape the root canal completely from start to finish (5). It has been recently introduced by Dentsply Maillefer (Ballaignes, Switzerland) (1,3). It has been introduced to simplify canal shaping. Only one single file is suggested to reach adequate root canal size and taper (1,2). It consists of 3 single use files: small [ISO 21 tip and 6% taper] for fine canals; primary (ISO 25 tip and 8% taper) for the majority of canals, and large (ISO 40 and 8% taper) for large canals. The files are manufactured with M-Wire NiTi alloy (1,2).

Single use, reciprocating motion and M-wire alloy manufacturing are the main characteristics of these instruments (1). Reciprocating motion was proposed to increase canal centering ability as well as to reduce the risk of root canal deformity (1). WaveOne enables the realization of the one file concept, lowers the fracture risk and also reduces the risk of prion transmission (11).

The recently introduced nickel-titanium files Reciproc (VDW, Munich, Germany) are claimed to be able to completely prepare and clean root canals with only one in-

strument (15). These files are made of a special NiTi alloy called M-wire that is created by an innovative thermal treatment process. The benefits of this M-wire NiTi are increased flexibility of the instrument and improved resistance to cyclic fatigue (15). These files are used in a reciprocal motion and are available in sizes i.e. 25, taper 08;40, taper 06 ;50, taper 05 (15).

Although single file technique has been conceptualized for decades, it has been, at best, illusive and only sporadically possible in straighter and more wide open canals. Today this long-sought-after objective has become a clinical reality. Whether you choose to prepare canals using continuous rotation vs. a reciprocating method, the 3 sacred tenets for shaping canals are safety, efficiency and simplicity (4).

One shape is a unique, sterile, economic and innovative system. With this file a complete canal shaping is done with only one single file in continuous rotation (14). Rapid treatment occurs and a root canal treatment is approximately four times faster than the conventional method. Minimal fatigue along the length of the file virtually eliminates the risk of separation (19).

PROTAPER NEXT rotary files by DentsplyMaillefer (Ballaignes, Switzerland) are made with proven M-Wire NiTi. The PROTAPER NEXT® instruments are recommended to be used with a brushing motion, away from external root concavities, to facilitate flute unloading and apical file progression (16). Use the PROTAPER NEXT® files to passively follow the canal until the working length is achieved. This patented alloy offers greater flexibility than traditional NiTi for navigating even challenging canals. It also provides greater resistance to cyclic fatigue, the leading cause of file separation. The result is added flexibility and strength when you need it most (17).

## MATERIALS AND METHODS:

One hundred twenty freshly extracted mandibular first molar human teeth severely curved mesial root with two separate canals i.e. mesiobuccal and mesiolingual and apices with a curvature angles ranging within 20-30 degrees were divided into two groups [ n = 60 each] Group I: With Glide Path; Group II: Without Glide Path. The two groups were then subgrouped into four subgroups [ n=15 each] and the mesial canals were then prepared with four different file systems using WaveOne, Reciproc, One Shape and Protaper Next file instrumentation systems in strict accordance

with each manufacturer's recommendations.

CBCT images were obtained before and after instrumentation with glide path at 90 high resolution dental mode. The technical outcomes were then compared at 0, 1, 2, 3, 4, 5, 6 and 7 mm intervals to evaluate the progressive changes in canal shape after using reciprocatory and rotary single file systems with Protaper Next multiple file system. The parameters evaluated were:

1. Working Time
2. Angle of Curvature
3. Canal Volume
4. Cross-sectional area
5. Centric Ability
6. Canal Transportation
7. Residual Dentin Thickness

### Working Time

Time taken to prepare the mesial canals in the mandibular molars was calculated for both groups with the help of a stop watch.

### Root Canal Curvature

Mandibular molars having severely curved mesial root with two separate canals i.e. mesiobuccal and mesiolingual and apices with a curvature angles ranging within 20-30 degrees were used.

### Canal Volume

It was calculated in cubic millimeters by using the formula  $\frac{3}{4}r^3$ .

### Root Canal Cross-sectional Area

It was calculated millimeters square by using the formula  $\pi r^2$ .

### Centering ability

The centering ability ratio i.e. the ability of the instrument to remain in a central position within the canal, was calculated for each cross-section using the ratio of  $(X1 - X2)$  to  $(Y1 - Y2)$  where X1 is the distance between the mesial portions of the root and the uninstrumented canal, X2 is the distance between the mesial portions of the root and the instrumented canal, Y1 is the distance between the distal portions of the root and the uninstrumented canal, and Y2 is the distance between the distal portions of the root and the instrumented canal. Whenever these numbers were not equal, the lower figure was considered to be the numerator of the ratio. According to this formula, a result of 1 indicates optimal centering ability.

### Canal transportation

Canal transportation was calculated in millimetres with the formula  $[(X1 - X2) - (Y1 - Y2)]$ , as described by Gambill et al. Pre- and postoperative measurements were compared to reveal the presence or absence of deviations in canal anatomy and to iden-

tify the most affected region.

### Residual Dentin Thickness

Residual dentin thickness is calculated by measuring the amount of dentin left on the mesial and distal side of the canal before and after instrumentation. According to Lim & Stock, 1987, 0.3 mm of residual dentin should be left in order to resist fracture.

### STATISTICAL ANALYSIS

The mean difference and standard deviations in root canal curvature, working time, centric ability, cross-sectional area and canal transportation were measured for each instrumentation technique. These were compared statistically using t-test and Chi-square tests.

### RESULTS

Using t-test and Chi-square test there was a statistical difference between the root canal curvatures and working time between the two groups ( $P < 0.05$ ).

Protaper Next Multiple File System showed minimum or no canal transportation at all the levels - 0, 1, 2, 3, 4, 5, 6 and 7 mm as compared to Reciprocatory-WaveOne and Reciproc and Rotary- One Shape Single File Systems both in group I and Group II i.e. with and without glide path.

Protaper Next Multiple File System had the optimal centering ability to remain in a central position within the canal for each cross section at 0, 1, 2, 3, 4, 5, 6 and 7 mm as compared to Reciprocatory-WaveOne and Reciproc and Rotary- One Shape Single File Systems and also showed the maximum residual dentin thickness both mesially and distally at each cross section levels.

### DISCUSSION

Root canal shaping is a key stage of endodontic treatment, when performed properly; it is a predictive factor for success. Ideally, root canal shaping should create a continuous tapered preparation from crown to apex while maintaining the original path of canal and keeping the foramen size as small as practical [Schilder 1947] (17).

Blum et al (2003) suggested that a glide path should be created with small flexible stainless steel hand files to create or verify that within any portion of the root canal there will be sufficient space for the rotary instrument to follow. In 2004, Berutti et al recommended manual preflaring of the root canal to create a glide path before using NiTi rotary instrumentation (19).

## RESEARCH SECTION

**Table I [a] : Mean & Standard Deviation Of Mesio Buccal Canal In Waves One, One Shape, Reciproc&Protaper Next For Canal Transportation At Different Levels Of Canal Length [Group I- With Glide Path].**

| S.NO. | Length Of Canal At Different Levels [in mm] | SubGroup1 [WaveOne] | SubGroup2 [OneShape] | SubGroup3 [Reciproc] | SubGroup4 [ProtaperNext] |
|-------|---|---------------------|----------------------|----------------------|--------------------------|
| 1     | 0   | 0.00±0.00           | 0.00±0.00            | 0.00±0.00            | -0.004±0.01              |
| 2     | 1   | 0.00±0.00           | 0.00±0.00            | 0.00±0.00            | -0.01±0.01               |
| 3     | 2   | -0.003±0.01         | -0.02±0.03           | 0.00±0.00            | 0.00±0.00                |
| 4     | 3   | -0.002±0.01         | -0.05±0.07           | -0.03±0.04           | 0.00±0.00                |
| 5     | 4   | -0.001±0.01         | -0.05±0.06           | -0.10±0.01           | 0.00±0.00                |
| 6     | 5   | -0.002±0.01         | -0.09±0.09           | -0.06±0.09           | 0.00±0.00                |
| 7     | 6   | -0.003±0.01         | -0.05±0.07           | -0.03±0.04           | 0.00±0.00                |
| 8     | 7   | -0.005±0.01         | -0.05±0.12           | -0.01±0.01           | -0.01±0.01               |

**Table I [b] :Mean & Standard Deviation Of Mesiolingual Canal In Waves One, One Shape, Reciproc&Protaper Next For Canal Transportation At Different Levels Of Canal Length[Group I- With Glide Path].**

| S.NO. | Length Of Canal At Different Levels [in mm] | SubGroup1 [WaveOne] | SubGroup2 [OneShape] | SubGroup3 [Reciproc] | SubGroup4 [ProtaperNext] |
|-------|---|---------------------|----------------------|----------------------|--------------------------|
| 1     | 0   | 0.00±0.00           | 0.00±0.00            | 0.00±0.00            | 0.00±0.00                |
| 2     | 1   | -0.004±0.01         | -0.02±0.03           | 0.00±0.00            | 0.00±0.00                |
| 3     | 2   | -0.004±0.01         | -0.06±0.07           | -0.02±0.03           | 0.00±0.00                |
| 4     | 3   | -0.004±0.01         | -0.07±0.08           | -0.06±0.09           | 0.00±0.00                |
| 5     | 4   | -0.002±0.01         | -0.08±0.09           | -0.04±0.06           | 0.00±0.00                |
| 6     | 5   | -0.002±0.01         | -0.06±0.09           | -0.08±0.12           | 0.00±0.00                |
| 7     | 6   | -0.002±0.01         | -0.07±0.13           | -0.08±0.09           | 0.00±0.00                |
| 8     | 7   | -0.01±0.01          | -0.05±0.10           | -0.12±0.27           | 0.00±0.00                |

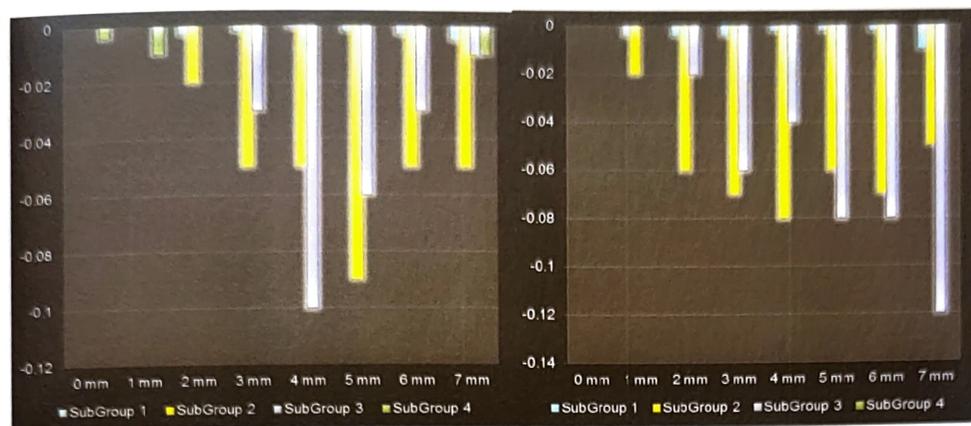
In this study it was seen that Glide path is necessary for both multiple and single file systems and for rotary and reciprocatory motion in order to achieve a path so that files can enter from the orifice and follow the smooth canal walls uninterrupted to the terminus.

This study compared the WaveOne, Reciproc, One Shape single file systems with the Protaper Next multiple file system. The parameters evaluated were root canal curvature, working time, centric ability, apical transportation, root canal cross-sectional area, canal volume and residual

dentin thickness in mesial root canals of mandibular first molars using Cone Beam Computed Tomography (CBCT).

Computed tomography allow a noninvasive and reproducible three dimensional evaluation of external and internal morphology of the tooth (Rhodes et al. 1999,

**GRAPH I : Mean & Standard Deviation Of Canal In Waves One, One Shape, Reciproc&Protaper Next For Canal Transportation At Different Levels Of Canal Length[Group I- With Glide Path].**



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**Table II [a] : Mean & Standard Deviation Of Mesio Buccal Canal In Waves One, One Shape, Reciproc&Protaper Next For Canal Transportation At Different Levels Of Canal Length[Group II- Without Glide Path].**

| S.NO. | Length Of Canal At Different Levels [in mm] | SubGroup1 [WaveOne] | SubGroup2 [OneShape] | SubGroup3 [Reciproc] | SubGroup4 [ProtaperNext] |
|-------|---|---------------------|----------------------|----------------------|--------------------------|
| 1     | 0   | 0.00±0.00           | 0.00±0.00            | 0.00±0.00            | -0.004±0.01              |
| 2     | 1   | 0.00±0.00           | 0.00±0.00            | 0.00±0.00            | -0.01±0.01               |
| 3     | 2   | -0.003±0.01         | -0.02±0.03           | 0.00±0.00            | 0.00±0.00                |
| 4     | 3   | -0.002±0.01         | -0.05±0.07           | -0.03±0.04           | 0.00±0.00                |
| 5     | 4   | -0.001±0.01         | -0.05±0.06           | -0.10±0.01           | 0.00±0.00                |
| 6     | 5   | -0.002±0.01         | -0.09±0.09           | -0.06±0.09           | 0.00±0.00                |
| 7     | 6   | -0.003±0.01         | -0.05±0.07           | -0.03±0.04           | 0.00±0.00                |
| 8     | 7   | -0.005±0.01         | -0.05±0.12           | -0.01±0.01           | -0.01±0.01               |

Bergmans et al. 2001a, 2003, Peters et al. 2001a,b, Hartmann et al. 2007, Moore et al. 2009).

In this study Protaper Next Multiple File System showed the better cleaning and shaping ability with respect to all the parameters evaluated in this study both with and without glide path followed by Reciprocating- WaveOne , Reciproc and the Rotary- One Shape – Single File Systems.

Canal volume is a variable used to analyse the effects of canal instrumentation on the amount of dentine removal. In this study, root canal instrumentation resulted in an increase in canal volume specially at

2mm interval with both rotary and reciprocating single file systems. The increase in canal volume was especially noticeable in the middle and and coronal aspects [2mm interval] of the canals which helps in improving access of irrigants to the apical-third of the canal clinically. If the canal preparation in the apical-third of the root is not centered, it might lead to blockages, perforations and ledges.

The four subgroups in both groups had a comparable scores for canal transportation and centering with Protaper Next exhibiting better centric ability because of its modified tip design and brushing motion

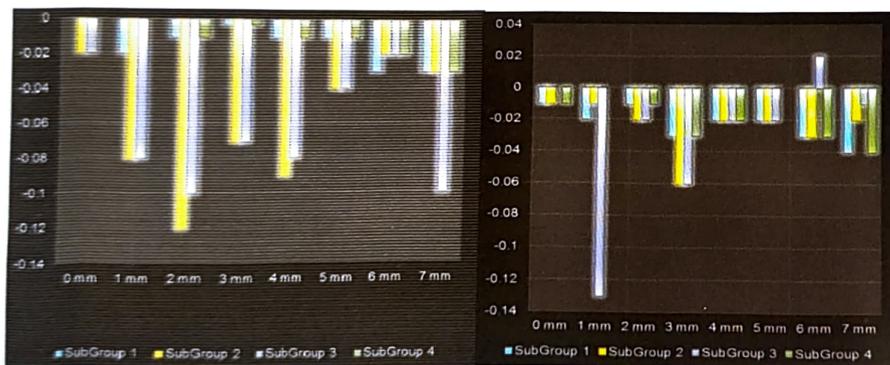
which is a slightly modified technique which reduces the differences in canal transportation between this group than the other groups. The limited canal transportation in this study might be related to the good centralization capacity of the instruments in the canal, especially in the apical and middle third. Statistically , there was a significant difference in the time taken for shaping of the canals between two groups and the subgroups with WaveOne group exhibiting the minimum time to prepare the canal because of its reciprocating motion as compared to the rotary group which took longer time to reach the working

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**Table II [b] : Mean & Standard Deviation Of Mesiolingual Canal In Waves One, One Shape, Reciproc&Protaper Next For Canal Transportation At Different Levels Of Canal Length[Group II- Without Glide Path].**

| S.NO. | Length Of Canal At Different Levels [in mm] | SubGroup1 [WaveOne] | SubGroup2 [OneShape] | SubGroup3 [Reciproc] | SubGroup4 [ProtaperNext] |
|-------|---|---------------------|----------------------|----------------------|--------------------------|
| 1     | 0   | 0.00±0.00           | 0.00±0.00            | 0.00±0.00            | 0.00±0.00                |
| 2     | 1   | -0.004±0.01         | -0.02±0.03           | 0.00±0.00            | 0.00±0.00                |
| 3     | 2   | -0.004±0.01         | -0.06±0.07           | -0.02±0.03           | 0.00±0.00                |
| 4     | 3   | -0.004±0.01         | -0.07±0.08           | -0.06±0.09           | 0.00±0.00                |
| 5     | 4   | -0.002±0.01         | -0.08±0.09           | -0.04±0.06           | 0.00±0.00                |
| 6     | 5   | -0.002±0.01         | -0.06±0.09           | -0.08±0.12           | 0.00±0.00                |
| 7     | 6   | -0.002±0.01         | -0.07±0.13           | -0.08±0.09           | 0.00±0.00                |
| 8     | 7   | -0.01±0.01          | -0.05±0.10           | -0.12±0.27           | 0.00±0.00                |

**GRAPH II : Mean & Standard Deviation Of Canal In Waves One, One Shape, Reciproc&Protaper Next For Canal Transportation At Different Levels Of Canal Length[Group II- Without Glide Path].**



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length and more apical force, with a pecking approach.

It is remarkable that Protaper Next-multiple file system used in this study caused less damage when compared with all the single file systems and also had the better centric ability and showed no or minimum canal transportation when compared to the single file systems both in group I [With glide path] and group II [Without Glide Path].

There are no studies and case reports till date evaluating the progressive changes in canal shape after using reciprocatory and

rotary single file systems with Protaper Next. Due to ProtaperNext's modified tip design and a brushing motion, away from external root concavities, to facilitate flute unloading and apical file progression. In the present study, Protaper Next was proven to be a better file system in cleaning and shaping the root canals (16,17).

### CONCLUSION

Glide path is necessary for both multiple and single file systems and for rotary and reciprocatory motion. Within the limits of this study Protaper Next appeared to be

suitable instrument used both with and without creation of glide path.

### REFERENCES

1. Berutti, MD, DDS, et al : Root canal anatomy preservation of WaveOne reciprocating files with or without glide path. JOE – Volume, Number 1, January 2012.
2. Elio Berutti, MD, DDS and et al: Effect of canal length and curvature on working length alteration with WaveOne reciprocating files. JOE – Volume,

**Table III[a] :Mean & Standard Deviation Of Mesio Buccal Canal In Waves One, One Shape, Reciproc&Protaper Next For Centric ability At Different Levels Of Canal Length[Group I- With Glide Path].**

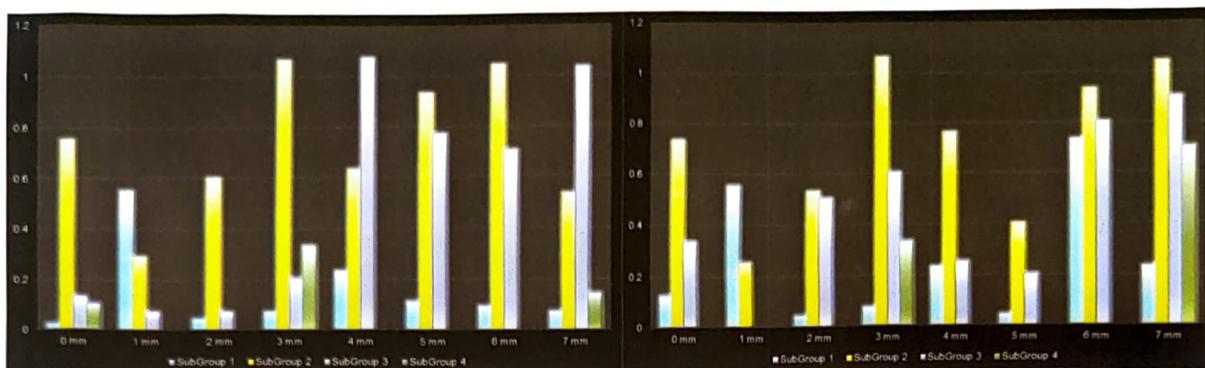
| S.NO. | LENGTH OF CANAL AT DIFFERENT LEVELS [in mm] | SubGroup1 [WaveOne] | SubGroup2 [OneShape] | SubGroup3 [Reciproc] | SubGroup4 [ProtaperNext] |
|-------|---|---------------------|----------------------|----------------------|--------------------------|
| 1     | 0   | 0.02±0.06           | 0.75±0.73            | 0.13±0.19            | 0.10±0.15                |
| 2     | 1   | 0.55±0.09           | 0.29±0.26            | 0.07±0.09            | 0.00±0.00                |
| 3     | 2   | 0.04±0.05           | 0.60±0.83            | 0.07±0.09            | 0.00±0.00                |
| 4     | 3   | 0.07±0.13           | 1.06±1.57            | 0.20±0.22            | 0.33±0.05                |
| 5     | 4   | 0.23±0.55           | 0.63±0.68            | 1.07±1.42            | 0.00±0.00                |
| 6     | 5   | 0.11±1.56           | 0.93±1.03            | 0.77±0.91            | 0.00±0.00                |
| 7     | 6   | 0.09±0.14           | 1.04±0.95            | 0.70±0.95            | 0.00±0.00                |
| 8     | 7   | 0.07±0.13           | 0.53±0.36            | 1.03±1.44            | 0.14±0.14                |

**Table III[b] :Mean & Standard Deviation Of Mesiolingual Canal In Waves One, One Shape, Reciproc&Protaper Next For Centric ability At Different Levels Of Canal Length[Group I- With Glide Path].**

| S.NO. | LENGTH OF CANAL AT DIFFERENT LEVELS [in mm] | SubGroup1 [WaveOne] | SubGroup2 [OneShape] | SubGroup3 [Reciproc] | SubGroup4 [ProtaperNext] |
|-------|---|---------------------|----------------------|----------------------|--------------------------|
| 1     | 0   | 0.12±0.06           | 0.73±0.75            | 0.33±0.05            | 0.00±0.00                |
| 2     | 1   | 0.55±0.96           | 0.25±0.26            | 0.00±0.00            | 0.00±0.00                |
| 3     | 2   | 0.04±0.05           | 0.53±0.83            | 0.50±0.73            | 0.00±0.00                |
| 4     | 3   | 0.07±0.13           | 1.06±1.57            | 0.60±0.88            | 0.33±0.05                |
| 5     | 4   | 0.23±0.55           | 0.76±0.74            | 0.25±0.37            | 0.00±0.00                |
| 6     | 5   | 0.04±0.05           | 0.40±0.83            | 0.20±0.29            | 0.00±0.00                |
| 7     | 6   | 0.73±0.13           | 0.93±1.03            | 0.80±0.89            | 0.00±0.00                |
| 8     | 7   | 0.23±0.55           | 1.04±0.95            | 0.90±0.86            | 0.70±0.95                |

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**GRAPH III : Mean & Standard Deviation Of Canal In Waves One, One Shape, Reciproc&Protaper Next For Centric ability At Different Levels Of Canal Length [Group I- With Glide Path].**



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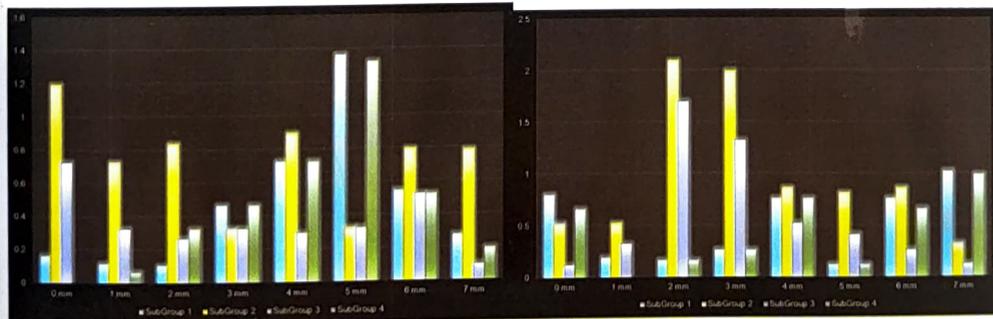
**Table IV[a] :Mean & Standard Deviation Of Mesio Buccal Canal In Waves One, One Shape, Reciproc&Protaper Next For Centric ability At Different Levels Of Canal Length[Group II- Without Glide Path].**

| S.NO. | LENGTH OF CANAL AT DIFFERENT LEVELS [in mm] | SubGroup1 [WaveOne] | SubGroup2 [OneShape] | SubGroup3 [Reciproc] | SubGroup4 [ProtaperNext] |
|-------|---|---------------------|----------------------|----------------------|--------------------------|
| 1     | 0   | 0.17±0.19           | 1.20±1.05            | 0.73±0.39            | 0.00±0.00                |
| 2     | 1   | 0.12±0.13           | 0.73±0.95            | 0.33±0.26            | 0.07±0.09                |
| 3     | 2   | 0.11±0.13           | 0.84±0.80            | 0.27±0.39            | 0.33±0.05                |
| 4     | 3   | 0.47±0.39           | 0.33±0.35            | 0.33±0.35            | 0.47±0.39                |
| 5     | 4   | 0.73±0.93           | 0.90±1.17            | 0.30±0.25            | 0.73±0.93                |
| 6     | 5   | 1.37±1.25           | 0.33±0.13            | 0.33±0.13            | 1.33±1.29                |
| 7     | 6   | 0.55±0.69           | 0.80±0.97            | 0.53±0.42            | 0.53±0.71                |
| 8     | 7   | 0.28±0.26           | 0.79±1.13            | 0.10±0.15            | 0.20±0.29                |

**Table IV[b] :Mean & Standard Deviation Of Mesiolingual Canal In Waves One, One Shape, Reciproc&Protaper Next For Centric ability At Different Levels Of Canal Length[Group II- Without Glide Path].**

| S.NO. | LENGTH OF CANAL AT DIFFERENT LEVELS[IN mm] | SubGroup1 [WaveOne] | SubGroup2 [OneShape] | SubGroup3 [Reciproc] | SubGroup4 [ProtaperNext] |
|-------|--|---------------------|----------------------|----------------------|--------------------------|
| 1     | 0  | 0.81±0.93           | 0.53±0.76            | 0.13±0.09            | 0.67±0.98                |
| 2     | 1  | 0.20±0.25           | 0.53±0.74            | 0.33±0.47            | 0.00±0.00                |
| 3     | 2  | 0.17±0.24           | 2.10±1.87            | 1.70±1.73            | 0.17±0.24                |
| 4     | 3  | 0.27±0.18           | 2.00±1.07            | 1.33±0.49            | 0.27±0.18                |
| 5     | 4  | 0.77±0.91           | 0.87±0.95            | 0.53±0.43            | 0.77±0.91                |

**GraphIV :Mean & Standard Deviation Of Canal In Waves One, One Shape, Reciproc&Protaper Next For Centric ability At Different Levels Of Canal Length**



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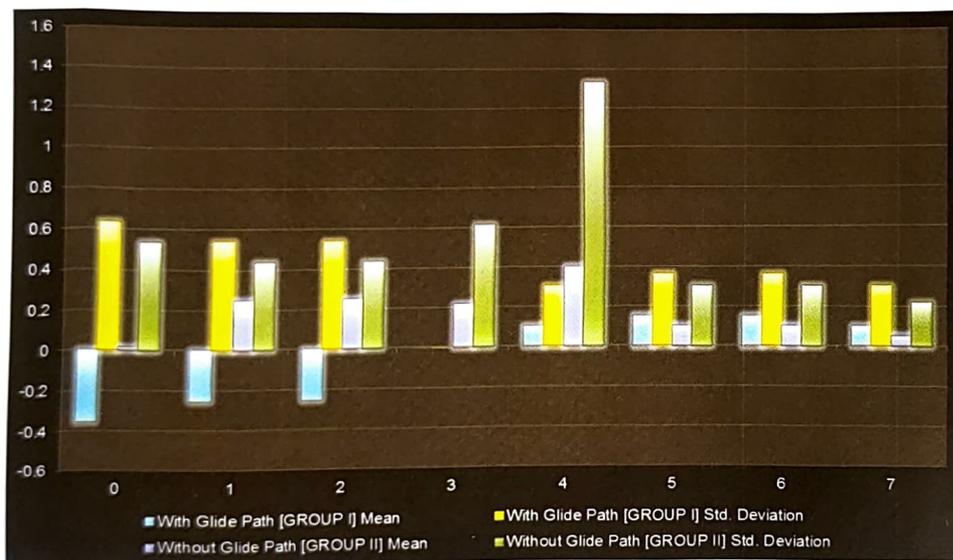
MESIOLINGUAL CANAL

## RESEARCH SECTION

**TABLE V: Mean and Standard Deviation of residual dentin thickness between group I and Group II of the canal At 0,1,2,3,4,5,6 &7mm .**

| GROUP                     |                | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      |
|---------------------------|----------------|--------|--------|--------|--------|--------|--------|--------|--------|
| With Glide Path [GROUP I] | Mean           | -.3500 | -.2500 | -.2500 | .0000  | .1000  | .1500  | .1500  | .1000  |
|                           | N              | 60     | 60     | 60     | 60     | 60     | 60     | 60     | 60     |
|                           | Std. Deviation | .63313 | .54072 | .54072 | .00000 | .30253 | .36008 | .36008 | .30253 |
|                           | Median         | .0000  | .0000  | .0000  | .0000  | .0000  | .0000  | .0000  | .0000  |
|                           | Minimum        | -1.00  | .00    | .00    | -1.00  | .00    | .00    | .00    | .00    |
|                           | Maximum        | 1.00   | 1.00   | 1.00   | 1.00   | 6.00   | 1.00   | 1.00   | 1.00   |

**Graph V : Mean and Standard Deviation of residual dentin thickness between group I and Group II on the right side of the canal At 0,1,2,3,4,5,6 & 7mm**



- Number, 2011
- Elio Berutti, MD, DDS, \* Giorgio Chiandussi, MS, PhD, and et al: Canal shaping with WaveOne primary reciprocating files and protaper system: A comparative study. JOE- Volume 38, Number 4, April 2012
  - Clifford J. Ruddle, DDS: Endodontic canal preparation :WaveOne single-file technique. Dentistry Today, January 2012
  - Dr. Julian Webber, UK ; Drs Pierre

- Machtou and Wilhelm Pertot, France and et al : The WaveOne single-file reciprocating system. 28/ roots, 2011.
- DensplyTulsa Dental Specialties: WaveOne reciprocating file
  - Julian Webber, Pierre Machtou and et al : The WaveOne single- file reciprocating system. International Dentistry – African Edition VOL. 2, No. 1
  - Peter Parashos MDSc, PhD, and Harold H. Messer MDSc, PhD :RotaryNiTi instrument fracture and its consequences.

- JOE – Volume 32, Number 11, November 2006.
- Purification Varela-Patino, DDS, MSc, PhD, Adalce Ibanez- Parraga, MSc, an-detal :Alternating versus continuous rotation : A comparative study of the effect on instrument life. JOE- Volume 36, Number 1, January 2010
  - Dr. Julian Webber, UK : “ WaveOne is a simple system”. 28, roots/ 2- 2011