

## ORIGINAL ARTICLE

# ROOT CANAL CURVATURE ASSESSMENT EMPLOYING MANUAL AND ROTARY INSTRUMENTATION TECHNIQUE. AN IN-VITRO STUDY.

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## ABSTRACT

**Background:** Endodontics is the study of the form, function, diseases, health and injuries of the dental pulp and peri radicular region. It also deals with their prevention and treatment. Manual instruments have been used since long now significant development in modern endodontic instrumentation is introduction of Rotary files. In this study we have compared root canal curvature maintenance by manual and rotary instrumentation technique.

The objective of the study is to determine changes in root canal curvature after preparation with manual or rotary instrumentation technique

**Methods:** This In vitro Quasi Experimental study was carried out over a period of six months. Mandibular molars, extracted due to caries or periodontal reasons and mesiobuccal canals, with curvature between 20-40° were included. In Group A preparation was carried out with ProTaper instruments and in group B with manual NiTi files. An ISO #15 NiTi file was placed in the canal and radiograph taken to determine working length, radiograph was scanned, print made and canal curvature determined. Upon completion of preparation, radiograph with #30 NiTi file was taken and the working length was assessed. The same radiograph was scanned, and changes in curvature were assessed by comparing preoperative and postoperative prints. Data analysis was done with Paired and Independent sample t-tests using Statistical Package for the Social Sciences (SPSS) version 20.0 available at university campus. P-value < 0.005 was taken as statistically significant.

**Results:** Difference in Pre and Post-operative root canal curvature was lower in ProTaper group, but not satisfactorily significant.

**Conclusion:** ProTaper instrumentation technique maintained curvature better than manual instrumentation technique.

**KEY WORDS:** Root Canal Therapy, root canal preparation, pulpectomy

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## INTRODUCTION

The objective of root canal preparation is to clean and shape the canal. The reduction in intra canal micro-organisms is the major goal of root canal

treatment. This can be achieved by using a proper chemo-mechanical preparation technique<sup>1,2</sup>

The root canal should be conically prepared but should be changed as little as possible in its original

shape. Shaping implies the development of a unique shape for every root canal, related directly not only to the length but to the position and the curvature of each individual root canal.

Significant development in modern endodontic instrumentation is an introduction of nickel-titanium (NiTi) files. These files are more flexible than stainless steel. Due to their flexibility they are used to negotiate curved root canals and there is reduced risk of canal transportation.

Many studies have been carried out on manual and rotary root canal preparation techniques which have shown an improved preparation quality in less time. There is also lower incidence of post-operative pain and discomfort.<sup>3-9</sup>

Recent prospective studies with untrained operators and inexperienced undergraduate dental students, demonstrate that the improved technical quality of root canal treatments (RCTs), obtained with NiTi instruments, lead to better obturation results compared with stainless steel (SS) K-files.<sup>4</sup> ProTaper Universal instruments have a convex triangular cross-section and a flute design that combines multiple tapers within the shaft<sup>10-13</sup>

The null hypothesis tested projects there is no difference between the rotary Protaper and manual Niti files systems regarding canal curvature maintenance.

The purpose of this study was to determine which instrumentation technique is better in maintaining root canal curvature. Many studies on root canal preparation can be found in literature; however the clinical appropriateness of different instruments and techniques still remain unclear and vague. Mostly this dilemma arises when methodological problems are compared with different techniques. Similarly not many studies have compared manual and rotary instrumentation techniques and the results are still very contradicting regarding the choice of instrumentation technique. In addition, very few studies have been carried out in developing countries so far, therefore it was important to carry out a study which could help us in determining an instrumentation technique which was more beneficial in achieving the objectives of root canal treatment.

## METHODS

This is in Vitro Quasi experimental study and it was carried out over a period of six months. Total sample size was sixty extracted molar teeth. The inclusion criteria for the study were human mandibular molars, extracted due to caries or periodontal reasons and mesio buccal canal of mandibular molars, with curvature between 20-40 degrees as

measured by Schneider's method.<sup>15</sup>

Teeth with calcified canals, internal or external restoration are with less than 20° curvature. However, severely curved canals are with more than 40° curvature as measured by Schneider's method and which were excluded from the study. Teeth were randomly distributed into two boxes, thirty teeth in each box, labeled 'A' and 'B'. Each group was assigned an instrumentation technique. This was done by a draw performed by a colleague, who was not related to the study. Group A: Prepared with rotary (ProTaper/ DENTSPLY) instruments. Group B: Prepared with manual instruments (Ni-Ti Files/ DENTSPLY).

Ethical Clearance: Ethical clearance was approved from the University Research Council for conducting this study.

Access cavities were prepared and occlusal surfaces reduced to solid flat reference points in both the groups. An ISO #15 Ni-Ti file was placed in the canal and radiograph was taken. Radiographs were taken with the help of standardized XCP (Henry Schein) in mesiodistal direction using paralleling technique. For preoperative canal curvature assessment the radiograph, was scanned and the image was transferred to computer. The image was magnified ten times (Adobe Photoshop 6.0), a print was made and the canal curvature was measured and determined by Schneider's method. In group A, instrumentation with rotary instruments was carried out according to manufacturer's instructions. In group B, instrumentation with manual technique was carried out with NiTi files using step back technique. Upon completion of root canal preparation in both the groups, post interventional radiograph with #30 NiTi master apical file was taken. The post interventional radiograph was scanned and transferred to the computer. The image magnified ten times (Adobe Photoshop 6.0), a print was made and the canal curvature measured as determined by Schneider's method.

The Deviation in canal curvature (degrees) was determined by comparing postoperative curvature measurements with preoperative values.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. The difference in the pre and post-operative readings of canal curvature was compared using Paired samples t-test (within the group comparison). Independent samples t-test (between the groups comparison) was used to compare the canal curvature in the two groups. A p-value less than 0.05 were taken as statistically significant. Error graphs (Mean with 95% confidence intervals for mean) were also made for pre-operative and post-operative root canal curvature

**RESULTS**

Root Canal Curvature in group A prepared with Rotary instruments was better maintained as compared to group B prepared with Manual instruments (Table I). No significant difference was also

observed between the two groups before procedure for root canal curvature. The average difference of the curvature in pre and post operation was found to be lower among Rotary technique when compared with manual technique (p-value=0.119) (Table II).

**Table 1: Mean Distribution of Manual and Rotary (ProTaper) Instrumentation Techniques with 95 percent Confidence Interval for the Difference**

| Manual or Rotary (Protaper) | Pre-operation | Post-operation | 95% Confidence Interval for the difference | p-value |
|-----------------------------|---------------|----------------|--------------------------------------------|---------|
|                             | Mean (SD)     | Mean (SD)      |                                            |         |
| Manual Curvature            | 25.9 (5.35)   | 21.6 (5.31)    | 4.3 (3.2, 5.34)                            | <0.001  |
| Rotary Curvature            | 26.0 (5.19)   | 22.9 (5.53)    | 3.1 (2.04, 4.16)                           | <0.001  |

**Table 2: Mean Difference (Pre – Post) Distribution of Manual and Rotary (Protaper) Instrumentation Techniques with 95 percent Confidence Interval for the Difference**

| Working Length or Curvature | Difference in pre-post Manual | Difference in pre-post Rotary (Protaper) | 95% Confidence Interval for the difference | p-value |
|-----------------------------|-------------------------------|------------------------------------------|--------------------------------------------|---------|
|                             | Mean (SD)                     | Mean (SD)                                |                                            |         |
| Curvature                   | -4.27 (2.86)                  | -3.10 (2.84)                             | -1.17 (-2.64, 0.31)                        | 0.119   |

**DISCUSSION**

The aim of this study was to assess and compare the canal curvature maintenance ability of Manual NiTi files and ProTaper system in root canals of extracted human molar teeth.

The root canals of natural human teeth are not geometrically straight; also, the curvature of the straight root canal group was in the range of 0–5°. Despite the variations in the morphology of natural teeth, attempts were made in the present study to ensure comparability of the experimental groups. Therefore, the teeth in both the groups were balanced with respect to the apical diameter and the length of the root canal and canal curvature.

Conventional hand instruments produced significant differences between straight and curved canals at the apical level, but not at the mid-level. The challenge of preparing a curved canal cannot be satisfactorily solved with these instruments, which tended to straighten in the apical part of the root canal, therefore NiTi instruments are used.

Straightening of curved canals is one of the most common procedural errors encountered by dental students, especially during molar endodontics.<sup>14</sup>In various studies canal shape differed significantly, at the measuring points with different instruments.<sup>15</sup>Although with the NiTi instruments there was reduced amount of transportation towards the danger areas in the bifurcation region and curved canals.<sup>1</sup>NiTi instruments are considered safer during procedures.

According to studies done earlier NiTi instrumentation achieved better preparation length and curvature while preparing curved canals (P = 0.0004).<sup>14</sup>

Previous studies have assessed ProTaper instruments when used in a reciprocating working motion regarding preparation of curved root canals.<sup>16, 17</sup>

According to our study ProTaper instrumentation technique maintained curvature better than manual instrumentation technique. The results obtained for canal curvature maintenance were

comparable with those of previous studies conducted under similar experimental conditions<sup>10,18-20</sup> and with previous studies using different experimental setups<sup>21-24</sup>. The observation that curved root canals can be instrumented with only minor canal straightening with NiTi instruments coordinates with the findings of previous reports.<sup>16, 17, 25</sup>

In developing countries this area of endodontics needs to be evaluated, this system is used widely, therefore we felt a need to conduct a study in order to assess the capabilities of this system in maintaining working length and canal curvature and our results statistically prove that this system maintains working length and canal curvature better than manual Nickel Titanium instruments.

Following are the limitations of our study.

1. They cannot generalize the results as they were performed by one operator.
2. Inter examiner reliability cannot be measured, since it was performed by one operator.
3. Bias: Due to single person examination, personal bias might be introduced, although precautions were made.

### CONCLUSION

Within the limitations of this study, following conclusions were drawn:

- No difference in the operative curvature was observed, although the difference was smaller in ProTaper group.
- ProTaper instruments prepared canals in extracted human mandibular molars without obvious procedural errors to a smooth tapered shape of appropriate sizes.

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