Review Article

Biomechanical preparation of teeth: A comprehensive review

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Abstract

One of the routinely employed dental procedures these days is root canal therapy. In involves cleaning and shaping of the root canal space followed by obturating with a biocompatible material. Biomechanical preparation is an important component for the success of root canal therapy. Hence; we aim to provide review on some of the important aspects of the biomechanical preparation of the teeth.

Key words: Biomechanical, Preparation, Root canal therapy

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INTRODUCTION

The root canal preparation is one of the major components of root canal treatment and is directly related to subsequent disinfection and filling. The goal of root canal preparation is to form a continuously tapered shape with the smallest diameter at the apical foramen and the largest at the orifice to allow effective irrigation and filling, using techniques and instruments which have the greatest precision and the shortest working time. Several types of endodontic instruments have been recommended but only a few seem to be capable of achieving these primary objectives of root canal preparation consistently.[1-4]Bio mechanical preparation of root canal system mainly consists of 3 elements namely,

1) Mechanical removal of pulp tissue & infected dentin
2) Irrigation of root canal &
3) Intra-canal medicaments.

In case of single visit RCT, third element is of no use. Hence, we have to do with first 2 elements only. Both are equally important & depend on each other for their effectiveness & ultimate success of the procedure. None of them is effective alone. Mechanical removal of infected pulp & dentin helps irrigating solutions to reach & disinfect root canal system in deeper aspects. Vice versa, copious irrigation removes debris & gives clean & clear path for insertion & working of root canal instruments in root canals.[5-7]

Mechanical removal of infected pulp & dentin

Many dentists consider removal of pulp (& not infected dentin) is only objective of this step. They consider dentin removal unnecessary. This is one of the biggest misconceptions in field of Endodontics. Due to this misconception only, there is big failure rate for single sitting RCT cases especially in non-vital teeth. Fact is that, bacteria are present in dentinal tubules, which creates bacterial toxins. These toxins are equally offending agent for peri-apical pathology. These bacterial colonies are more in non-vital teeth cases. Even, clean dentinal shavings can't ensure you 100% that infected dentin is completely removed. Hence, it is important to remove infected dentine so that irrigating solutions penetrates deep in to the tubules & kills bacteria. Thus, ultimately disinfects the root canal system.[8]

REVIEW OF LITERATURE

Aguiar CM et al examined the instrumented walls of root canals prepared with the ProTaper Universal™ rotary system. Twenty mesiobuccal canals of human first mandibular molars were divided into 2 groups of 10 specimens each and embedded in a muffle system. The root canals were transversely sectioned 3 mm short of the apex before preparation and remounted in their molds. All root canals were prepared with ProTaper Universal™ rotary system or with Nitiflex™ files. The pre and postoperative images of the apical thirds viewed with a stereoscopic magnifier (×45) were captured digitally for further analysis. Data were analyzed statistically by Fisher's exact test and Chi-square test at 5% significance level. The differences observed between the instrumented and the noninstrumented walls were not statistically significant ($p<0.05$). The Nitiflex™ files and the ProTaper Universal™ rotary system failed to instrument all the root canal walls.[9]

Kumar VR et al compared the efficacy of different irrigation systems comparing irrigation with syringe and needle (Dispo Van), Max-I-Probe needle (Dentsply Maillefer), EndoActivator (Dentsply Maillefer), and EndoVac (Sybron Endo) in removing the smear layer generated at apical third. Instrumentation was done in 40 extracted premolars using different irrigation regimes (Group 1, saline and syringe; Group 2, Max-I-Probe needles with NaOCl and ethylenediaminetetraacetic acid (EDTA); Group 3, irrigant activation with EndoActivator using needlesNaOCl and EDTA; and Group 4, irrigation with EndoVac using needles NaOCl and EDTA). The percentage of debris was seen with scanning electron microscope (SEM) and evaluated using one-way analysis of variance (ANOVA), Kruskal-Wallis test, followed by Mann-Whitney test for significance. The mean score ± standard deviation for the conventional group was 2.8 ± 0.42 with median value of 3.00 (2-3). The results for the Max-I-Probe needle group were 2.3 ± 0.48 with median value of 2.00 (2-3) The mean debris score for EndoActivator group were 0.8 ± 0.42 with median value of 1 (0-1). The mean debris score for EndoVac group were 0.4 ± 0.52 with median value of 1 (0-1). EndoVac and EndoActivator performed much better than other available systems in removing the smear layer from apical third. So they should be incorporated as a regular part of the irrigation regime.[10]

Lopes DS et al determined the centering capacity of ProTaper Universal™, Twisted File™ and Revo-S® rotary systems using cone beam computed tomography analysis before and after the instrumentation of root canals. Thirty mesiobuccal roots from human lower first molars were divided into three groups of ten: Group 1 - ProTaper Universal™ Rotary System; Group 2 - Twisted File™ Rotary System; and Group 3 - Revo-S® Rotary System. All teeth were scanned using computed tomography to determine the condition of the root canal before and after instrumentation (4mm, 3mm and 2mm from the root apex). Images were made using ICAT VISION software for both instrumented and non-instrumented canals. The results were analyzed statistically using the Kolmogorov-Smirnov normality test for quantitative variables. Comparisons were made with two groups (Mann-Whitney - abnormal) and with more than two groups (Kruskal Wallis - abnormal). The level of significance was set at $p<0.05$. A statistically significant difference was found for the measurement of 4 mm between the “ProTaper Universal” and “Twisted File” systems. For the Twisted File system, a statistically significant difference was recorded between the measurements of 4mm and 3 mm. None of the assessed instruments was completely effective in terms of the biomechanical preparation of root canals since all created deviation from the original anatomy of the canal.[11]

Gade VJ et al compared the efficacy of EndoVac irrigation system and conventional needle (30

gauges side venting needle) irrigation for removal of debris from the root canal walls at coronal, middle and apical third by using the scanning electron microscopy (SEM). A total of 20 mandibular premolars with completely formed roots were selected and randomly divided into two groups - Group 1: Irrigation with the Conventional system and Group 2: EndoVac irrigation. After access opening and working length determination biomechanical preparation completed up to a rotary protaper F4 file. Groupwise irrigation with sodium hypochlorite and ethylenediaminetetraacetic acid was done with each canal in between instrumentation. Then, the teeth were sectioned in buccolingual direction and the halves were sputter-coated with gold palladium and coronal, middle and apical third were examined by SEM at x2000 magnification. Mann-Whitney test for comparison between methods, Kruskal-Wallis test for comparison among thirds and Miller test for individual comparisons. The apical, middle and cervical root canal thirds were evaluated and the results were analyzed statistically by the Mann-Whitney test for comparison between methods, Kruskal-Wallis test for comparison among thirds and Miller test for individual comparisons. EndoVac group resulted in significantly less debris at apical third compared with the conventional needle irrigation group. There was no statistical significant difference found in debris removal at coronal and middle third of root canal wall between the EndoVac group and conventional needle irrigation group.[12]

FARIA G et al evaluated the efficacy of the Self-Adjusting File (SAF) and ProTaper for removing calcium hydroxide [Ca(OH)2] from root canals. Thirty-six human mandibular incisors were instrumented with the ProTaper system up to instrument F2 and filled with a Ca(OH)2-based dressing. After 7 days, specimens were distributed in two groups (n=15) according to the method of Ca(OH)2 removal. Group I (SAF) was irrigated with 5 mL of NaOCl and SAF was used for 30 seconds under constant irrigation with 5 mL of NaOCl using the Vatea irrigation device, followed by irrigation with 3 mL of EDTA and 5 mL of NaOCl. Group II (ProTaper) was irrigated with 5 mL of NaOCl, the F2 instrument was used for 30 seconds, followed by irrigation with 5 mL of NaOCl, 3 mL of EDTA, and 5 mL of NaOCl. In 3 teeth Ca(OH)2 was not removed (positive control) and in 3 teeth canals were not filled with Ca(OH)2 (negative control). Teeth were sectioned and prepared for the scanning electron microscopy. The amounts of residual Ca(OH)2 were evaluated in the middle and apical thirds using a 5-score system. None of the techniques completely removed the Ca(OH)2 dressing. No difference was observed between SAF and ProTaper in removing Ca(OH)2 in the middle (P=0.11) and the apical (P=0.23) thirds. The SAF system showed similar efficacy to rotary instrument for removal of Ca(OH)2 from mandibular incisor root canals.[13]

CONCLUSION

Predictable success of endodontic treatment requires accurate diagnosis, proper cleaning and shaping and hermetically obturation of the root canal. Special care should be taken while performing the biomechanical preparation of the tooth for best prognosis.

REFERENCES

1. Jafarzadeh H, Abbott PV. Dilaceration: review of an endodontic challenge. J Endod. 2007;33:1025–30.
2. Hamasha AA, Al-Khateeb T, Darwazeh A. Prevalence of dilaceration in Jordanian adults. Int Endod J. 2002;35:910–2.
3. Jain N, Tushar S. Curved canals: ancestral files revisited. Indian J Dent Res. 2008;19:267–71.
4. Wiene FS. Endodontic therapy. 6th ed. St Louis: Mosby; 2004.
5. Saunders EM. Hand Instrumentation in root canal preparation. Endodontic Topics. 2005;10:163–7.
6. Stock CR, Gulabiwala WK. Endodontics. 3th ed. St Louis: Mosby; 2004.
7. Charles TJ, Charles JE. The 'balanced force' concept for instrumentation of curved canals revisited. Int Endod J. 1998;31:166–72.
8. Schilder H. Cleaning and Shaping of the root canals. Dent Clin N Amer. 1974;18:269–96.
9. Aguiar CM, Mendes D de A, Câmara AC, de Figueiredo JAP. Assessment of canal walls after biomechanical preparation of root canals instrumented with protaper universaltm rotary system. Journal of Applied Oral Science. 2009;17(6):590-595.

10. Kumar VR, Bahuguna N, Manan R. Comparison of efficacy of various root canal irrigation systems in removal of smear layer generated at apical third: An SEM study. Journal of Conservative Dentistry : JCD. 2015;18(3):252-256.
11. Lopes DS, Pessoa MAV, Aguiar CM. Assessment of the Centralization of Root Canal Preparation with Rotary Systems. Acta Stomatologica Croatica. 2016;50(3):242-250.
12. Gade VJ, Sedani SK, Lokade JS, Belsare LD, Gade JR. Comparative evaluation of debris removal from root canal wall by using EndoVac and conventional needle irrigation: An in vitro study. Contemporary Clinical Dentistry. 2013;4(4):432-436.
13. FARIA G, KUGA MC, RUY AC, et al. The efficacy of the self-adjusting file and ProTaper for removal of calcium hydroxide from root canals. Journal of Applied Oral Science. 2013;21(4):346-350.

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