



THE EFFECT OF MEDICAMENTS USED IN ENDODONTIC REGENERATION ON ROOT DENTIN FRACTURE STRENGTH –AN IN VITRO STUDY

Dental Science

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ABSTRACT

The aim of this in vitro study was to evaluate the effect of intracanal medicaments on root dentin fracture strength at different time intervals. Sixty single rooted extracted human permanent mandibular premolar teeth were used. Access opening, working length determination, biomechanical preparation were done. The teeth were then randomly assigned as Group I - Triple antibiotic paste, Group II - Double antibiotic paste, Group III - Ca(OH)₂ paste and Group IV - Control. Teeth were kept in normal saline solution, changed every week and fracture strength was tested.

There was percentage reduction in fracture strength with all the three medicaments Group I, II and III which was 30%, 27% and 27% respectively. Group I showed maximum reduction in root dentin fracture strength.

KEYWORDS

Calcium hydroxide, Double antibiotic paste, Fracture strength, Triple antibiotic paste.

INTRODUCTION

Endodontic regeneration has been introduced as a treatment option for immature permanent teeth with necrotic pulps. This technique has been suggested to reduce the risk of fracture associated with traditional apexification procedure by inducing dentin-pulp complex that may lead to increased length and width of fragile immature roots.¹

The key factor for the success of this process in necrotic, infected, immature teeth is disinfection of the root canal system, since it is theorized to be essential to create an environment conducive to revascularization of the root canal system.²

In endodontic regeneration bacteria free biologic environment is provided by the intracanal antibacterial medicaments which have shown to reduce the dentin strength significantly when used at different time intervals.

Acids are commonly added to some of the antibiotics used as intracanal medicaments to maintain chemical stability, control tonicity or to ensure physiological compatibility. However long-term exposure of the dental hard tissues to acidic antibiotics might cause demineralization and negatively affect their mechanical properties.

The importance of exploring the effect of medicaments used in endodontic regeneration on root fracture strength should not be overlooked because the application time of intracanal medicaments reported in some cases of endodontic regeneration is relatively long, which may reach up to 11 weeks.^{2,3} Additionally, the increase in root wall thickness was found to be limited to mid- and/or apical root structures in the majority of reported endodontic regeneration cases rather than the cervical part of the root, which is the area prone to fracture in treated immature teeth with necrotic pulps.^{4,5} Therefore, in cases where root thickening in the cervical area is not achieved through regeneration, the potential of further weakening the root structure through long-term use of medicaments should be avoided.⁶

Thus the aim of the present study was to evaluate the effect of Triple antibiotic paste(TAP) Double antibiotic paste(DAP) and Calcium hydroxide Ca(OH)₂ used in endodontic regeneration on root dentin fracture strength at different time intervals.

MATERIALS AND METHODS

Sixty extracted human permanent mandibular premolar teeth with single root and single canal were collected. The local Institutional Ethical Committee approval was obtained. Samples were stored in 0.1% thymol solution at 4°C. Carious teeth, root cracks, restored and endodontically treated teeth were excluded from the study. Teeth with

similar mesiodistal and buccolingual root dimensions (10%) were included.

An endodontic access opening was done, the working length was determined by visualizing the tip of a size 15 K file and subtracting 1 mm from that length of file. The root canal was mechanically prepared using Protaper F5 rotary instrument to the apical file size 50. Along with instrumentation, 1 ml of 3% sodium hypochlorite was used as an irrigant between each succeeding file. Furthermore, the canals were finally rinsed with sterile saline. Root canal was dried with sterile paper points. The teeth were then randomly assigned to three treatment groups Group I, Group II, Group III and one control Group IV. For the control group no medication was applied.

For Group I medication paste was prepared by mixing IP grade antibiotic powder compounded of equal proportions of metronidazole, ciprofloxacin and minocycline with distilled water (powder/liquid ratio of 3:1); Group II medication paste was prepared by mixing IP grade antibiotic powders compounded of equal proportions of metronidazole and ciprofloxacin with distilled water (powder/liquid ratio 2.5:1); Group III medication paste was prepared by mixing Ca(OH)₂ powder with distilled water (powder/liquid ratio of 2:1). The prepared pastes were applied to the canal walls with a sterile lentulospirals in a slow speed handpiece and was tamped in the canal space to the level of cemento-enamel junction using various sizes of sterile pluggers.

The root canals of all treatment groups were sealed apically with flowable composite and access opening with thickness of atleast 4mm of cavitation. All teeth were kept in normal saline at 37°C for one week, one month, three months and the solution was changed every week.

After each storage interval, five teeth were randomly selected from each group. Thus there were one control subgroup and three treatment subgroups at each time interval. Then teeth were decoronated at the level of 0.5 mm apical to the facial cemento-enamel junction with a low speed diamond saw under water cooling. Then from this level a cervical 5 mm root cylinder was cut and used for fracture strength testing using an universal testing machine. Statistical analysis was done by one way Anova followed by Tukey's pairwise comparison test at 5% level of significance using SPSS software version 19.00 (IBM Corp, Armonk, NY, USA).

RESULTS

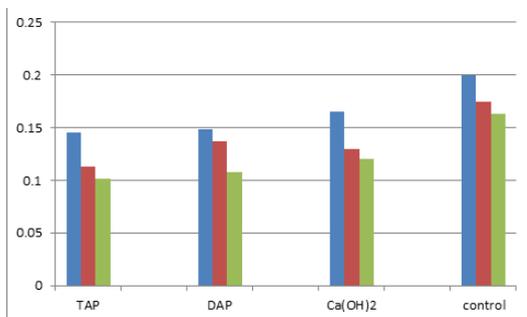
Mean comparison by one way Anova showed that for Group I there is significant difference at different time interval with p value of 0.03 (p < 0.05), for Group II there is significant difference in different time

interval with p value of 0.002 ($p < 0.05$), for Group III there is significant difference in different time interval with p value of 0.002 ($p < 0.05$) and for Group IV there is no significant difference at different time period with p value of 0.07 ($p < 0.05$).

Table 1. Mean fracture strength of TAP, DAP, Ca(OH)₂ and control groups at different time intervals.

| | TAP | | | DAP | | | Ca (OH) ₂ | | | Control | | |
|------|-------|--------|--------|-------|--------|--------|----------------------|--------|--------|---------|--------|--------|
| | 1week | 1month | 3month | 1week | 1month | 3month | 1week | 1month | 3month | 1week | 1month | 3month |
| Mean | .1449 | .1128 | .1015 | .1485 | .1375 | .1080 | .1655 | .1293 | .1205 | .1995 | .1749 | .1630 |
| SD | .0088 | .0337 | .0202 | .0114 | .0082 | .0216 | .0194 | .0204 | .0170 | .0348 | .0139 | .0124 |

Graph 1. Mean comparison of fracture strength of four groups at different time intervals.



DISCUSSION

In this study TAP, DAP, and Ca(OH)₂ pastes were used as intra-canal medicaments and the vehicle used was saline. The control group was without placement of any medicament. The methodology of present study was in accordance with the study undertaken by **G. H. Yassen et al.**⁶

In this study mandibular premolar teeth were taken as samples because these are the teeth which become necrotic most of the time because of the presence of dens evaginatus with thin enamel on the occlusal surface which is more prone for fracture and leading to immature necrotic tooth.⁷

Biomechanical preparation was done till Protaper F₃ which corresponds to ISO size 0.5mm. This is to simulate the clinical condition of an immature tooth with wide canals which is usually the case chosen for regenerative endodontics.

Studies have shown reduction in microhardness of dentin of teeth after use of 1%, 2.5% and 6% of sodium hypochlorite as an endodontic irrigant.⁸ Studies have also shown that EDTA also reduces the microhardness of dentin by its chelating action on inorganic components of dentin and thereby reducing the root resistance to fracture.⁹ So, in this study standard volumes of 3% sodium hypochlorite and EDTA were used.

The cervical part of the root cylinder was taken for fracture strength test because increasing clinical experience of cervical root fractures has lately been noted in immature teeth treated with calcium hydroxide. These fractures seem to be caused by weak forces, which aroused a suspicion among clinicians that Ca(OH)₂ may increase the brittleness of dentin.¹⁰

In the present study, group IV showed highest fracture strength as compared to the other three groups i.e. TAP, DAP and Ca(OH)₂ at all the three time intervals which is in agreement with previous studies. A study by **Ghaeth Hamdon Yassen et al** showed a significant reduction in phosphate/amide I ratio found in dentin treated with TAP and Ca(OH)₂ compared to untreated control dentin, which indicates a net superficial demineralization effect of medicaments.¹¹

TAP and DAP groups showed decrease in the fracture resistance from one week to three months which was statistically significant. This is in accordance with the previous studies where **Sehnaz Yilmaz et al** showed that four week application of DAP and TAP significantly reduced the microhardness of dentin discs. However, in the control group, there was neither a statistical difference between the baseline and other time periods nor a decrease in the KHN values.¹²

The present study showed decrease in fracture strength in all the four groups from 1 week to 1 month and 1 month to 3 months but in the three medicament groups the decrease in fracture strength was statistically

Mean comparison of fracture strength of four groups at different time intervals one week, one month and three months showed that there was percentage reduction in fracture strength from 1 week to 3 months with all the medicaments, TAP(30%), DAP(27%) and Ca(OH)₂(27%).

significant from 1 week to 3 months. So to avoid the deleterious effects of these medicaments and also to achieve adequate disinfection required for endodontic regeneration, these medicaments have to be kept in the canal for 1 week or less than 3 months.

CONCLUSION

Within the limitations, the present in-vitro study concludes that

- TAP, DAP and Ca(OH)₂ used in regenerative endodontics have a demineralizing effect and hence can cause decrease in fracture strength of root dentin at cervical area.
- Decrease in fracture strength was significant from 1 week to 3 months for all medicaments and it was significant from 1 week to 1 month for Ca(OH)₂ and 1 month to 3 months for DAP.
- Further studies are required to optimize the application time of medicaments in endodontic regeneration in vivo to explore the disadvantages of demineralizing effect.

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