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# Fracture Resistance of Endodontically Treated Teeth Restored Using Various Root Reinforcement Methods: An Invitro Study

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## ABSTRACT

**Aim** of the present study was to compare the fracture resistance of endodontically treated teeth restored using various root reinforcement methods.

**Materials and Methods:** In this study Fifty extracted human single rooted teeth were used as specimen. The samples were decoronated and working length was determined. Obturation was carried out by lateral condensation. Leaving 4mm of guttapercha apically rest was removed with the help of Gates Glidden drills. The specimens were divided into 5 groups with 10 each. **Group -1** restored with glass fibre post luted with resin cement. **Group-11** Ribbond fibre luted with resin cement. **Group-III** Restored with cast post and core luted with resin cement. **Group-IV** restored with glass fibre post luted with resin cement. **Group-V** Restored with light transmitting post.The samples were subjected to universal testing machine at angle of 45$^{o}$ to the long axis of the tooth at compressive loads of 0.5mm/min.

**Results:** Results were statistically analyzed under Anova and Tukey test.The study revealed results with Group 1 (800N) group 11(594N) GROUP III (308N) GROUP IV (898N) GROUP V (903N).the study revealed higher resistance to fracture with the prefabricated post systems when compared with the metal post systems.

**Conclusion**: Prefabricated post systems can be used as an alternative to the traditional cast post and core systems.

**Keywords:** Root reinforcement, fiber post, resin cement,.

## INTRODUCTION

Endodontics is that branch of dental sciences concerned with the study of form function, health and diseases of the dental pulp and periradicular tissues and their treatment. The treatment is usually achieved by root canal treatment or in combination with endodontic surgery.[1] The tooth structure that remains after endodontic treatment has been undermined and weakened by all of the previous episodes of caries, fracture, tooth preparation and restoration. Endodontic manipulation further removes important intracoronal and intraradicular dentin.[5]

Finally, the endodontic treatment changes the actual composition of the remaining tooth structure. The combined results of these changes are the common clinical findings of increased fracture susceptibility and decreased translucency. These being overall drawback of endodontically treated teeth. It remains a challenging task to improve the overall condition and longevity of the natural tooth.2 The various techniques involved in post &

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core preparation are cast post & core which was traditionally recommended.

Some of the factors associated with metal posts like more invasive preparations and the dark appearance associated with non vital tooth lead to the advent of more advanced tooth coloured materials. Many dentists now prefer the use of prefabricated post systems[1].these post increase the transmission of light within the root and overlying gingival tissues. Thereby eliminating or reducing the dark appearance often associated with metal post.[4]Also techniques like root reinforcement of that of poly ethylene tissue like Ribbond which consists of ultra high strength polyethylene fibres with patented leno weave structure.[3]Ribbond is also designed with a lock stitch feature that effectively transfers forces throughout the weave[1] At present few studies were carried out to evaluate the root reinforcement procedures for weakened endodontically treated teeth. Hence this study is aimed for most apt method of root reinforcement.

## MATERIALS AND METHOD

Fifty extracted human single rooted teeth with similar root size and lengths were used as specimen. Radiographs of all the specimens were taken to rule out any abnormalities. The specimens were decoronated 2mm coronal to the cemento enamel junction. The working length was determined. Cleaning & shaping of the canals done upto #60 K-file. Obturation was carried out using lateral condensation technique. Gutta percha was removed coronally leaving 4mm apically with the help of Gates glidden drills. The specimen were divided into 5 groups with 10 teeth each.

**GROUP-I (Glass fibre post luted with resin cement)** The canals in this group were instrumented with 1.5mm drills. The glass fiber posts were placed into the canals and radiographs taken to ensure proper fit of the post prior to cementation. After confirmation, the posts were cemented with (Rely-X) dual cure resin cement. Then core buildup was done with light cure composite.

**GROUP-II (Ribbond fiber as post and luted with resin cement)** The canals in this group were flared with 2mm peeso reamers. The ribbond fibre which is of 2mm wide was double folded and placed into the canal with the help of a file. Radiographs were taken to ensure proper fit of the fiber. Once this was achieved the strip was removed and treated with dual cure resin cement and double folded & molded into a shape of post, which was then reinserted into the canal and luted with dual cure resin cement. The core buildup was done using light cure composite.

**GROUP- III (Custom made post luted with resin cement )**All the canals in this group were flared with 2mm size peeso reamer. The post and core wax patterns were made; the wax patterns were then invested with phosphate bonded investing material. This was followed by casting procedures. The obtained metal post and core were placed into the canals and ensured proper fit with the help of radiographs. All the posts were cemented with dual cure resin cement.

**GROUP-IV (Glass fibre post luted with resin cement)** In this group the canals were flared with a 2mm size peeso reamer. The glass fibre post used in (group-I) was used in this group. Radiograph of the post placed into the canal was taken to ensure proper fit. All the post were luted with (rely x) dual cure resin cement. specimens received composite core buildup.

**GROUP-V (Light transmitting post luted with resin cement)**In this group the entire specimens were flared upto 2mm peeso reamer. The light transmitting posts were placed into the canal and radiographs taken to ensure proper fit. Then all the posts were cemented with dual cure resin cement which was light cured. The core buildup was done using light cure composite.All the specimen were embedded into acrylic colour coded blocks for differentiation, the specimen were positioned on a jig and subjected to a compressive load of 0.5 mm/min under universal testing machine at $45^0$ to the long axis of the tooth. The results were analyzed statistically under Anova test & turkey test.

## RESULTS

Table 1: Anova Compressive Load.

| | Sum of Squares | | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 3726032.743 | 5 | 745206.549 | 97.790 | 0.000 |

| | | | | | |
|---|---|---|---|---|---|
| Within Groups | 411506.579 | 54 | 7620.492 | | |
| Total | 4137539.322 | 59 | | | |

Table 2: compressive load Tukey HSD[a]

| Groups | N | Subset for alpha = 0.5 | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| 3 | 10 | 308.000 | | |
| 2 | 10 | | 594.460 | |
| 1 | 10 | | | 800.000 |
| 4 | 10 | | | 898.590 |
| 5 | 10 | | | 903.350 |
| Sig | | 0.997 | 1.000 | 0.0000 |

## DISCUSSION

The present study consists of fifty extracted human single rooted teeth, divided into five groups with 10 samples each[8]. The samples were free of cracks caries and fractures [9,10] with similar mix of tooth types (centrals, laterals, canines).[10] The inclusion criteria was teeth with root length between 16mm and 19mm.[11]

**Group 1-** The canals in this group were prepared with 1.5mm drill. The canals were restored with 1.5mm diameter glass fibre post according to manufactures instructions.[9] The study revealed fracture loads of (800N). The study revealed specimen with more number of core fractures which were favorable to repair. **Ela- Omar M et al** reported in a study which compared metallic posts with non-metallic posts. The study revealed higher fracture resistance in glass fibre groups (516N) when compared with other groups. In search for factors that support these results. The higher fracture resistance was attributed to the un-polymerized form in which this post is supplied, which allows the resin monomer at the surface to react well with monomer in the resin cement.This finding is in accord with the findings of the present study.[10]

**Group II-** The canals were restored with ribbond fibre posts. The canals were flared with 2 mm drill and restored with 2mm wide fibre post as recommended by the manufacturer.[7] The study revealed higher resistance to fracture when compared to the cast post and core (594N>308N).When compared to that of the glass fibre and light transmitting posts showed lower values (903N> 898N>308N). The study also revealed more number of fractures that were repairable. **Sonthi Sirimai et al** reported teeth restored with Polyethylene Woven fibre ribbond used as a post alone did not increase the strength of the post and core. To increase the strength of cast post and cores the addition of small size prefabricated post to the poly ethylene Woven fibre significantly increased the strength of the post and core complex system. These findings were in accord to the present study.[7]

**Group III** :- All the canals in this group were flared with 2mm size drill. The post and core wax patterns were prepared followed by investment procedures[14],The study revealed lowest values when compared to the other groups (308N>594N>898N>903N). The cast post and core group specimen exhibited fracture loads of (308N). These values when compared with fibre reinforced posts were significantly lower. This group also exhibited predominantly root fractures which were un-repairable. The findings of the present study are in agreement with previous studies. **Fernando Massa et al** reported that due to juxtaposed position of the cast post and core to the dentinal wall of the canal, the compressive force is therefore transferred to the wall at a higher speed and intensity during the resistance test. However the prefabricated posts have a more passive adaptation and require large amount of resin cement. This results in a higher capacity to absorb compression because the luting agent acts as shock absorber.These over all factors contributed to the decreased resistance to fracture of cast post and core groups. **Group 1V**:- The canals were flared with a 2mm size drill. The specimen were subjected to universal testing machine. The study revealed higher resistance to fracture loads when compared to the ribbond and cast post and core groups (898N>594N>308N).The study also revealed more number of core fracture that favored repair. **Marcela P Newman et al** revealed no significant differences between the flared and the narrow canal groups. However, the mode of failure (or) deflection of the fibre-reinforced posts is protective to the remaining tooth structure. According to the manufacturer the weight percentages of the Glass

fibre in Glassix fibre posts is 42% which aids increased fracture resistance of the tooth. The study also revealed that more amount of resin cement aids in the resistance to fracture by absorbing the forces.[20]**Group V**:- The canals in this group were flared with 2mm peeso reamer. The light transmitting posts were placed into the canal. Then all the posts were cemented with dual cure resin cement which was light cured .The core buildup was done using light cure composite. The study revealed higher resistance to fracture when compared to all the other groups (903N> 898N>594N>308N). The study also revealed more fractures of the core than the roots which aid in restoring the tooth. **Begum Akkayan et al** reported light transmitting posts exhibited higher resistance to fracture when compared to other groups (91kg) the reasons attributing to these results are that light transmitting post systems closely resemble the morphology of the root form, absorb stress rather than transferring it and thus protect endodontically treated teeth against fracture. The light transmitting property of the light posts systems make it possible to polymerize the cement through the post, this characteristic feature also may have contribution to the significant better results obtained. Glass fibre posts exhibited a modulus of elasticity similar to that of root dentin which results in reduced stress concentration and thus reduced failure rate.[9]The descending order of fracture strength for the groups. Light transmitting post > Glass fibre posts > Ribbond posts.

## CONCLUSION

Within the limitations of this invitro study following conclusions were made. Higher resistance to fracture was observed with the fiber reinforced posts system when compared to that of the cast post and core systems. Furthermore, the fractures associated with that of the fiber reinforced post systems were amendable to repair when compared to the metal post systems which were non-repairable.Ribbond poly ethylene fiber evolved as liable alternative to cast post and core systems.Overall it can be concluded that fiber reinforced post systems can be preferred over the metal post systems in restoring endodontically treated teeth. Further research is required.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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