International Journal of Dental Sciences
www.dentaljournal.in
E-ISSN: 2663-4708, P-ISSN: 2663-4694
Received: 28-03-2025, Accepted: 27-04-2025, Published: 13-05-2025
Volume 7, Issue 2, 2025, Page No. 13-15

Composite reinforcing fibers (FRC) on endodontically treated dentin by compressive strength tests

Morales Huachi Andrea Lorena
Department of Dentistry, Universidad de los Hemisferios, Quito, Ecuador

Abstract
Aim: To compare the adhesive strength of FRC glass fibers under different conditions on endodontically treated dentin of anterior teeth, using compressive strength tests.
Method: An *in vitro* experimental study. 60 single-rooted premolars extracted for orthodontic reasons were selected, of which 40 met the inclusion criteria. The samples were standardized using a precision cutter. Each sample underwent endodontic treatment and fillings. All samples used various root anchorage materials and were therefore divided into 4 groups: G1(N:10) First group with polyethylene FRC fibers (Ribbond- TBR Dental); G2(N:10) Second group with polyethylene FRC fibers (Construct - Kerr); G3(N:10) Third group with quartz sFRC fibers (Quartz Splint- RTD); G4(N:10) Fourth control group with glass fibers.
Each of the samples was unfilled according to the manufacturer's instructions. These materials were then placed as root anchors to subsequently create a stump. Once this was done, the samples were subjected to artificial saliva for 168 hours. The samples were then subjected to ain an Instron universal testing machine. The compression machine will exert a force at a rate of 0.5 mm per minute.
Results: It was concluded that Ribbond polyethylene fibers presented greater resistance to compression, thereby reducing the risk of fracture compared to the other materials evaluated in said research.

Keywords: Oral Rehabilitation; Endodontic Tooth Rehabilitation; Root Canal Anchorage; Root Canal Post; Composite Reinforcement Fibers (FRC); Polyethylene Fibers; Ribbond Fibers; Construct Fibers – Kerr; Quartz Splint Fibers – RTD; Fiberglass Post

Introduction

Root canal treatment, upon completion, results in a substantial reduction in tooth strength. A loss of tooth structure, moisture, and dentin flexibility can be detected. Therefore, the tooth must receive an appropriate post-endodontic restoration to reinforce its strength. The use of intracanal posts has been the treatment of choice over the years, along with a crown.(Shah *et al*. 2021)
Structural changes in teeth are associated with tooth structure loss, cariogenic extension, dentin cracks, chamber access, etc. Endodontic posts can be made of fiberglass, carbon fiber, ceramic, metal cores, and even resin-reinforced polyethylene fiber in different sizes (diameters) and shapes.(Shimokawa *et al*. 2023). Intracanal retainers consisting of independent multifilament glass fiber posts (m-FGP), also known as microfasciculated posts, have recently been introduced to the market. They can be used without prior root space preparation, thus minimizing dentin removal from the canal; they are flexible, can adapt to any root canal anatomy, and can be used when the access cavity is not in axis with the root canal orifice.(Kharouf *et al*. 2023).

Materials and methods

An experimental type of research is proposed, the specimens to be used will be 60 single-rooted lower premolars divided into 4 groups.
After a thorough analysis of each sample, 40 samples met the inclusion criteria.
The 40 healthy single-rooted mandibular premolars will be treated using the same cleaning and storage protocol. The teeth will be stored in airtight plastic containers containing 0.5% chloramine T at a temperature of 36°C.
Subsequently, a cut will be made at the level of the dentin-melon junction, using a DEWALT-632 precision cutter. The root length is 16 mm.

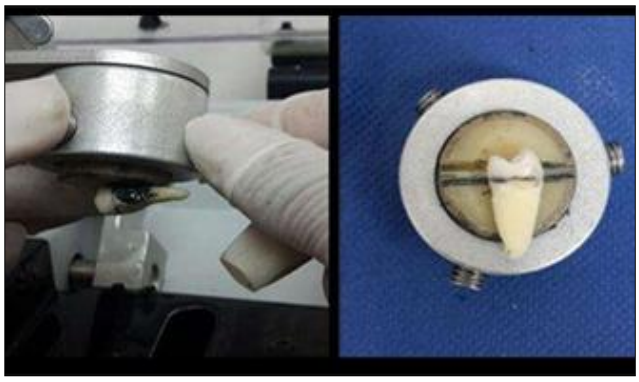

Fig 1: Sample Standardization – Precision Cutting Machine

Endodontic treatment of each of the samples

The root canal will be instrumented with the RECIPROC - VDW rotary system using 25/0.8, 40/0.6 and 50/0.5 files. The canals will be irrigated again with 5.25% sodium hypochlorite and immediately after with saline solution to neutralize the NAOCL inside the canal. Irrigation will be done with 17% EDTA for 30 seconds, EUFAR brand. The canal will be dried with sterile RECIPROC - VDW paper points. The canals will be filled with RECIPROC-VDW gutta-percha cones along with epoxy resin-based cement (VIO SEAL). Using the single-cone technique. The samples will be randomly divided into 4 groups, with the corresponding unclogging process being carried out in each group.

Remove filling material (all samples)
The filling material was removed from the root canal. In this case, the B&L brand endodontic puggler will be used. The filling material will be removed from the coronal third, approximately 4 to 5 mm.

G1(N:10) First group with polyethylene FRC fibers (Ribbond)
We then measure and cut the necessary amount of Ribbond. The length of the material is measured with a periodontal probe. We cut a strip of Ribbond measuring twice that length, 6 mm (3 or 4 times the height of the core buildup). We continue etching the root canal with Condac 37-FGM for 30 seconds. We rinse with plenty of water for twice as long and dry the canal again with RECIPROC-VDW absorbent paper cones. Once this is finished, we apply the fourth-generation Gold Standard adhesive (Optibond Fl. - Kerr), initially using primer for 30 seconds and aerating for another 30 seconds and then we apply the adhesive of the same brand (Optibond Fl. – Kerr) rubbing the entire internal surface of the canal and aerating again for 30 seconds. We immediately moisten the fibers in Ultradent brand Permasil for a time interval of 40 seconds.
We injected Nexcomp Flow - Metabiomed brand high-load fluid resin into the canal. Using forceps, we positioned the moistened fibers midway in a U-shaped insertion pattern.

Fig 2: Placement of Ribbond Fibers As Root Anchorage

The sample was previously placed on a matrix of heavy condensation silicone, the Speedex Putty brand (Coltene) used for all samples. The curing light (Valo X – Ultradent) was placed at a standardized distance of 2 cm using a plastic support at a predetermined distance for all samples. The same was kept stable by using plastic cables that embraced the curing light.

G2(N:10) Second group with polyethylene FRC fibers (Construct-Kerr)
We then measure and cut the necessary amount of Construct. The length of the material is measured with a periodontal probe. We cut a strip measuring twice that length, 6 mm (3 or 4 times the height of the core buildup). We continue etching the root canal with Condac 37-FGM for 30 seconds. We rinse with plenty of water for twice as long and dry the canal again with RECIPROC-VDW absorbent paper cones. Once this is finished, we apply the fourth-generation Gold Standard adhesive (Optibond Fl. - Kerr), as we mentioned earlier. We inject high-load fluid resin, a Nexcomp Flow - Metabiomed brand, into the canal. Using forceps, we position the moistened fibers midway in a U-shaped insertion pattern.
The sample was previously placed on a matrix of heavy condensation silicone, the Speedex Putty brand (Coltene) used for all simples and curing light (Valo X – Ultradent) as we mentioned earlier.

G3(N:10) Third group with quartz FRC fibers (Quartz Splint RTD)
We then measure and cut the necessary amount of Quartz Splint - RTD. The length of the material is measured with a millimeter ruler. We cut a strip of Quartz Splint - RTD measuring twice that length (6 mm) (3 or 4 times the height of the core buildup).

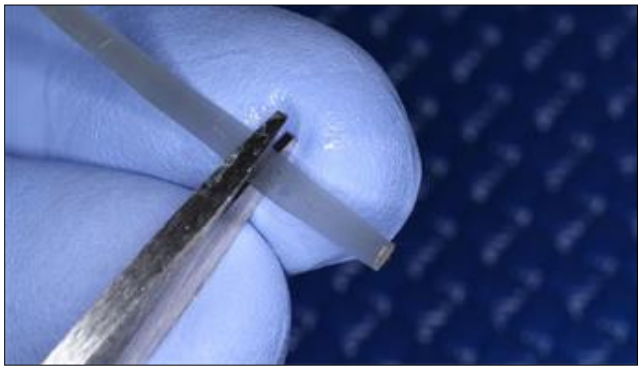

Fig 3: Quartz Splint Fibers – Rtd

We continue etching the root canal with Condac 37-FGM for 30 seconds. We rinse with plenty of water for twice as long and dry the canal again with RECIPROC-VDW absorbent paper cones. Once this is finished, we apply the fourth-generation Gold Standard adhesive (Optibond Fl. - Kerr), as we mentioned earlier. We immediately moisten the fibers in Ultradent brand Permasil for a time interval of 40 seconds.
We inject high-load fluid resin, a Nexcomp Flow - Metabiomed brand, into the canal. Using forceps, we position the moistened fibers midway in a U-shaped insertion pattern and curing light (Valo X – Ultradent) as we mentioned earlier.

G4(N:10) Fourth Control Group with fiberglass
The filling material will be removed from the root canal. In this case, the B&L 50/0.5 endodontic puggler will be used: The filling material will be removed from the coronal to the apical third 11 mm, leaving 5 mm of gutta-percha in the apical portion. We then tested the fiberglass bolt to fit the unsealed length.
An irrigation protocol is performed for gutta-percha removal. Finally the area is dried with RECIPROC-VDW brand absorbent paper points. We continue etching the root canal with Condac 37-FGM and dry the canal again with RECIPROC-VDW absorbent paper cones. Once this is finished, we apply the fourth-generation Gold Standard adhesive (Optibond Fl. - Kerr),), as we mentioned earlier.
We immediately moisten the fibers in Ultradent brand Permasil for a time interval of 40 seconds.

Fiberglass Bolt Preparation
Disinfect the fiberglass pin with Condac 37-FGM phosphoric acid for 30 seconds. Immediately rinse with water and dry. Then, apply Prosil silane along the entire length of the fiberglass. We proceeded to remove the excess fiberglass, we use a dual-cure cement (Allcem) to cement the fiberglass post. We inject the cement into the root canal. We wait 5 minutes for the cement to chemically activate.
The sample was previously placed on a matrix of heavy condensation silicone, the Speedex Putty brand (Coltene) used for all samples. The curing light (Valo X – Ultradent).

We use a prefabricated TOP M celluloid matrix, fill it completely with LLIS-FGM compactable resin, and insert it with the already polymerized fibers for all the simples.
All specimens will be inserted into a 6 x 6 cm diameter silicone prototype, filled with self-curing pink acrylic resin. The samples were immersed in containers containing one liter of artificial saliva solution for 168 hours. The samples were compressed in an Instron universal testing machine. The compression machine exerted a force at a rate of 0.5 mm per minute. The results were expressed in Newtons, and the values were recorded on established research forms. ANOVA statistical analysis was then performed using SPCS software.

Fig 4: Sample Contraction Test

Conclusions

It was concluded that Ribbond polyethylene fibers presented greater resistance to compression, thereby reducing the risk of fracture compared to the other materials evaluated in said research. The fiberglass pin, Construct-Kerr polyethylene fibers and Quartz Splint-RTD fibers did not present significant statistical differences.

References

1. Alenezi Ali A, Alyahya Sereen O, Aldakhail Noura S, Alsalhi Hanin A. Clinical behavior and survival of endodontically treated teeth with or without post placement: a systematic review and meta-analysis. Journal of Oral Science,2024:66(4):207–214.
2. Alves Paula Barbosa, Brandt William Cunha, Neves Ana Christina Claro, Cunha Leonardo Gonçalves, Silva-Concilio Lais Regiane. Mechanical properties of direct and indirect composites after storage for 24 hours and 10 months. European Journal of Dentistry,2013:7(1):117–122.
3. Baraba Anja, Cimic Samir, Basso Matteo, Ionescu Andrei C, Brambilla Eugenio, Miletić Ivana. Microtensile bond strength of fiber-reinforced and particulate filler composite to coronal and pulp chamber floor dentin. Materials,2021:14(9):240.
4. Carvalho Marco Aurélio de, Lazari Priscilla Cardoso, Gresnigt Marco, Del Bel Cury Altair Antoninha, Magne Pascal. Current options concerning the endodontically-treated teeth restoration with the adhesive approach. Brazilian Oral Research,2018:32:74.
5. Fadhil Noor Hayder, Ali Ahmed Hamid, Al-Hashimi Raghad Abdulrazzaq, Al-Qathi Omar Sabri, Foschi Federico. Assessment of treatment quality risk factors influencing the radiographic detection of apical periodontitis in root-filled teeth: a retrospective CBCT analysis. European Endodontic Journal,2024:9(3):252–259.
6. Faria Adriana Cláudia Lapria, Rodrigues Renata Cristina Silveira, Antunes Rossana Pereira de Almeida, Chiarello de Mattos Maria da Gloria, Ribeiro Ricardo Faria. Endodontically treated teeth: characteristics and considerations to restore them. Journal of Prosthodontic Research,2011:55(2):69–74.
7. Ferrari Marco, Ferrari Cagidiaco Edoardo, Pontoriero Denise Irene Karin, Ercoli Carlo, Chochlidakis Kostantinos. Survival rates of endodontically treated posterior teeth restored with all-ceramic partial-coverage crowns: when systematic review fails. International Journal of Environmental Research and Public Health, 2022, 19(4).
8. Freire Laila Gonzales, Iglecias Elaine Faga, Cunha Rodrigo Sanches, Dos Santos Marcelo, Gavini Giulio. Micro-computed tomographic evaluation of hard tissue debris removal after different irrigation methods and its influence on the filling of curved canals. Journal of Endodontics,2015:41(10):1660–1666.
9. Galiatsatos Panagiotis, Galiatsatos Aristidis. The role of porcelain veneers in the aesthetic restoration of discolored endodontically treated teeth. Clinics and Practice,2024:14(5):2080–2088.