

3M post and core solution

RelyX™ Fiber Post 3D

Glass Fiber Post



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Introduction

3M post and core solution. Featuring RelyX™ Fiber Post

The 3M post and core solution stands for a simplified but robust procedure with reliable, predictable outcomes – requiring only four clinically proven products and significantly fewer work steps:

Filtek™ Bulk Fill Posterior Restorative offers material and handling characteristics, which make it an ideal core build-up material, especially for big lesions in combination with a post: With one-step increments up to 5 mm, core build-ups can be done faster and easier.



Scotchbond™ Universal Adhesive provides a strong bond of the core build-up material to post and tooth structure. In one easy application – with no need for an additional primer.



RelyX™ Fiber Post 3D Glass Fiber Post's coronal 3D macro retentions ensure a secure bond to the core build-up. Together with RelyX™ Unicem 2 Automix Cement its microporous surface also offers excellent bond strength in the root canal.



RelyX™ Unicem 2 Automix Self-Adhesive Resin Cement not only offers high bond strength but also saves precious time, as a pretreatment is not required. The automix syringe together with the endo tip are designed to apply the cement directly into the root canal, reducing the chance of air pockets and voids.





Procedure steps and product descriptions

Selection of the post

POST RelyX™ Fiber Post 3D Glass Fiber Posts (and also the existing RelyX™ Fiber Posts) are radiopaque, translucent, glass fiber-reinforced composite posts.

The new generation posts feature coronal 3D macro retentions and superficial micro-porosities which together ensure a strong bond from root to core.

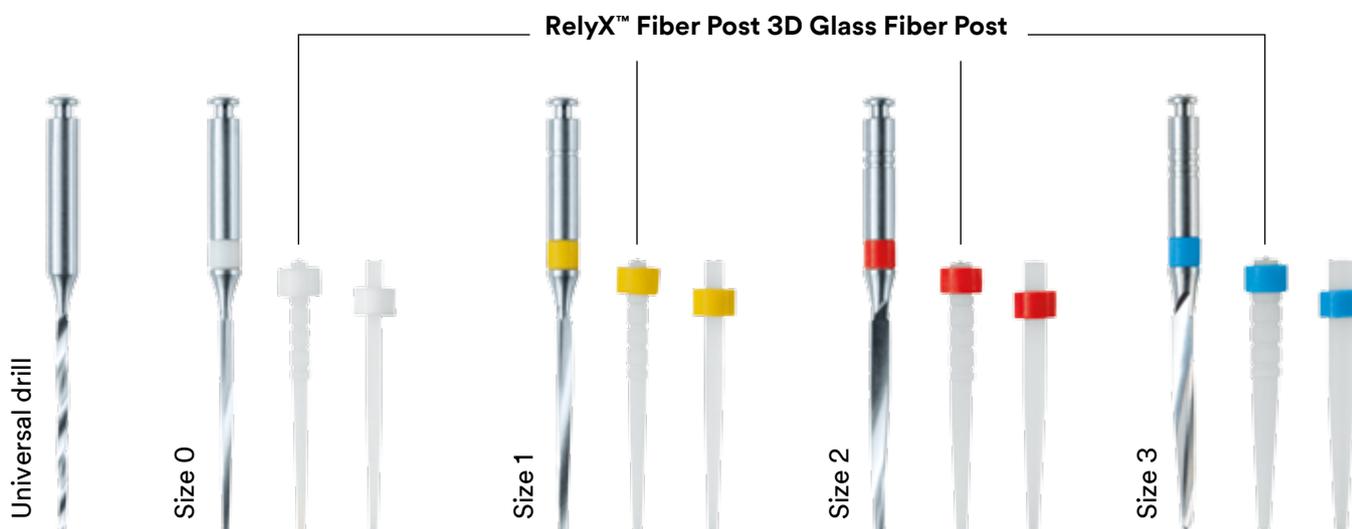


Sizes

All glass fiber posts are available in four sizes: 0, 1, 2, and 3. Colour codes ensure an accurate match to the drills. Drills (available in five sizes including one universal drill) are the same for both types of 3M Oral Care posts and are used for removal of the root canal filling and preparation of the root canal.

COMBINATION POST/DRILL				
POST SIZE/COLOUR CODE	0/white	1/yellow	2/red	3/blue
REMOVAL OF THE ROOT FILLING	Universal drill	Universal drill	Universal drill	Universal drill
PREPARATION OF THE ROOT CANAL	Drill white	Drill yellow	Drill red	Drill blue
TECHNICAL DATA POSTS				
DIAMETER OF APICAL POST END (MM)	0.60	0.70	0.80	0.90
DIAMETER OF CORONAL POST END WITHOUT RETENTION (MM)	1.10	1.30	1.60	1.90
TAPER	2.86° (5%)	3.44° (6%)	4.58° (8%)	5.72° (10%)
LENGTH	20 mm	20 mm	20 mm	20 mm

Fig. 1: RelyX™ Fiber Post 3D Glass Fiber Post sizes and technical data.

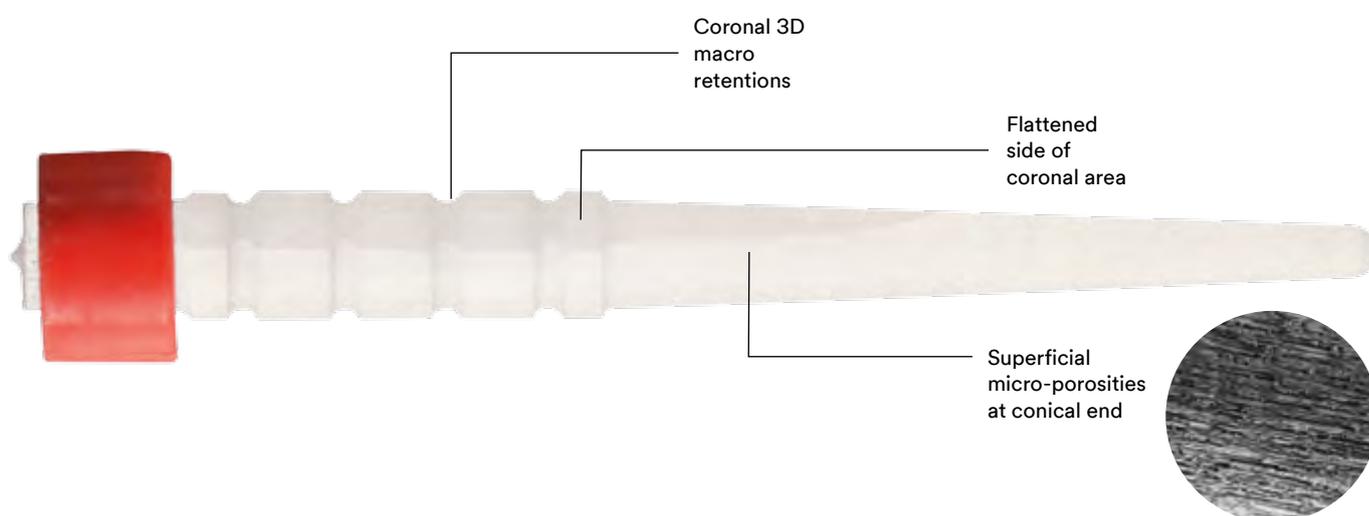


Shape

RelyX™ Fiber Post 3D and RelyX Fiber Post Glass Fiber Posts have both a tapered shape: They are parallel-walled (cylindrical) at the coronal end and conical at the apical end. The coronal end of the cylindrical part offers a large surface area for the adhesion of the core build-up material and the greatest material thickness to withstand mastication forces.

Moreover, the coronal area of the new generation post is also equipped with unique 3D macro retention rings that allow for secure retention to the core build-up material. The area is partly flattened, enabling a safe grip with tweezers.

The microporous surface of the conical end allows high mechanical retention for the cement and a strong bond to the root canal.



Composition

RelyX Fiber Post 3D Glass Fiber Posts are made from highly radiopaque glass fibers embedded into a composite resin matrix. For superior mechanical properties, the glass fibers have a parallel orientation and are distributed equally over the surface area (Fig. 2).

In addition, the glass fibers are pre-tensioned for enhanced post stability during the manufacturing process. A two-step manufacturing procedure that includes chemical and thermal curing, assures virtually complete curing of the composite resin matrix.

Due to their advantageous combination of mechanical and aesthetic properties, RelyX Fiber Post 3D posts are ideally suited for highly aesthetic restorations.

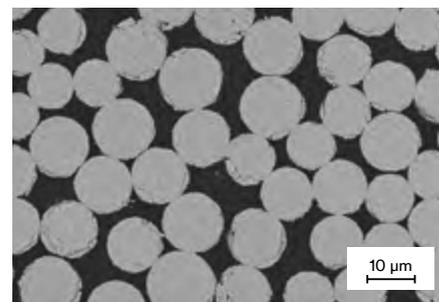


Fig. 2: SEM image (magnification 2kx) of a cross-section of RelyX™ Fiber Post 3D Glass Fiber Post. Glass fibers are depicted as white spots surrounded by a composite resin matrix. Source: 3M Oral Care internal data.

Radiopacity

Both RelyX™ Fiber Post 3D and RelyX Fiber Post Glass Fiber Posts are radiopaque. The radiopacity of RelyX Fiber Post (size 2) equals 2.5 mm Al/mm. With the new fibers used in RelyX Fiber Post 3D, the radiopacity is further increased to 3.5 mm Al/mm (Fig. 3)¹, enabling better post position control¹. These findings are also confirmed by Peetz et al.²

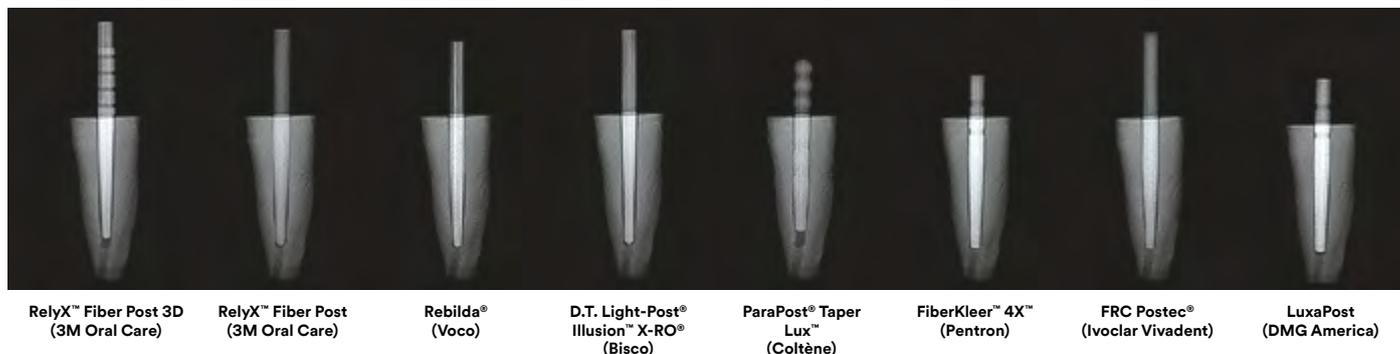


Fig. 3: Radiopacity of RelyX™ Fiber Post 3D and RelyX™ Fiber Post Glass Fiber Posts compared to competitive products. Source: THE DENTAL ADVISOR, Research Report Number 70 – June 2015.¹

Flexural strength

The flexural strength of the post contributes to the overall stability of the restoration. The flexural strength of RelyX Fiber Post 3D and also RelyX Fiber Post Glass Fiber Posts equals or exceeds that of competing products tested (Fig. 4). Thermocycling tests assess the long-term stability under simulated aging conditions. RelyX Fiber Post 3D and RelyX Fiber Post show both high flexural strength values even after 10,000 thermocycles (Fig. 5) and thus meet one of the key prerequisites for the longevity of restorations.

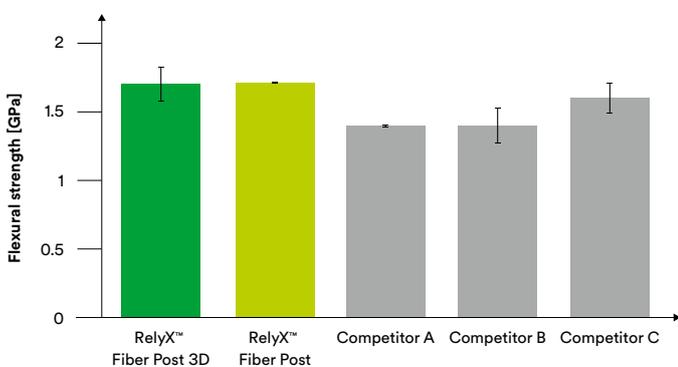


Fig. 4: One-point flexural strength testing of RelyX™ Fiber Post (3D) Glass Fiber Posts and competitive endodontic posts. All posts with a similar diameter of 1.5 – 1.6 mm. Source: 3M Oral Care internal data. Data available upon request. See last page for contact information.

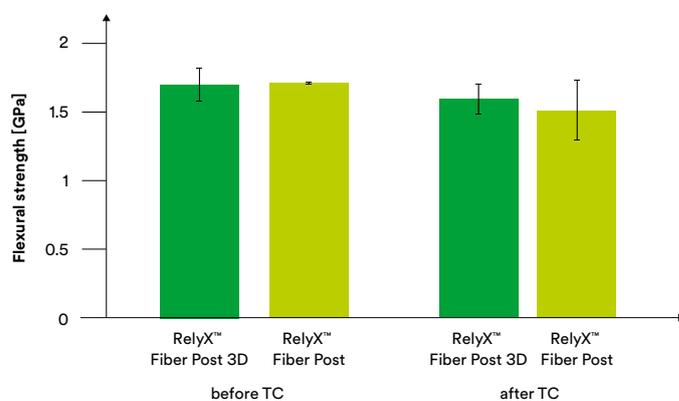


Fig. 5: One-point flexural strength testing before and after thermocycling (TC), 10,000 cycles, 5°C/55°C, dwell time 30 s, change time 8 s. Source: 3M Oral Care internal data. Data available upon request. See last page for contact information.

The higher the Young’s modulus of a material is, the less flexible it is. In contrast to posts made from metal alloys or ceramics, the Young’s modulus of RelyX Fiber Post 3D is more similar to dentine.

Due to the high Young’s modulus of metal and ceramics, failures with these posts mainly occur as a result of excessive stress on the dentine and, consequently, in a higher incidence of root fractures. With fiber posts, very little stress arises during use and the stress is evenly spread all along the root.³ The tapered shape in the apical area of RelyX Fiber Post 3D and the shape congruency of the prepared canal and post further contribute to an even stress distribution.

In addition to the biomechanical behavior, other advantageous properties of fiber posts in general have contributed to their rapid diffusion among clinicians. Fiber posts simplify the endodontic restoration procedure compared to the use of metal cast posts by eliminating the laboratory step. If a retreatment is needed, fiber posts are relatively easy to remove with a rotary instrument. Moreover, fiber posts offer the most favorable aesthetic properties for reproducing the natural look of the restored tooth.⁴

*Compared with RelyX Fiber Post.

Post cementation



CEMENT RelyX™ Unicem 2 Automix Self-Adhesive Resin Cement provides a reliably high bond strength – without pretreatment steps. The automix syringe together with the endo tip enable a smart and void-free application of the cement directly into the root canal.



Generally, decementation at the cement/dentine interface is considered to be the main cause of fiber post failures.³

By eliminating the etching, priming and bonding steps, self-adhesive resin cements simplify the cementation and they are a reliable and robust alternative for luting glass fiber posts. Due to the reduced number of work steps, the procedure is less technique-sensitive and less prone to mistakes.⁵

With RelyX Unicem 2 Automix Cement, dentists get the same high bond strength to tooth structure⁶ as with adhesive resin cements but with significantly fewer steps required.

Peez et al.¹ investigated the bonding performance of RelyX Unicem 2 Automix Cement to RelyX Fiber Post 3D and compared the data to a control group with an adhesive resin cement (RelyX Ultimate Adhesive Resin Cement, 3M Oral Care). Both the adhesive resin cement (RelyX Ultimate Cement) and the self-adhesive resin cement (RelyX Unicem 2 Automix Cement) showed consistently high bond strength values with RelyX Fiber Post 3D (Fig. 6).

In a clinical environment, RelyX Unicem 2 Automix Cement might be easier to use. Due to the micro roughness ($R_z = 10 \pm 4 \mu\text{m}$) of the post surface (Fig. 7) and the excellent chemical compatibility of the resin components of RelyX Fiber Post 3D and RelyX Unicem 2 Automix Cement, no pretreatments of the post such as etching or silanisation are necessary.

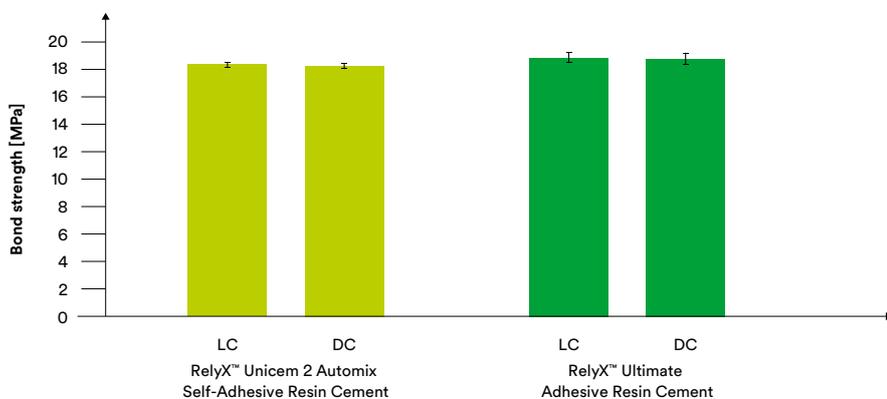


Fig. 6: Pull-off bond strength values of RelyX™ Ultimate Cement and RelyX™ Unicem 2 Automix Cement in comparison. Both materials show same performance in light-cure (LC) and dark-cure (DC) mode. Source: Peez et al.¹

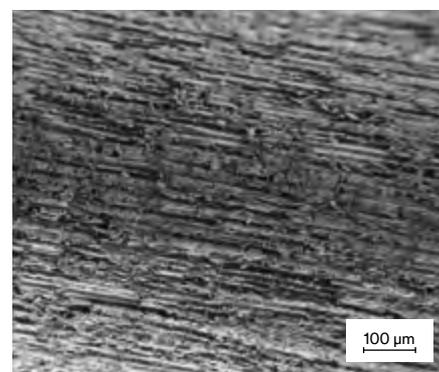


Fig. 7: Surface of RelyX™ Fiber Post 3D Glass Fiber Post (SEM, 200x magnification). Source: Peez et al.¹



Core build-up

ADHESIVE Scotchbond™ Universal Adhesive provides a strong, reliable bond of the core build-up material to the post and tooth structure in one application – with no need for an additional primer.



To achieve a secure bond between the post and the composite core build-up material, it is sufficient to apply Scotchbond Universal Adhesive to the post and the surrounding tooth structure once and after removal of any excess cement. A separate etching step is not required.

Schwarz et al.⁷ evaluated the effect of macro retentions in the coronal part of endodontic posts by testing the combination of Filtek™ Bulk Fill Posterior Restorative bonded with Scotchbond Universal Adhesive to post samples with and without macro retentions: Overall, both coronal designs showed high bond strength values of the core build-up to the post using Scotchbond Universal Adhesive. Nevertheless, the significantly higher values for samples with macro retentions might be advantageous for a reliable clinical outcome (Fig. 8).

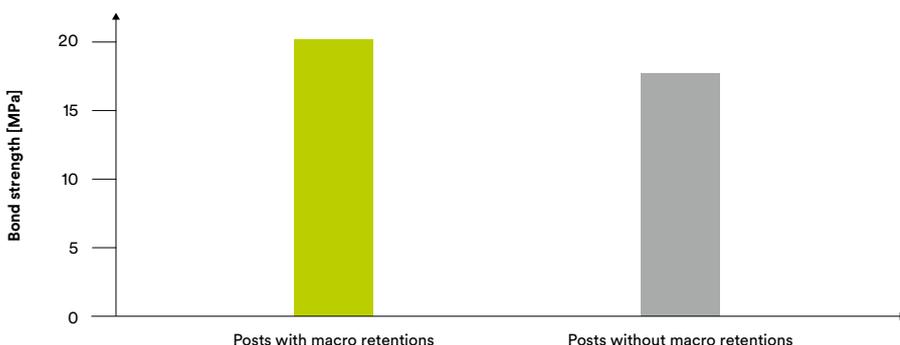


Fig. 8: Bond strength comparison of posts (median values) with and without macro retentions using a pull-off test method (speed: 1mm/min). Bonding surface treated with Scotchbond™ Universal Adhesive. Filtek™ Bulk Fill Posterior Restorative light-cured from front side for 20 s, samples were stored (1h 36°C/>95% rel. humidity; 23h water 36°C) prior to testing. Source: Schwarz et al.⁷

The chemistry of Scotchbond Universal Adhesive utilises phosphorylated monomers in a water/ethanol-based solution that provides acidity and allows the adhesive to bond to dentine and enamel without the use of a separate phosphoric acid etching step. With a pH value of 2.7, it can be considered as a mild self-etch adhesive.

Scotchbond Universal Adhesive uses three trusted and well-known adhesion promoters in one formulation (VMS technology) and thus also bonds to restoration substrates like fiber posts:

- **Vitrebond™** Copolymer provides consistent bonding to dentine under varying moisture levels.
- **MDP** provides self-etching properties and high bond strength to zirconia, alumina, metals, and metal alloys.
- **Silane** allows for chemical bonding to glass ceramic surfaces without using a separate ceramic primer.



CORE BUILD-UP MATERIAL Filtek™ Bulk Fill Posterior Restorative enables an easy and void-free core build-up around the post.



Due to its material properties, Filtek Bulk Fill Posterior Restorative is ideally suited for making core build-ups: It is a visible, light-activated restorative composite optimised for posterior restorations providing excellent strength for durability. Shades are semi-translucent and allow low-stress curing, enabling up to 5 mm depth of cure. Thus, core build-ups can be made faster than when placing and curing restorative material in increments. The capsule tip design allows void-free application of the material.

By modifying the proportions of high molecular weight monomers, a resin system with the properties of a sculptable bulk fill material was developed. In addition, the higher molecular weight effectively reduces shrinkage, while still creating a tough, highly cross-linked network. For easier preparation, the cured material cuts like dentine.

Filtek Bulk Fill Posterior Restorative is one of 3M Oral Care’s most radiopaque composites. This high level of radiopacity is achieved by incorporating nano ytterbium trifluoride. The remaining fillers are a combination of a non-agglomerated/non-aggregated 20 nm silica filler, a non-agglomerated/non-aggregated 4 to 11 nm zirconia filler, an aggregated zirconia/silica cluster filler (composed of 20 nm silica and 4 to 11 nm zirconia particles), making the total inorganic filler loading approximately 76.5 % by weight (58.4 % by volume).

These properties make Filtek Bulk Fill Posterior Restorative an ideal material, especially for larger core build-ups in combination with a post.

Using Filtek Bulk Fill Posterior Restorative for a core build-up around RelyX™ Fiber Post 3D Glass Fiber Post leads to a strong and void-free core build-up. The material is sculptable but easy to adapt to both tooth structure and post. Peez et al.¹ analysed samples using μ CT measurements. On the μ CT images of the cross-section, close, void-free contact between Filtek Bulk Fill Posterior Restorative and RelyX Fiber Post 3D Glass Fiber Post is visible (Fig. 9).

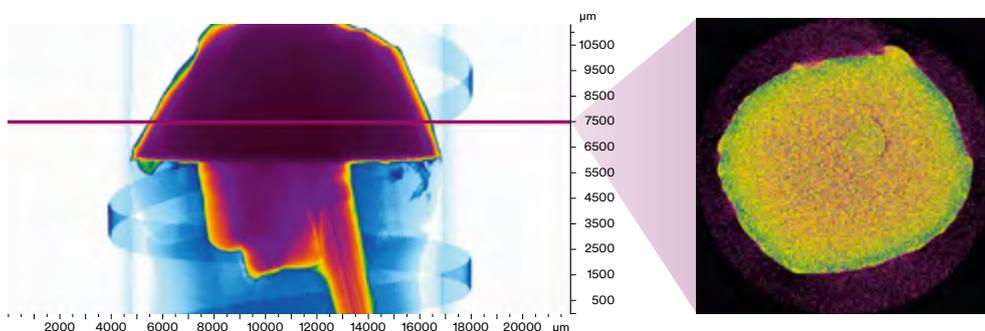
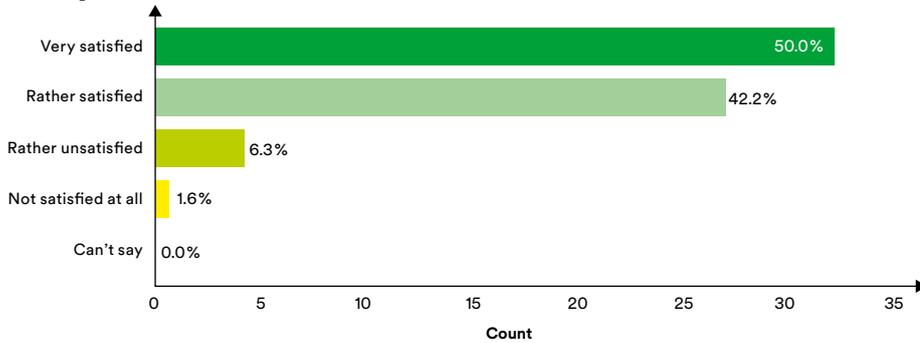


Fig. 9: X-ray microtomography data were collected on samples placed on endodontic training teeth showing void-free contact between Filtek™ Bulk Fill Posterior Restorative and RelyX™ Fiber Post 3D Glass Fiber Post. Source: Peez et al.¹

Field evaluation results

In an in-office evaluation, the 3M post and core solution was tested by dentists from Europe and the U.S. More than 700 RelyX™ Fiber Post 3D Glass Fiber Posts were placed and documented during the evaluation period. The dentists' feedback confirms the very high clinical acceptance. When asked for the **overall performance of the 3M post and core solution**, 92% responded they were very satisfied or satisfied (Fig. 10).

How do you rate the overall performance of the 3M post and core solution?



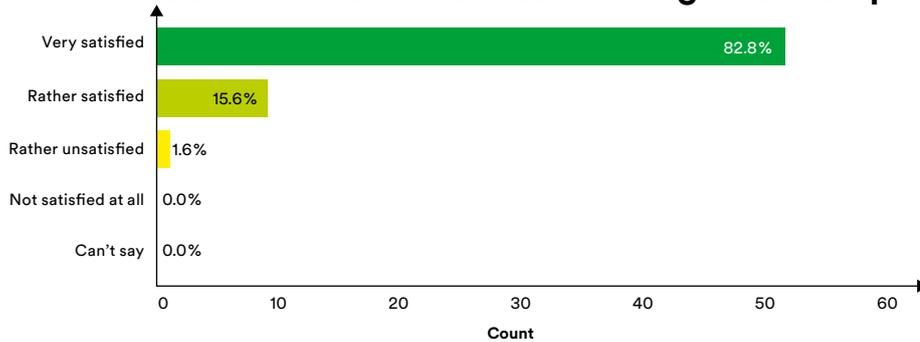
92%
are very satisfied or satisfied.

Fig. 10: Overall performance of the 3M post and core solution. Source: Field evaluation conducted by 3M Oral Care.

In particular, the **new RelyX Fiber Post 3D Glass Fiber Post** – specifically its easy handling, good aesthetics and the significantly improved radiopacity – **was rated excellent**.

Together with the clinically proven RelyX Unicem 2 Automix Cement and Filtek™ Bulk Fill Posterior Restorative, the entire system enables a convenient, fast and reliable procedure for endodontic restorations (Figs. 11/12).

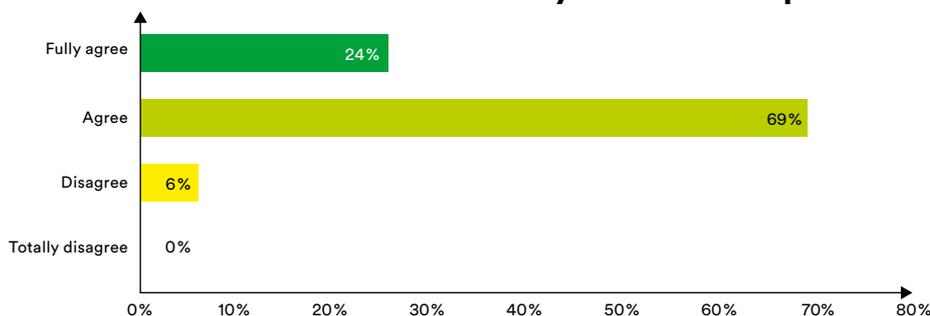
How do you rate the direct application of RelyX Unicem 2 Automix Cement into the root canal using an endo tip?



98%
are very satisfied or satisfied.

Fig. 11: Rating of direct application of RelyX™ Unicem 2 Automix Cement into the root canal using an endo tip. Source: Field evaluation conducted by 3M Oral Care.

Would you agree that Filtek Bulk Fill Posterior Restorative enables a fast and easy core build-up?



93%
fully agree or agree.

Fig. 12: Agreement that Filtek™ Bulk Fill Posterior Restorative enables a fast and easy core build-up. Source: Field evaluation conducted by 3M Oral Care.

Clinical case

3M post and core procedure in anterior region

Dr. Gunnar Reich, Munich, Germany

Pretreatment and post selection



Fig. 1: Situation after endodontic treatment of left upper incisor and canine. Endodontic treatment is indicated after tooth trauma and bridge loss. The coronal tooth loss requires an endodontic post treatment.



Fig. 2: For endodontic restorative treatment, the guttapercha filling is removed with the Universal Drill. Then, the cavity is widened and shaped with the drills up to the size required.



Fig. 3: RelyX™ Fiber Post 3D Glass Fiber Posts are shortened to the necessary length at the coronal end with a diamond disc.



Fig. 4: Prior to cementation of the posts, root canals are cleaned by rinsing and dried.

Post cementation



Fig. 5: RelyX™ Unicem 2 Automix Cement is used to cement the posts. The endo tip helps to easily fill the root canals from bottom to top.



Fig. 6: After insertion of the post into the root canal, the excess cement is removed using a micro brush. Then the cement is allowed to set.

Application of adhesive



Fig. 7: Scotchbond™ Universal Adhesive is applied to post and dentine once the cement has set.



Fig. 8: Scotchbond™ Universal Adhesive is light-cured for 10 sec. The situation is now ready to build up the core.

Core build-up



Fig. 9: Filtek™ Bulk Fill Posterior Restorative is used as core build-up material. With the capsule, the composite can be applied directly. Then, the composite is adapted and shaped with a Heidemann spatula. A matrix is not necessary.



Fig. 10: Finally, the core build-ups are prepared and finished, ready for the impressing procedure and temporary restoration.



References

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- ⁶ R.R. Pacheco, R.V. Rodrigues, G.M.B. Ambrosano, F.M. Pascon, M. Giannini: Dentin Bond Strength of Fiber Posts Cemented with Resin Cements, J Dent Res 93 (Spec Iss A): 248, 2014, (www.dentalresearch.org)
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