Technical Specifications

Rev. 01- Dec/07



Fiber Post

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1. Presentation

White Post DC is a root canal reinforcement post manufactured from fiberglass composite and epoxy resin. Its conical format allows excellent adaptation to root canals without a large removal of tooth structure. The post is highly aesthetic, translucent, radiopaque, and resistant.
White Post is available in 8 sizes: DC0,5 ; DC0,5E ;DC1; DC1E; DC2;DC2E ; DC3 and DC 4.
The White Post Special DC fiberglass posts aim to assist in cases where the root canal is worn out and consequently there is a larger mechanical effort in the cervical third of anterior teeth. The format of a White Post DCE post present the same apex of the original White Post DC (0.65mm of the post DC0. 5), a shorter conical area and a significant increase in diameter in the cervical area (parallel area).

2. Presentation Data

Full kit (White Post DC)
05 post sizes (DC0. 5, DC1, DC2, DC3, and DC4), 05 posts of each size (total of 25 posts) and their respective drills.

Special kit (White Post DC and DCE)
Kit containing posts in the sizes DC0. 5, DC0.5E, DC1, DC1E, and DC2E, 5 posts of each size and their respective drills.

Basic kit (White Post DC or DCE)
Packing containing 05 White Posts of a certain size and their respective drills.

Refill (White Post DC or DCE)
Packing containing 05 posts of a certain size.

3. Main Features

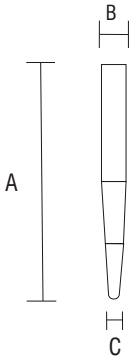
Double Conicity: The Conical format, especially in double cone, allows a highly conservative preparation, as it requires the minimum possible waste in the apical area and very high resistance in the cervical area due to the largest diameter of the post in this part.
Size Options (diameters): The 8 sizes are suitable for the great majority of clinical cases which are common nowadays. The size (DC0. 5) is suitable for cases of incisor teeth and molars while the size DC4 is suitable for cases of extremely wide and worn out canals. With this size range and the conical format, most cases can be assisted without the use of accessory posts or, at the most, with the use of a small addition of resin High Translucence: The good relation of refraction index between epoxy resin and fiberglass offers excellent translucence to the product. The high translucence level gives the product an excellent aesthetic condition and allows cements to be light cured through transillumination.
Radiopacity: The radiopacity of White Post is identical to the one of the dentin which allows the visual follow up of the post adaptation to the root canal.

Specific drills: The adaptation of a post to the preparation of a root canal is a Critical factor for the success of the cementation. The White Post drills follow the format of the posts and allow the preparation of the root area in a way to perfectly adapt the post to the cavity.
High Resistance: The high level of fibers, their compactability and excellent affinity with epoxy resin give the product excellent mechanical properties. The conical format also contributes to its characteristics of mechanical resistance, as it allows a larger diameter and resistance in the cervical area without requiring larger waste in the apical area.

4. Technical Data

Basic Composition: Fiberglass, Epoxy Resin, inorganic load and polymerization promoters.
Expiry: 5 years from the production date.

4.1. Product Dimensions



		A	B	C
whitepost	0,5	20mm	1,4mm	0,65mm
whitepost	0,5E	18mm	1,8mm	0,65mm
whitepost	1	20mm	1,6mm	0,85mm
whitepost	1E	18mm	2,0mm	0,85mm
whitepost	2	20mm	1,8mm	1,05mm
whitepost	2E	18mm	2,2mm	1,05mm
whitepost	3	20mm	2,0mm	1,25mm
whitepost	4	20mm	2,2mm	1,45mm

4.2. Physical-chemical and mechanical properties of the composite:

Property	Specified
Appearance	Translucent colorless
Fiberglass Level (%)	80,0 ± 5,0
Epoxy Resin Level (%)	20,0 ± 5,0
Elastic Modulus* (GPa)	30 a 50
Flexural Strength* (MPa)	Minimum 800

Note: * Tests Accomplished according to ISO 10477 three-point bending test.

4.3. Typical fracture strength values of different post diameters

Post Size				
DC 0.5 (1.4 mm) 60 to 80 N	DC1 (1.6 mm) 100 to 120 N	DC2 (1.8 mm) 140 to 160 N	DC3 (2.0 mm) 170 - 190 N	DC4 (2.2 mm) 200 - 220 N

Note: * Tests accomplished according to ISO 10477 3 point flexural test, support opening of 20 mm..

4.4. Precautions, Contraindications, and possible Side Effects:

The posts may present exposed fiberglass shards which can perforate skin. The cutting of the posts for length adjustment can also expose perforating shards. Always use latex protective gloves when manipulating the product. Use protective goggles while cutting the posts and avoid cutting them near the patient's face in order to prevent some eventual accident or discomfort from the residues. Avoid inhaling dust from the cutting process. The posts should be free of oil, dust, organic materials or any other polluting agents at the moment of cementation to avoid bond failure.

5. Selecting and Using White Post

The concept of applying fiberglass posts has evolved since its introduction in the market. Initially it was said that the use of fiberglass posts was only advisable for posterior teeth in order to offer anchorage to the restorative material in cases of large destruction of the dental crown. Recently, the posts have been applied in anterior teeth, but with the restriction that there should be some level of tooth structure left in the cervical area (a minimum of 2 to 3 mm) so that there was a chance for the dental restoration to resist against the mechanical demands. From this moment, there is larger dependence on the mechanical resistance of the material and also on the format of the post (conical, so that it may preserve the root structure and keep an appropriate diameter in the cervical area from the mechanical point of view). Nowadays, the posts are used in all types of teeth, even in cases of anterior teeth without remaining tooth structure (gingival margin). These applications in more challenging cases, as they are relatively recent, still require longer controlled clinical evaluations but they are already considered a new concept for the application of posts.
The selection of the post size which should be used in certain situations should follow some criteria so that a durable result can be achieved. The following indications are suggestions which serve as a guide for the selection of different sizes of White Post DC.

5.1. Posterior teeth

The indications are usually restricted to cases where a large portion of the dental crown has been destroyed and there is a large risk of restoration fracture or when there is no structure for the cementation of prosthesis. Since they present more irregular and thinner root canals, the commonly used sizes are DC 0.5 and DC 1 (at the most, when possible). In posterior teeth, the exercised forces are parallel to the axis of the tooth and do not present the risk of fracturing the post. In these cases, the post serves only as retention for the definitive restorative material or for the filling material in the case of indirect restorations.

5.2. Anterior teeth

In anterior teeth there are oblique forces (±45°) to the dental axis, thus, there is

Significant risk of fracture indeed. In these cases, the correct post selection according to the expected mechanical forces is decisive for the success of a dental restoration. The main characteristics which should be observed when selecting the post are the amount of remaining tooth structure, the conditions of the root canal preparation (if it is well conserved or worn out), the patient's mastication habits and practical conditions for post implantation.

Partial loss of the dental crown: These are cases of quite favorable prognostic and the selection of the post should follow the rule of better adaptation to the root canal. The most conservative post is usually chosen (smaller size) but, if the canal is to worn out, it is not possible to cement a post with larger diameter (larger size). The conical format of the posts allows, in most of the cases, to fill in the excess space of wider canals in a quite satisfactory way without requiring the use of accessory posts. For maxillary lateral incisor teeth and mandibular incisor teeth the chosen posts are usually DC0. 5 and sometimes DC1 (wider canals). For maxillary central incisor teeth, the posts usually chosen are DC1 and even DC2 depending on the level of wear in the canal.

Complete fracture of the crown, but with remaining tooth structure in the cervical area (minimum of 2 to 3 mm): In these cases the situation is more challenging than the previous one as more mechanical pressure on the post can be expected, even though it is a known fact that the resistance offered by the remaining tooth structure to the restoration is still quite large and it will make most of the effort. To increase restoration resistance a thicker post should be selected whenever possible. The mechanical resistance of a post is related to the diameter of its section in the area corresponding to the cervical area of the tooth and, as mechanical pressure will be larger in these cases, the choice of a thicker post is convenient. Again, the conical format of the posts contributes significantly to a larger preservation of the root structure due to the significantly smaller diameter in its apical area, which allows the choice of a larger size post without risking the tooth structure in the medium and apical third of the root. The migration of one size for another represents an increment of 0,2 mm in diameter, which in turn represents 0,1 mm of wear in the canal wall. Therefore, for teeth with complete fracture of the crown but with some remaining tooth structure in the cervical area, try to select a slightly thicker post. If the diameter of the canal is calling for a DC0.5 post, check if it would not be possible to cement a DC1 post and so on. Special attention is necessary in case of canals with larger wear in the cervical area. If the option of a thicker post is not viable, then try to fill in the excess space with a resin or material resistant to compression to prevent the post from flexing in this area. An eventual flexure of the post, even if does not fracture, will also represent restoration flaw by catastrophic failure.

Complete fracture of the crown, without remaining tooth structure in the cervical area (fracture at the gingival margin): This is the most challenging clinical situation there is. The resistance of the restoration is almost completely dependent on the resistance of the post and/or on the quality of the remaining root structure. The success of the restorative process strongly depends on the selected post. In these cases, a significantly thicker post is recommended, as for instance DC2 or DC3, even if this means some additional wear of the root canal structure. Thinner posts (less than 1,5 mm) frequently do not present enough resistance to avoid cementation flaw and, especially, post fracture.

Brittle Non-Vital Teeth: Non-vital teeth with severe wear of the root canal have frail resistance and may fracture more easily. The use of a post to reinforce the interior

Structure of the tooth may prevent it from an eventual fracture. In these cases, the recommendation is to use the post which best adapts to the format of the canal without the need of further wear.
The table below summarizes the main applications of the different White Post DC sizes.

Post Size				
DC 0.5/DC 0.5E	DC1/DC1E	DC2/DC2E	DC3	DC4
• Molars and pre-molars;Molares e pré-molares; • Central incisors and upper and lower laterals • Reinforcement of brittle non-vital teeth due to excessive wear of the canal.		• Cases with more mechanical pressure (significant loss of tooth structure) • Wider canal (larger wear) • Reinforcement of brittle non-vital teeth due to excessive wear of the canal.		• Overly wide canals • Cuspids with significant structural loss

Anterior teeth: Fiberglass posts, in contrast with metal posts and metallic buildup, may flexure and even fracture. These characteristics protect the root structure from possible irreversible damage, such as root fracture, which occurs more frequently in teeth restored with the metal posts and prefabricated posts. However, the relative easiness to flexure of fiberglass posts may also be a limitation for their use and represent a cause of failure of the restorative process. A post does not necessarily need to fracture to mean restorative flaw. If it does not resist the pressures and allow a certain flexure, fracture of the restorative material will occur and or even interface failure, along with long-term consequences such as marginal leakage, recurrent caries, and lost of bonding. Therefore, it is of the highest importance that a good interpretation and diagnosis is made of the case and that the professional try to analyze the mechanical needs involved in each case. If the clinical situation is critical and the mechanical pressures are high, a thicker post (more than 1,7 mm) is the most reliable option. Overly big slacks in the cervical area and failure in the filling of such slacks may also allow fractures of the restorative material and consequent restorative failure.

5.3.Specific information (Overall)

The replacement of metallic root canal reinforcement posts for fiberglass and resin posts is an irreversibly set trend. The main reasons for such tendency are the high aesthetic level of the fiber-resin posts, which practically disappear inside the tooth (the metallic posts are poor in aesthetics: their metallic color and lack of translucence give the tooth a discolored aspect), fiber-resin posts present a higher safety level, with no cases of rejection, corrosion or cases of fracture of the root portion (metallic posts often present oxidation problems and many cases of fracture of the root portion due to their lack of elasticity, which compromises the tooth irreversibly). Fiber-resin posts are prefabricated and greatly reduce the clinical time needed for reinforcement implantation (metallic posts often need to be customized). Fiber-resin posts are easy to remove in cases of necessary replacements.
Some properties are required and sought after to compose fiber-resin posts. Not all of them can always be conjugated into a single product and there are property differences among the models. Such properties will be discussed in the topics to follow in order to visually highlight the differences between White Post dowels and the competing brands while presenting properties which make White Post superior to such brands.

6. Main Properties and their characteristics

6.1. Shape

There are basically 3 shapes being manufactured in the world market:

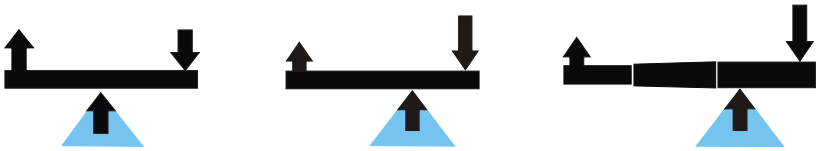
Parallel: It is the simplest model and less conservative of the tooth structure. It is said that its format is more applicable to wider or ground canals, where the opening of the deepest area is already quite large. This model requires a larger opening of the canal until the end of the length of the post (bottom of the canal), it also usually requires the use of accessory posts to solve any gaps in the superior part. It may often be replaced by a conical post with no need to open the canal too widely and with the additional advantage of the post offering a wider diameter in the cervical area. The large availability of canal opening drills is perhaps one of the factors which have led to the fast implantation of fiber-resin posts. Such posts require Gates' or Peeso drills, which are commonly found in dental supply stores. The presence of grooves which work as mechanical retainers in the cementation end up reducing mechanical resistance since they represent spots where the real diameter of the pin is smaller than the nominal diameter. These grooves for mechanical retention are questioned and will be discussed in the topic on cementation which follows. Despite being a less advantageous model, it has its applications and its followers.

Conical: It is said to be a model more conservative of the tooth structure since the opening of the canal is very smaller at the bottom part. Its format also allows larger diameter in the cervical area, where there is indeed larger stress on the post and where fracture may occur, thus representing a more resistant model than the parallel one. As an example of this characteristic, it can be considered that, for a certain tooth which requires a more resistant post, the conical post will have a finer tip than the parallel post (this will require less tooth structure removal) and much larger diameter in the cervical area, which means larger resistance. Conical posts are usually grooveless and require a specific drill for the opening of the canal in order to achieve perfect adaptation. The great majority of European and American posts are in the conical format, demonstrating that it is the most accepted model due to its properties. Examples of this post model are: FRC - Postec / Ivoclar-Vivadent.

Conical with Double Cone: This model gathers the most modern concepts in terms of resistance and adaptation of the post to the root canal. This format resulted from a study where the aim was to adapt the post to the canal and not the other way around. It is the model which requires the least removal of tooth structure. Like the conical post, it has a fine tip and wide diameter in the cervical area, the difference is that the thickening of the post from the tip to the cervical area is accomplished by a second cone in the intermediary area. It is usually grooveless and requires a specific drill for opening the canal in order to achieve its perfect adaptation. This model was introduced in the market by the BISCO Company in the USA with the name of DT Light-Post. The concept and the post are an unquestionable success, especially with opinion makers. The conical format also has the advantage of rarely requiring accessory posts as they better complete the cervical area.

Performance Principle

The resistance of a certain posts is essentially based on its resistance in the cervical area, in other words, the area of larger stress. For fiberglass posts, this resistance is proportional to the diameter of the post in this area, that is, the larger the diameter, the larger the resistance. The performance principle of a lever is what is used here to explain the stress which occurs on a post cemented in the root canal. The part which is cemented inside the canal and inside the crown is totally immobilized and the most fragile part is indeed the joint between the root part and the crown, in other words, the cervical area. If a fracture eventually occurs, it is very likely to occur in this area. This is particularly true for fiberglass pins since they have certain elasticity and can be bent without being fractured. For metallic posts, this does not apply due to the lack of elasticity of such material which often ends up fracturing the root portion, causing tooth loss. The illustration below shows the function of a lever and the involved forces:

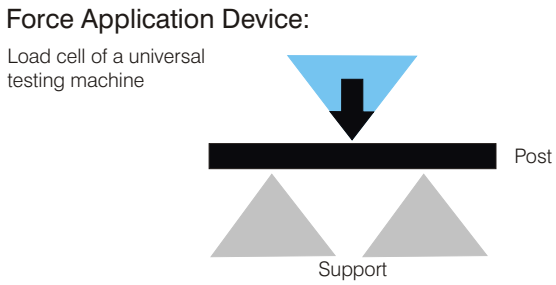


Situation 1 Situation 2 Situation 3

In situation 1, the lever is supported in the center and the force applied downward is transmitted upward with the same intensity.
In situation 2, the model resembles the situation of a post cemented in a root canal. A large force has to be applied downward on the short end so that a small upward force results on the long end. If this situation is reversed, a small force on the long end results in a very large force on the short end. The lever principle is used when we open a bottle using an opener or when we open a cap by levering it with a spoon. In the case of the posts, we have the long end cemented in the root and responsible for the dissipation of great forces that are applied perpendicularly on the crown part. For this reason, it is important that the posts are implanted as deep as possible. Fiberglass posts still have the advantage of a certain elasticity level, which helps dissipate the large forces that are eventually imposed on the crown, thus preventing root fracture.

Resistance Measurements

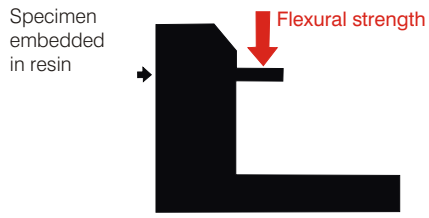
It is quite common to find post resistance tests and measurements in the literature based on the intrinsic properties of the material constituting them, especially in terms of flexural strength and elastic modulus. Flexural strength and elastic modulus are indeed properties which reflect resistance and flexure capacity of the material in the extreme application of a force when fracture and failure of the material occurs. This type of property is measured with the so-called Three-Point Bending Test (ISO 10477) as illustrated below:



The three-point bending test: The post is supported on a device that exposes its central part which is pressed by a cutlass linked to a load cell. The post is pressed until its fracture and the load cell registers the applied force x the occurred flexure. The information is used to calculate the modulus and flexural strength of the material, which are regarded as intrinsic properties.

In this test, the post is placed on two supports leaving its central portion free to flexure. A force is applied in the middle of the post until its fracture. The relation between the necessary maximum force to fracture the post, its diameter, the extension between the two supports and the deflexure which occurred until the moment of fracture will allow the calculation of the fracture resistance and flexural modulus.

As mentioned previously, this is the most common type of test used to measure the intrinsic resistance properties of the material. However, it can also be said that this test is not the ideal model to evaluate the practical behavior of a post, in reality the post will never receive pressure on its center but on one of the extremities and being supported in the center (lever model). In order to evaluate the behavior of the post in this situation, Flexural strength tests were accomplished with the post immobilized at the root part until the cervical area by a device, similarly to what occurs when a post is cemented. The force applied in the extremity represents the coronal portion of the post, leaving it free to be flexed. As such, it is possible to evaluate the force against which the post resists in case such force is perpendicular to its implantation angle in the root. The illustration below shows the test outline.



Two-point Bending Test:The post is only supported in its cervical part and it is pressured by a cutlass linked to a load cell. The post is pressured until fracture and the load cell registers the applied force until that moment.

Therefore, the simulation is closer to the real use conditions of the post.

The results obtained with several different posts allowed the confirmation of what was already known in clinical practice: Some posts with high flexural strength perform insufficiently in clinical cases since they often fail. Such flaw can be caused by its fracture or a large flexural movement which causes rupture of the crown cementation. The high flexibility of a post harms its cementation. The post should offer resistance against movement of the cemented parts. These parts do not endure such movement. Flexure and fracture are only sought after in more extreme cases when an accident could cause fracture of the tooth or root.

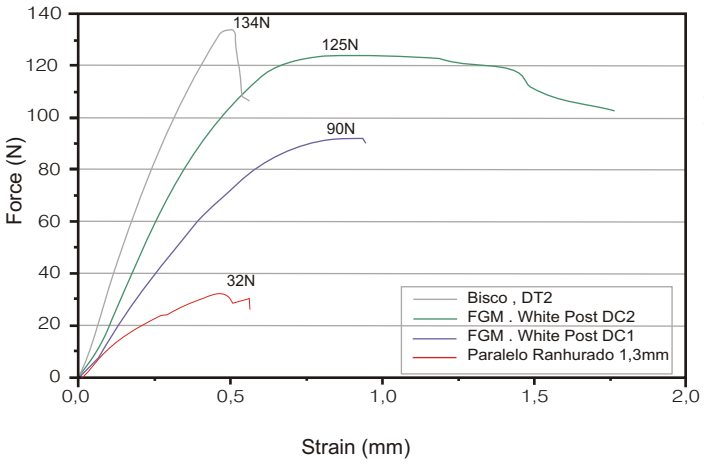
The table below presents measured values of flexural strength and maximum loads for fracture. Observe how the format of the post influences flexural strength and fracture resistance.

Table 2 Flexural strength and maximum fracture loads of some commercially available posts.

Post Identification	Maximum force until failure (N)	Measured Flexural Strength (MPa)****	Fracture mode
White Post DC 1* (0.85 x 1.6 mm)	90	850 to 935	Plastic Flexure
White Post DC 2* (1.05 x 1.8 mm)	125	850 to 935	Plastic Flexure
DT Ligth Post #2 (1.0 x 1.8mm) (BISCO USA) **	134	918	Flexure and Internal Fracture
Parallel Post (1.3 mm nominal) (Nacional)***	32	1343	Intense Deformation and Fracture

Notes: * = Average of 3 readings, (diameter at the tip x diameter in the cervical area);* * = Average of 2 readings; * * * 1 Single value. 2 points were analyzed but the second presented a worse curve; * * * * = Value of Flexural Strength measured in the Three-Point Flexural test with a gap between supports of 10 mm. Tests accomplished at FGM in an EMIC - Universal Testing Machine model DL 3000.

The graph below shows the curves obtained in the tests. It is also possible to observe the flexure behavior of the posts.



Graph1
Deformity profile in relation to applied force of a different fiber glass post

In the table and the graph above, there is a very large difference between the necessary force to cause the fracture of a parallel post and the fracture of a conical post. The parallel post required much smaller flexure and fracture forces than the other posts, reflecting the reason for the frequent fractures in real practice. Obviously, the difference is caused by the wider diameter of the conical post in the cervical area. It is also observed that one of the main advantages of the conical model over the parallel one is a more conservative implantation (less removal of dental material) due to the smaller diameter at the tip of the post while having a larger resistance level due to the wider diameter in the cervical area. It can also be stated that in the conical model, the forces at the extremity of the post are quite low and there is a high flexibility level. This condition is favorable as it allows the post to absorb the forces against it well without placing the root structure at risk. On the other hand, in the parallel model there is a larger waste level in the deepest portion of the root to allow cementation. A finer post must be used in the cervical area to avoid compromising the structure of the tooth. If we consider that the tested parallel post would require a canal opening of 1.3 mm in diameter and that it could be replaced for a conical model DC 2 (1.0 x 1.8 mm) without harming the tooth structure (smaller apical diameter and possibly without the need of accessory posts), the flexural strength and fracture resistance results of such post would be 6 times superior. The fracture modes of the posts also offer some interesting information regarding their properties, although it is not

Possible to correlate such data with their behavior at this time. One outstanding remark is that the flexural curve of the parallel post is clearly less inclined, indicating a larger tendency to flexure. None of the posts presented fractures in the immobilized part of the resin.

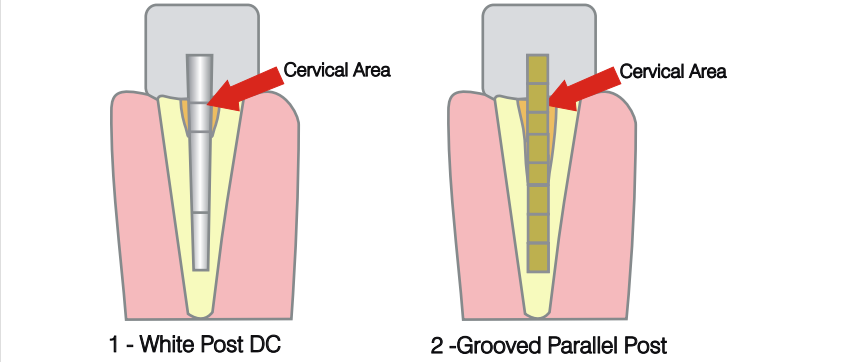
The cementation process has been a well studied subject for a long time. Some important details which determine the success of cementation are already well known. The most important details are:

1 - Care should be taken when cleaning and conditioning the canal before cementation. Acid conditioning residues may harm the cement curing process, especially cements which have amine as the basis to catalyze their polymerization.

2 - The cement layer between the post and the root structure should be as thin as possible. Dental cement does not have high mechanical resistance; therefore, thick layers will cause weak spots in the cementation. It can be concluded that a good adaptation of the post is fundamental and, consequently, the availability of specific drills for such adaptation is very important. The process of opening the canal with adaptation by trial (manual opening), besides being much slower, is one of the causes of flaws due to a bad adaptation of a post.

3 - Mechanical retention points on the posts in are not a decisive factor for a successful cementation. Specific results on post cementation are provided in the chapter on cementation coming up:

The illustrations that follow show the cementation process of a post, the characteristics of root waste, and cervical resistance of the different existing models.



The illustration 1, above shows the simulation of a White Post DC dowel cemented in a root canal with the dental crown over it. The post follows the natural anatomy of a dental root. In the cervical area, the post has the widest diameter and maximum resistance. Observe the difference between the adaptation of the DC post and the one of the parallel post, in the latter, the use of accessory posts can be observed

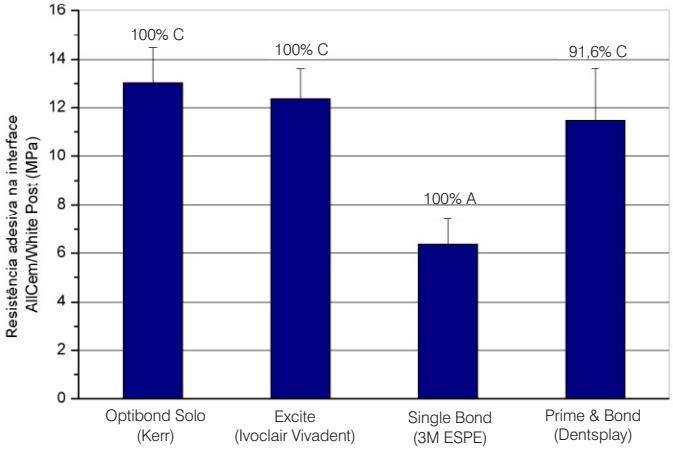
Figure 2 shows the same root canal, but adapted to a parallel post. Observe that the area apical is larger and there is a significant difference in the cervical area: besides the smaller diameter, the parallel post has circular rings (grooves) which reduce the real diameter of the post in such areas. This reduces its flexural resistance.

7. Cementation

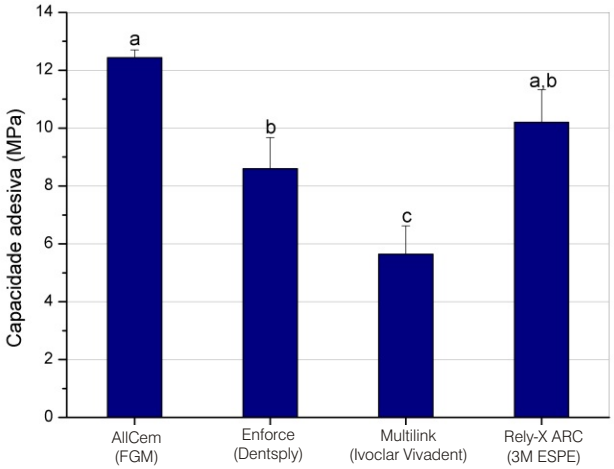
The capacity of adhesion or cementation of a post, along with its mechanical properties and the general quality of the cementation procedure, has an important influence in the success of the procedure as a whole. Several brands

and different cement composites are currently commercialized and are considered appropriate for the cementation of posts. With the aim of evaluating The cementation capacity of White Post, these were submitted to a Push Out test with several different cements considering the use or not of applied adhesives on the posts and the effect of different surface treatment agents (silanes). The specimens were prepared according to the following summarized procedure:

1 - Cylindrical posts (2 mm thick, obtained from stems before fabrication) were washed with ethanol, dried and treated with silane solutions.
2 - Adhesives were applied on the surface of a first group of posts.
3 - These posts were cemented with AllCem in molds to form cylinders with 4 mm in diameter and 11 mm in length. This specimen design allows an adhesion evaluation between post and cement. When a post presents cementation flaw in a canal, this usually occurs at the dentin-cement interface.
4 - The cemented posts were left at rest for 24 hours and then the cylinders were cut perpendicularly in 1 mm disks with a precision cutting machine..
5 - The disks were submitted to a push out test where a tip with 0.8 mm of thickness pressed and forced the extrusion of the cemented posts, thus allowing the measurement of adhesion force between the cement and the posts (White Post). The obtained results in this study are presented in Graph 1.
6- In a second study, the posts White Post DC3 were silanized with Prosil and cemented in molds using different commercial brands of resin cements. The cementation procedure was carried out according to the manufacturers' instructions (dual or single cure).
7- The specimens were placed in deionized water at 37o C for 24 hours and later submitted to a pull out test. The obtained results are described in Graph 2.
8- In a similar way to items 6 and 7, fiberglass posts of different commercial brands were cemented with AllCem and submitted to a pull out test. The results are compared in Graph 3. .

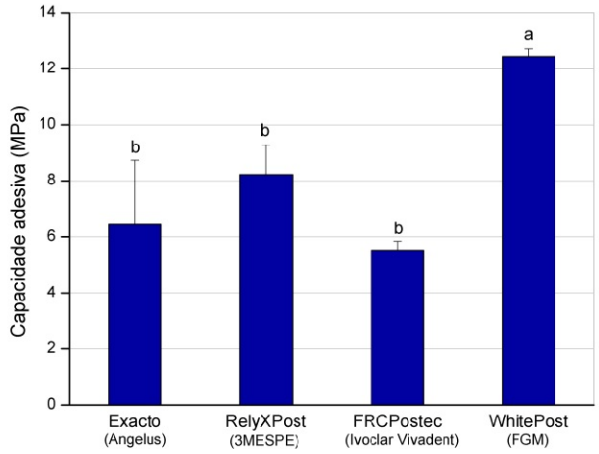


Graph 1
Pull out test result. Influence of different resin cements on the adhesive capacity with White Post DC3. No adhesive other than Prosil was applied on the posts.



Graph 2
Pull out test result. Influence of different resin cements on the adhesive capacity with White Post DC3. No adhesive other than Prosil was applied on the posts. .

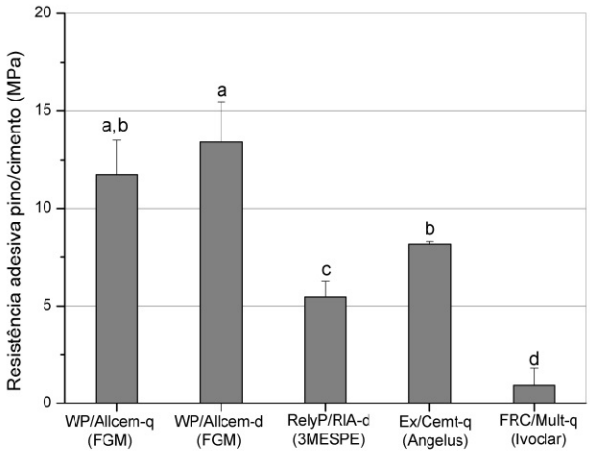
Graph 1 shows that, depending on the adhesive used on the posts, there may be some reduction in the bond strength of the cements. This observation may be associated with the usual limitations of the mechanical properties of adhesives, especially when compared to the properties of cements. Obviously, the surface of posts does not present the same characteristics of dentin. Thus, it is not possible to obtain the mechanical retention typically observed in the combination dentin-adhesive (hybrid layer). In conclusion, the application of an adhesive on the post is not recommended. The application of a silane is necessary and enough to guarantee anchorage between cement and post. Graph 2 clearly shows that the system White Post/Prosil/AllCem presented the best adhesive performance, followed by the group with Rely-X and Enforce. The group with Multilink presented a significantly inferior result when compared to the other groups. AllCem and Rely-X ARC were capable to generate a strong chemical interaction with the surface of the post contributing to the high adhesive capacity observed in this interface.



Graph 3
Pull out test results comparing different fiberglass posts cemented with AllCem. Different letters indicate statistically significant difference (p>0,05).

Graph 3 shows that the adhesive capacity between AllCem and White Post is superior to the other studied groups. The adhesive capacity of White Post is highly superior to the other tested posts.
With the aim of evaluating cementation systems, a study was accomplished where fiberglass posts of different brands were cemented with their respective

Resin cements. Through a pull out test, the adhesive capacity at the post-cement interface was determined, this is presented in Graph 4.

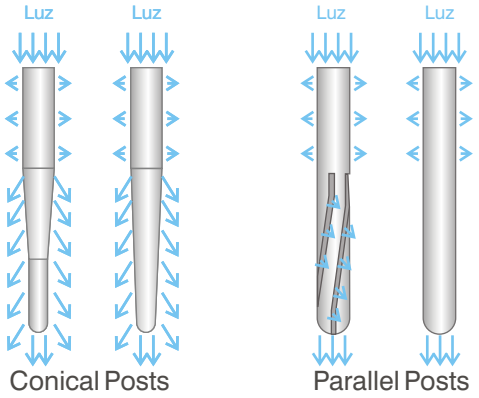


Graph 4
Pull out test results of fiberglass posts cemented with their respective resin cements. WP/Allcm-q = White Post DC3 and Allcem chemical cure, WP/Allcm-d = White Post DC3 and Allcem dual cure, RelyP/RIA-d = Rely-X Post and Rely-X ARC dual cure, Ex/Cemt-q = Exacto and Cement Post chemical cure, FRC/Mult-q = FRC Postec and Multilink chemical cure. Different letters indicate significant statistical difference (p>0,5).

When correlating Graphs 3 and 4 it is possible to observe that there is strong dependence between the combination of adhesive resin cement and fiberglass post. The same post may present different adhesive capacity when cemented with different resin cements. This is associated to the chemical affinity between the adhesive interfaces. Moreover, it is observed that the FGM cementation system presents superior results when compared to other systems and that, with chemical or dual cure, Allcem presented same the behavior.

8. Translucence

In order to enable the use of dual cure cements (chemical and light curable activation), it is essential that the post transmits light to its interface with cement. It is known that the use of dual cements with the light curing process through the post largely improves cementation resistance, especially as it allows a thorough previous polymerization of the cement through the whole extension of the canal and the chemical complementation of the polymerization in a shorter period of time. The light transmitting capacity of the posts is related to their translucence level and the longitudinal disposition of the types of fiberglass used, these work as fiber-optic cables. The translucence of the resin and consequently of the post are necessary to allow the entrance of plenty of light, so it can be transmitted through it and exit at its tip. In the market, there are posts with several translucence levels, from totally opaque posts (no light transmission), to posts with a slight level of translucence (e.g. Super Post dowels / Superdont), to posts with a good translucence level (e.g. FRC-Postec posts / Ivoclar) to posts with excellent translucence levels. White Post dowels can be regarded as posts of excellent translucence level. In fact, White Post has the highest translucence level in the market.
Besides translucence, the post design also influences the level and direction of light exiting the post. In a conical model a larger amount of light exits through the sides than in a parallel model. Such light exit through the sides is quite desirable, since the cement is distributed along the whole base of the post and not only at the bottom of the canal. The following illustrations show what occurs with the light that enters the posts and how it behaves in the different models.



In the conical posts, the light enters through the top and exits through the tip and the conical part where the fiberglass and the optic route are interrupted. Due to the characteristics of the material composing the pin, some light also exits through the upper parallel sides.
In the parallel posts, the light enters through the top and exits essentially through the tip since there is no interruption in the optical route. In the PSH post, some light is expected to exit through the grooves. Due to the characteristics of the material composing the post, some light also exits through the upper parallel sides.

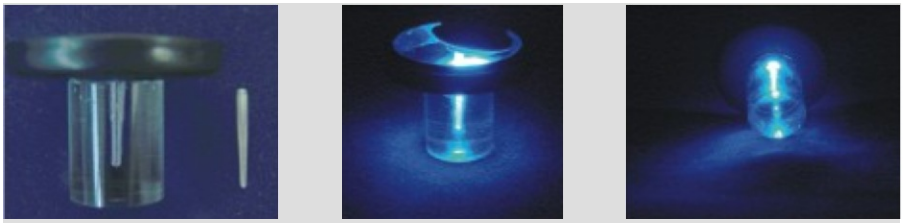


Illustration 1: Light behavior according to post model. The light transmission principle observed in fiber-optics is applied, such as the light conduction to the tip of light curing devices: The light enters through one extremity and exits the other without significant escape through the sides. It is observed that in the conical posts, the light exits through the conical part due to the cut of the fibers and diameter reduction. In the parallel posts, it is expected that most of the light will only exit through the tip, with little or no escape through the helical grooves like in the White Post PSH dowel. If the structure of the material followed the optic transmission principles of a crystalline fiber, light exit through the sides parallel to its entrance would not be expected but, for some reason which is probably connected to the structure of the material, it was observed that some light exits through the upper parallel part of the post. The 3 images above illustrate the light conductivity test accomplished with a White Post DC dowel and the table below presents the relative differences measured for 4 different post brands.

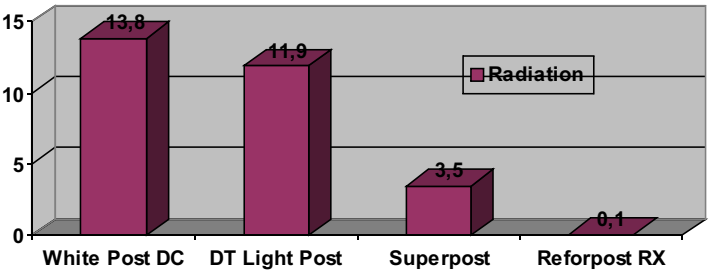


Illustration 2
Amount of light transmitted through some posts of different brands.

9.Radiopacity

This property is quite important as it allows the professional to monitor the adjustment and placement of the post. White Post dowels have identical radiopacity to the one of the dentin, which allows its location and distinction through a common x-ray.

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