Influence of Luting Cement and Surface Treatment on Retention of Different Types of Posts in Endodontically Treated Teeth – an in-vitro Study

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Running title:

Retention of post systems

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Material and Methods

Preparation of tooth specimens

For the current study 120 human teeth were selected, which had been extracted for medical reasons. Only upper incisors and canines, upper second premolars and lower canines and premolars with a caries free root were used to have samples with similar root geometry. All teeth were decapitated with a diamond bur at the enamel dentine junction. After removal of the pulp tissue the root canal was cleaned using Hedström files and Reamers until all remaining soft tissue was removed and a round cross section of the root canal was achieved. After every change of file size the canal was irrigated with 3% NaOCl-solution. Finally the root canal was rinsed with saline and dried with paper points. The roots were than filled using gutta-percha points and AH plus (DeTray Densply, Konstanz, Germany) as sealer.

Cementation of posts

The teeth were randomly allocated to 12 groups of ten samples each which got one post out of six different types (Table 1) fixed with one of three different luting cements with or without surface pre-treatment of the posts according to Table 2. The root canal of each tooth was prepared to accommodate the designated post according to the manufacturer's instruction and using the rotating instrument provided by the respective manufacturer. The root canal was prepared up to a length of 10 mm and irrigated after canal preparation.

For cementation, a zinc phosphate cement (Fixodont, Dentsply DeTray, Konstanz, Germany), a glass ionomer cement (Ketac cem, ESPE, Germany) or an adhesive composite cement (Panavia F 2.0, Kuraray, Osaka, Japan) was used. Panavia F 2.0 was chosen as this material had shown better bond strength with different post materials than other composite cements [2,9]. For adhesive cementation a dentine

primer (ED Primer II, Kuraray, Osaka, Japan) was applied in the root canal for 30 s and air dried before cementation of the post. All cements were mixed according to the manufacturer's instructions. After application of the cement, the posts were inserted manually into the root canal.

The ER Titanium Posts were luted with all three cements. For adhesive cementation, a silane (Alloy primer, Kuraray, Osaka, Japan) was applied on the post as a surface pre-treatment according to the manufacturer's instructions. The ER Cera Posts consisting of zirconium dioxide were luted with all three cements without surface treatment. Additionally, one group of these posts was treated with the Rocatec system for tribochemical surface coating prior to adhesive fixation because this system has been shown to be most effective in enhancing bond strength of resin cements to zirconium dioxide in comparison to other systems [2,10]. The ER Dentin Posts were cemented with Panavia with and without a surface pre-treatment by silanisation. According to the manufacturer's instructions, the LSL posts, the Cytec Carbon posts and the Mirafit Carbon posts were luted with the composite cement only. After cementation of the posts, all teeth were stored at least 48 hours in 100% humidity before mechanical testing was performed.

Pull-out test

To determine retentive strength, a pull-out test was performed during which a universal testing machine (Type 20K, UTS Testsysteme, Ulm, Germany) was used to dislodge the posts out of the respective teeth (Fig. 1). Beforehand, the root of each tooth was embedded in a socket measuring 3 cm in diameter using self curing resin (Acryfix, Struers, Willich, Germany). The titanium and zirconium dioxide posts were then clamped to a diamond-coated drill chuck (Hahn+Kolb Werkzeuge GmbH, Stuttgart, Germany) which, in turn, was fixed with its axis parallel to the direction of

originate from the serrated macroscopic structure of the Cytec Post. Similarly, an increased retention of a resin cement by macroscopic grooves on the post surface has been described in the literature [12].

Based on the pull-out forces measured in the current study, the adhesively bonded ER Cera Posts with surface activation by means of the Rocatec system are superior to the other posts, followed by silanised ER Titanium Posts. However, the clinical decision which post material should be used to restore endodontically treated teeth should not solely depend on the retention of the post in the root canal. Titanium posts have the disadvantage of their colour when used to restore anterior teeth or in combination with full ceramic restorations [13]. The main advantage of fibre posts is seen in their elastic modulus which is similar to that of dentine and results in a more even stress distribution within the root [3,14]. A reduced risk of root fractures has been described attributed to this effect [15-17].

Summary

An influence of the type of luting cement on retention of posts in the root canal could be shown for ceramic and glass fibre posts. This study showed that a chair side silanisation of glass fibre posts or a surface activation of ceramic posts can significantly enhance post retention in the root canal. Carbon fibre posts revealed a similar retention as glass fibre posts with surface treatment.

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Figures

Figure 1

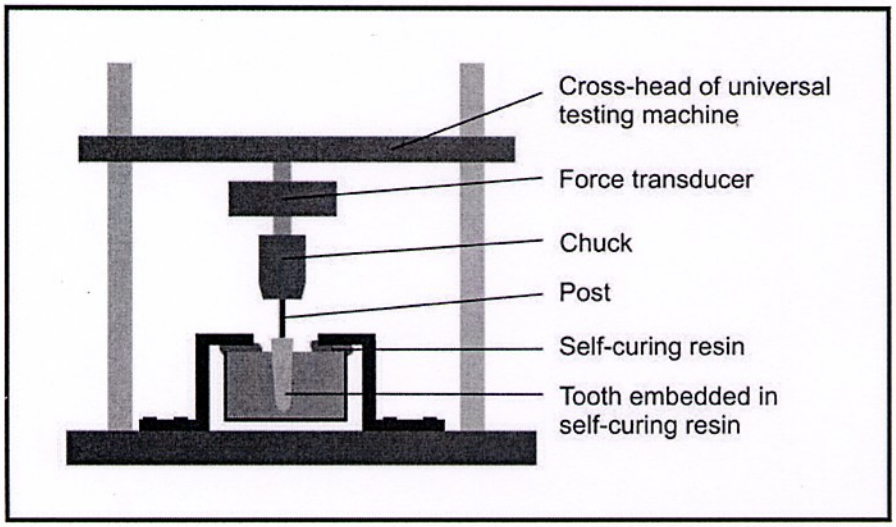
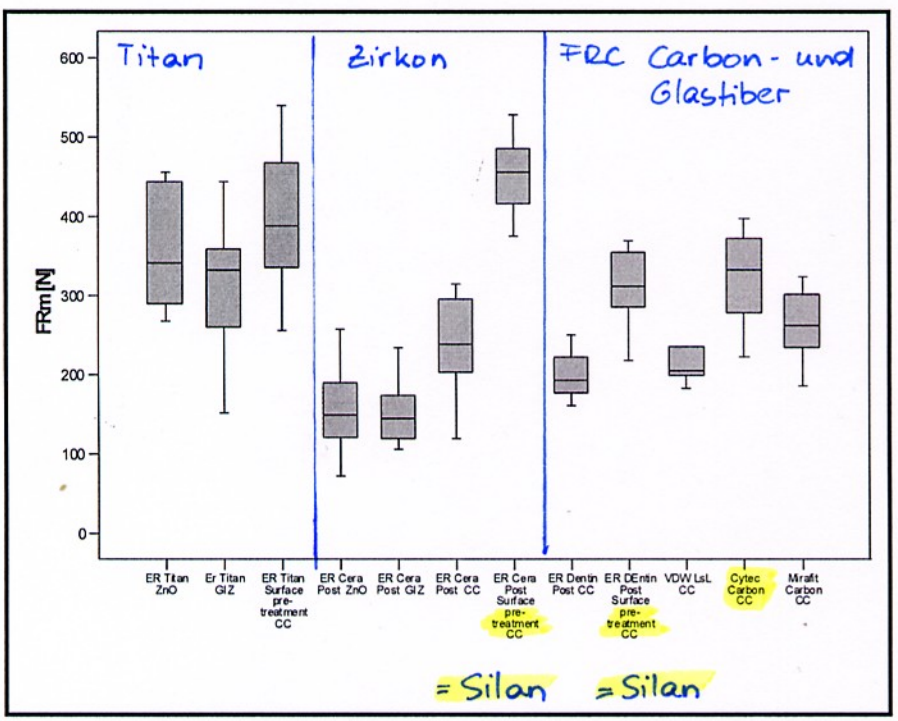


Figure 2



Tables

Table 1:

Post type	Post material	Post diameter	Post geometry	Type of retention	Manufacturer
ER Titanium Post	Titanium	1,65 mm	2,1° taper	Frictive	Komet-Brasseler, Lemgo, Germany
ER Cera Post	Zirconium dioxide	1,65 mm	2,1° taper	Frictive	
ER Dentin Post	Glass fibre	1,65 mm	2,1° taper	Frictive	
Cytec Carbon	Carbon fibre	1,85 mm	6° taper	Non frictive	Hahnenkratt, Königsbach-Stein, Germany
DT LSL	Glass fibre	1,50 mm	2° and 4° taper	Non frictive	VDW-Dental, München, Germany
Mirafit Carbon	Carbon fibre	1,25 mm	Parallel post with conical tip	Frictive	Hager & Werken, Duisburg, Germany

Table 2:

Group	Post system	Surface treatment	Luting cement
1	ER Titanium Post	none	ZnO
2			GIZ
3		Silane	CC
4	ER Cera Post	none	ZnO
5			GIZ
6			CC
7		Rocatec	CC
8	ER Dentin Post	none	CC
9		Silane	
10	Cytec Carbon	none	CC
11	DT LSL	none	CC
12	Mirafit Carbon	none	CC