



Dentists' perspectives on the reconstruction possibilities of a non-vital tooth

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Abstract

Background and aims. The decision-making process when restoring a non-vital tooth is influenced by multiple factors. This study aimed to survey the dentists' preferences regarding cast post-and-core and fiber post techniques for the reconstruction of non-vital teeth and to identify a correlation between reconstruction technique and practitioners characteristics, or dental characteristics.

Methods. The survey instrument was a questionnaire, which included a *general part* with questions regarding the practitioner's profile (gender, age, years of experience, pattern and location of practice, etc.) and the dental characteristics (anterior or posterior position of the tooth on the arch, the amount of dental remaining tissues, etc.) and a *technical part*, containing more specific questions regarding the manufacture and performance of root-coronal reconstructions.

Results. Among the surveyed practitioners (n=35), 69.7% use more often cast post-and-core reconstructions (CPR) while 30.3% choose fiber post reconstructions (FPR). No difference in the reconstruction type was observed regarding patient's age (p=0.23) or gender (p=0.092). The para-function criterion was considered important by 8.23% of the participants. When deciding the type of the root-coronal reconstruction depending on the remaining dentine walls, CPRs are significantly more frequently used in posterior areas (p=0.043) or when para-functional habits exist (p=0.022).

Conclusion. Cast post-and-core represent the most frequently used type of reconstruction for non-vital teeth. Fiber post reconstructions are indicated in the aesthetic zone and when the amount of healthy remaining dental structure is higher.

Keywords: non-vital teeth, reconstruction, fiber post, cast post-and-core

Background and aims

Over the past century, treatment options for the non-vital teeth have evolved greatly. Modern concepts regarding the treatment of non-vital teeth is influenced by multiple factors that may affect the prognosis such as caries, cusps fractures, trauma, the endodontic access and instrumentation and decreased moisture [1]. Although there is an abundance of literature on this topic, the decision should be made after a complete examination of the oral cavity, using a precise protocol that would integrate all data about tooth characteristics; as a result of this analysis, the practitioner would choose between two types of root-crown reconstructions – the use of a cast post-and-core or a fiber post [2].

New research has revealed information about the biomechanical and physiological properties of a non-vital tooth. As the predominant cause of failure of reconstructions on endodontically treated teeth is fracture, the mechanical resistance to this event being directly related to the amount of healthy dentin remaining [3]. An important factor that influences the risk of fracture represents the state of dentine hydration. The results presented by Papa et al. [4] have showed that there is a small difference between dentine water concentrations: 12.35% for the vital teeth, comparing to 12.10% for the devitalized teeth. But regarding this aspect, other studies suggest that for a non-vital tooth, the dentine degree of hydration is lower than for a vital tooth,

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so the tooth would be more predisposed to fracture [5].

In clinical practice, usually 2 types of root-coronal reconstruction can be distinguished: the direct method (manufactured fiber post and composite restoration material) and the indirect method (cast post-and core obtained in dental laboratory) [4].

New materials and therapeutic options based entirely on adhesion are nowadays available, such as endocrowns and CAD/Cam manufactured post and cores [6].

Cast metal posts were traditionally used for intraradicular retention and have shown high survival rates. Gomez-Polo et al. reported a 10 years survival rate of 82.6 for cast metal posts [7].

Fiber posts (glass or carbon) are nowadays frequently indicated in tooth reconstruction, transforming the use of cast metal posts in a secondary treatment alternative. Piovesan et al. reported a 97-month survival rate of 90.2% for fiber post restorations [8]. Fiber post systems present several advantages, such as similar mechanical properties to those of dental structures, resulting in similar behavior in occlusal force distribution as those of natural healthy teeth and also require a more conservative preparation of the root [5,9]. Conventional cast post-and cores present several disadvantages such as root fractures [10] or loss of retention [7,11]. Stress concentration in the post and higher dentin strain have been verified in teeth restored with cast post-and-core and other metallic posts [12]. An in vitro study realized by Sonkesriya et al. showed that the fracture resistance was higher for glass fiber posts (mean=1213.2 MPa) compared to custom made metal posts (mean=857.4MPa) [13].

However fiber reinforced posts are also exposed to failure, which can be related to the amount of residual coronal structure [14]. A prospective study [15] showed that type of post-and-core was not relevant with respect to survival, but the amount of remaining dentin after preparation influenced significantly the longevity of post-and-core restoration. The ferrule adds some retention, but primarily provides a resistance from and enhances longevity to the endodontically treated teeth restored with post and crown. A minimum of 1.5 - 2 mm ferrule of dentin has been consistently described as an essential factor for the success of fiber post systems [16]. In the absence of coronal ferrule, Fokkinga et al. [17] suggested to use cast post-and-core.

Cast post-and-core technique also presents several advantages. They contain one solid material and do not separate under stress or function. Cast metal posts are best used for those teeth with canals that are elliptical or irregular in diameter. Excessive tooth reduction does not have to be accomplished in order to accommodate a cast post; it will fill all shapes of canals [4,18].

This study aimed to survey the dentists' preferences between cast post-and-core and fibered post techniques for the management of a non-vital tooth requiring a reconstruction. Another objective of the study was to identify whether the use of a certain reconstruction technique is associated with the practitioners characteristics (gender, age, years of experience, pattern and location of practice, etc.) or with dental characteristics (anterior or posterior position of the tooth on the arch, the amount of dental remaining tissues, etc.).

Materials and methods

The questionnaire

The survey instrument was a questionnaire that has been tested among 5 specialists to evaluate and validate the design [12]. After adjustments, the questionnaire was finalized on the basis of two domains as follows:

The questionnaire contained 19 questions, divided in two parts, general and technical part (Table I).

The recruitment of participants

The dental practitioners invited to participate to our survey were selected randomly within all the four regions of Romania. The distribution of the questionnaires was done by email and the participants were asked to answer the questions via online forms (Google® online forms). Using this method, the answers were automatically inserted into an Excel document.

The questionnaire was distributed to 150 practitioners and data obtained from 35 respondents (response rate 23.3%; 33 general practitioners and 2 specialists) was validated and statistically analyzed.

Data analysis

The MedCalc Statistical Software version 15.4 (MedCalc Software, Ostend Belgium; [https:// www.medcalc.org](https://www.medcalc.org); 2015) was used to statistically analyze the data obtained from respondents.

Frequency distribution (for treatment philosophy, as well as standard deviation) was used for the descriptive statistical representation of the results.

The Cronbach's Alpha was calculated in order to evaluate the internal consistency of the questionnaire. Mann-Whitney test and Chi-square test were also used. A p value <0.05 was considered significant.

The data obtained from dentists who responded to our survey were statistically analyzed using the MedCalc Statistical Software version 15.4 (MedCalc Software, Ostend Belgium; [https:// www.medcalc.org](https://www.medcalc.org); 2015).

Mann-Whitney test and Chi-square test were used for the analysis of the data. The Cronbach's Alpha was calculated in order to evaluate the internal consistency of the questionnaire. A p value <0.05 was considered as significant.

Table I. The questionnaire used to accomplish the present survey.

GENERAL PART	1. What is your main activity?	General practitioner/ Endodontist / Oral Surgeon/ Other
	2. How many years have you been practicing?	<10 years/10-20 years/>20 years
	3. Do you think a devitalized tooth should be crowned routinely?	Yes/No
	4. What type of coronary re-construction do you use most often?	Fibered post reconstruction (FPR)/ Cast post-and-core reconstruction (CPR)
	5. Does the patient's age influence your choice of CPR?	Yes/No
	6. Do the morphological characteristics of the patient influence the choice of reconstruction?	Yes/No
	7. Do para-functional habits have an influence on the choice of reconstruction?	Yes/No
	8. For which reconstruction would you opt in case of an aesthetic purpose?	FPR / CPR /Other:
	9. Does the price/cost is an important aspect in the choice of treatment plan?	Yes/No
	10. Which of the factors influencing the decision-making do you consider to be the most important?	Tooth's morphology/ Para-functions/ Aesthetics/ Financial aspects
TECHNICAL PART	1. Which type of restoration would you choose according to the height of healthy tissue on supra-gingival level (ferrule)?	<ul style="list-style-type: none"> • If supra-gingival circular height (ferrule) between 2mm and 4mm: FPR/CPR • If supra-gingival circular height (ferrule) less than 1.5mm: FPR/CPR
	2. What type of reconstruction would you use in the presence of an adverse occlusal context?	Post-and-core reconstruction (PCR)/dowel-core reconstruction (DCR)
	3. Which restoration to choose according to the number of remaining walls?	<ul style="list-style-type: none"> • If there remains a wall: FPR / CPR • If there are two walls left: FPR / CPR • If there are three walls left: FPR / CPR • If all the walls remain: FPR / CPR
	4. Depending on the sector, do you have a preference for the type of reconstruction?	Anterior FPR/ Anterior CPR/ Posterior FPR/ Posterior CPR
	5. What type of DCR do you use most often?	Metallic/ Ceramic/ Composite
	6. What type of PCR do you use most often?	Metal/ Titanium/ Ceramic/ Composite/"Screw-post"/Other:
	7. What material do you use most often for DCR cementation?	Zinc-phosphate cement/ Polycarboxilate cement/ Resin-modified glass-ionomer cement/ Glass-ionomer cement/ Resin-based cement
	8. What complications are considered to be most common for PCR?	Loss of the post/ Fracture/ Dental complications (caries, peri-apical infection, lack of sealing ...)/ Other
	9. What complications are considered to be most common for DCR?	Loosening/ Fracture/ Dental causes (caries, peri-apical infection, lack of marginal sealing...)/ Other

Results

In the first part, responses to the questions in the general section were evaluated. Among the surveyed practitioners, 91.4% (n=33) were working in urban and peri-urban areas and 18.6% (n=2) in rural areas. Most of the participants presented a working-experience of 10-20 years (71.4%, n=25). No statistical significance was identified between the technique of reconstruction and years of experience or working area.

Regarding the aspects that may influence the decision when choosing between the two types of reconstructions, the practitioners' answers are presented in table II.

Table II. Factors influencing the practitioners decision.

Factor	Yes	No	P
Patient's age	5 (15%)	30 (85%)	0.08
Morphological characteristics of the patient	6 (16.46%)	29 (83.54%)	0.128
Para-functional habits	3 (8.23%)	32 (91.77%)	0.098
Price	18 (51.4%)	9 (48.6%)	0.1

For the second part of the questionnaire, the statistical analysis showed a significant correlation between the remaining walls and use of fibered posts - the higher number of remaining walls, the use of fibered post reconstruction was chosen more frequently as an option (p<0.005).

Table III. Technical aspects influencing the reconstruction type.

Question	PCR	CPR	P
What type of coronary re-construction do you use most often?	11 (31.5%)	24 (68.5%)	0.085
Which reconstruction would you select for an aesthetic treatment?	28 (80%)	7 (20%)	<0.05
Which restoration would you choose according to the height of healthy tissue on supra-gingival level (ferrule)?	Ferrule 2-4 mm: 27 (77.14%)	Ferrule < 1.5 mm: 29 (82.85%)	<0.05
What type of PCR would you use in the presence of an adverse occlusal context?	7 (20%)	28 (80%)	0.022
Which restoration to choose according to the number of remaining walls?	3 wall: 30 (85.71%) all walls: 32 (91.42%)	1 wall: 30 (85.71%) 2 walls: 23 (65.71%)	<0.05
Depending on the sector do you have a preference for the type of reconstruction?	Anterior: 24 (69%)	Posterior: 18 (52%)	0.043

A significant association was identified between the value of ferrule (2-4 mm) and the use of FPR, while in cases of supra-gingival remaining healthy tissue lower than 1.5 mm CPRs are more frequently used.

When deciding the type of the root-coronal reconstruction depending on the remaining dentine walls, two distinct groups were observed: when only 1 or 2 dentine walls remained, the cast post-and-core reconstruction was preferred, while for the situations with 3 or 4 remaining walls fibered post reconstruction was used (Table III). CPRs are significantly more frequently used in posterior areas and when para-functional habits exist.

A correlation was also observed between the location of the tooth on the arch (the sector) and the type of reconstruction. For the anterior sector practitioners use a FPR, while in the posterior area CPRs are preferred. Metallic alloys are usually the choice for manufacturing the cast post (n=34, 97.14%).

Regarding the type of cements used for cast post cementation the results showed that 75.8% (n=26) of the respondents use glass-ionomer cements.

When referring to the complications, which may appear after a fibered post reconstruction, fractures, losing and dental decays were chosen in the same proportions.

Discussion

Previously, restoring a non-vital tooth was a classic gesture in practice and often resulted in cementing a cast post-and-core and a crown. Our study shows that 87.9% of dentists surveyed consider that the cast post-and-core reconstruction along with the cementation of a crown should not be systematic. These results are in accordance with the findings of Naumann et al. [19] who, in their research, have found that, in Germany, there is a preference for fiber post systems. Based on the results of the study realized by Sterzenbach et al. [20], adhesive postandcore restoration of non-vital teeth using a proper ferrule design improves their reliability in serving as abutment teeth for prosthetic reconstructions.

In our study, age represents an important factor to be considered when choosing between CPR and FPR reconstruction. A study conducted by Dr. Marc Bolla [21] indicates that the risk of failure for a reconstruction of a non-vital tooth in a patient over 60 years old increases significantly (up to 1.5 times).

One of the advantages when using fiber posts is their transparency that insures adequate aesthetics. Dental composites meet all the required criteria for a post-and-core material: adhesion to dental tissues, adequate mechanical properties and possibility of immediate photo polymerization [22]. The translucent appearance of the fibered reinforced posts is very useful as a light vector [23].

For the anterior sector, FPRs are more frequently used due to higher aesthetic demands and lower masticatory forces; however when coronal destruction is severe and root anchorage is required, CPR is indicated [24].

Adhesion is the method of choice for post-and-core reconstructions for most of the practitioners included in the study. Chemical and mechanical properties and complete ability of sealing the endodontic space, preventing any future bacterial contamination represent their main advantages [25].

According to the answers obtained in our survey, zinc oxy-phosphate cement represents the material of choice for PCR cementation for 6.1% of respondents, while 9.1% would choose zinc poly-carboxylate cement. The clinical decline for those two cements over the years was observed by other researchers, the major flaw being the lack of adhesion and low retention through micromechanical anchoring only. Their advantages are a low price and good bactericidal properties due to zinc oxide [26].

On average, the success rate of a root-coronal reconstruction is 8.3 years. The occurrence of complications may be due to secondary caries issues, loss of seal, peri-apical infection. The complications depend mainly on the technique and the quality of canal preparation or of prosthetic reconstruction [27].

FPR fractures are more rare than CPR fractures, probably due to their modulus of elasticity, which is closer in value to dentin [28,29]. Salvi et al. [30] found frequent complications that included root fractures (6.2%) associated with prefabricated titanium posts. However, Hatzikyriakos et al. [31] observed no significant difference among metallic posts after three years.

There are few clinical studies comparing those two techniques of reconstruction. *In vitro* studies have compared the two procedures regarding physical properties and resistance to fracture. Zoghieb et al. published a research in 2009 in which the resistance to compression of different root reconstructions was analyzed. The authors concluded that the indirect method was more reliable, as a possible failure by fracture would allow a further reconstruction [32].

The decision-making process when restoring non-vital teeth is a complex process and the practitioner should take into consideration several factors, such as the quantity and quality of tooth structure, tooth position on the arch and its function, the characteristics of the materials used, biocompatibility, corrosion resistance, aesthetics, ease of cementation, etc., but also factors like the practitioner's technical possibilities [9].

Conclusions

Within the limits of our study, we can conclude that, cast post-and core represent the most frequently used reconstruction for non-vital teeth. Among the tested Romanian group, fiber post reconstructions are indicated in the aesthetic zone and when the amount of healthy remaining dental structure is higher. However the present study included a low number of participants, so further research on larger samples is necessary.

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