

Original article



## CLINICAL EVALUATION OF TREE-UNIT FPD WITH ENDOCROWN PREPARATION OF THE DISTAL ABUTMENT TOOTH.

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### SUMMARY

**Introduction:** The endocrown is a mean for restoring endodontically treated teeth. It has a circumferential preparation with a butt-joint border and accessory retention within the pulp chamber. It does not require root preparation for placement of posts or post and cores making it a more conservative restoration that evades the shortcomings of the above-mentioned.

**Aim:** Evaluation of the clinical performance and longevity of three-unit FPD's with endocrown preparation for the distal abutment tooth and comparison with a conventional FPD's employing the Split-mouth method.

**Methods and materials:** Patients with identical defects on the maxillary or mandibular dental arches are examined. 22 patients are chosen amongst them with a minimal step of randomization (n=3). The design of the study is based on the method of auto-control and consistent with the CONSORT Statement. The type of the preparation design for the distal abutment tooth is randomly chosen for each side of the dentition. Both FPD's are fabricated from Laboratory resin composite (Vita LC/VM) with infrastructure made from glass fibres - Turka GS/CSB (Stick Tech). Silane agent is applied to the inner aspects of the bridges and a 3 Steps adhesive system is used (Optibond (Kerr / Hawe). Luting is carried out with Resin cement (RelyX Ultimate Adhesive Resin Cement (3M ESPE)). In order to assess the clinical performance of the FPD's a modified USPHS criteria was used. All patients were examined at pre-determined time periods by one of the researchers. Analyses of the results are performed with descriptive statistics and Kaplan-Meier longevity test.

**Results:** The evaluation period is 4 years for all FPD's. Regular control appointments were conducted at 6 months, 1, 2, 3 and 4 years post cementation. The modified USPHS criteria showed full Alfa scores on colour match and anatomic contour. Kaplan Meier survival analysis showed 93.22% survival rate for all FPD's – conventional and endocrown retained. No statistical difference was observed between the different types of distal abutment preparation designs as well as between genders with an exception for the variable "Chipping" (p=0.018). The success rates were generally lower than the survival rates at 71.45%.

**Conclusion:** Within the limitations of this study it is concluded that both classic and endocrown retained FPD's made from laboratory composite resin, reinforced with FRChave a satisfactory performance for the 4 year evaluation period.

**Keywords:** FPD, endocrown, FRC, longevity,

### INTRODUCTION:

The restoration of endodontically treated teeth with compromised dentine core in the distal area of the dentition is often associated with difficulties in the planning, choice of restoration type, clinical and laboratory procedures [1]. The current treatment strategies include two major approaches– direct or indirect restoration techniques. The classical direct build-up – prefabricated post and amalgam core doesn't show satisfactory long-term results and are often the reason for tooth loss due to root fracture, micro-leakage or destruction of the material. With the development of dental adhesives and glass-ionomer cements, micro- and nano-leakage are practically solved, but the other issues remain.[2]

Alternatives to the aforementioned materials are resin based composites. The development of adhesive systems enables their usage without a macro-mechanical retention that is difficult to prepare in cases of severe loss of hard tooth substance. There are two main approaches when using a resin-based composite materials, namely:

1. Usage of prefabricated radicular posts - fibre-composite or metal;
2. Direct core build-up without an accessory mechanical retention.

Both methods have advantages and disadvantages, but the end result is still not satisfactory regarding the restoration's longevity. While the first approach is deemed as classical and used widely in the clinical practice, the second is rarely encountered in the literature - mainly as clinical case reports. The development and introduction of new generations of resin based dental composites is a prerequisite for better-performing restorations without the usage of radicular posts.[3, 4]

The other big group of methods for restoring endodontically treated teeth with compromised dental core are the indirect methods. There are two big modalities within this group, namely:

1. Usage of radicular anchorage and manufacturing of post and cores or post-crowns;
2. Adhesive restoration without an accessory anchorage in the root-canal system.

The first approach is accepted as a standard treatment protocol. Despite that, there are several disadvantages, which lead to a search for alternatives. If the practitioner chooses to solve a clinical case with a post and core restoration several accessory procedures need to take place – preparation of the remaining tooth structures, impression taking, laboratory procedures and cementation. Each one of these is prone to errors – gingival hypertrophy, reinfection of the root-canal system, perforations etc. One or more additional visits are required thus directly influencing the restoration process by making it slower and more expensive.[5]

The post-crowns have a long history of usage with the first publications regarding their implementation dating as far as two centuries ago. Their main disadvantage is the need for tooth extraction if any complications with the integrity of the restoration as well as with the root-canal treatment occur. [6]

Recent improvements in dental adhesives as well as composite resin cements enables the fabrication of indirect restoration without the usage of posts for accessory retention. Such construction is the endocrown. This type of restoration consists of a circumferential 1.0"1.2-mm butt margin preparation and a central retention cavity inside the pulp chamber, and constructs both the crown and core as a single- unit, i.e., a “monobloc”.[7]

The first publications regarding the usage of this type of restoration are in the field of pediatric dentistry, when frontal teeth need to be restored. Acrylic crowns are used utilizing the pulp chamber for accessory retention.[8]

The main research focus of endocrown usage is pointed at laboratory investigations – FEA and different experiments for fracture resistance. There are publications describing single or series of clinical cases but the literature is lacking controlled clinical trials.[9 - 11]

The material of choice for fabrication of these types of constructions are dental ceramics with enhanced me-

chanical properties – pressable, ZrO<sub>2</sub> ceramics etc. Another material with increased popularity for manufacturing of indirect restorations is laboratory composite which was introduced during the 80's of the 20th century. They are outperforming direct resin-composites in terms of fracture resistance, modulus of elasticity and colour stability. Their mechanical durability can be further augmented with the use of different types of fibres enabling the manufacturing of small FPD's.

#### **Aim:**

Evaluation of the clinical performance and longevity of three-unit FPD's with endocrown preparation for the distal abutment tooth and comparison with a conventional FPD's employing the Split-mouth method.

#### **MATERIALS AND METHODS:**

Patients with symmetric defects – missing teeth in the posterior area requiring fixed partial dentures fabrication, of the upper or lower jaw, are enrolled for participation in the study. The inclusion criteria are as follows:

- Symmetric posterior defects with missing molar or premolar
- No tooth mobility above 1st degree
- Normal occlusion
- Natural opposing dentition
- Endodontically treated distal abutments

Sixty six patients are included in the preliminary phase of the study. From them 22 are selected for the second stage utilizing a randomization process (with step n=3). Three unit FPD's are made for each patient with a different preparation design of the distal abutment teeth – classic or endocrown, which are randomly assigned. Both FPD's are fabricated from Laboratory resin based composite (Vita LC/VM) reinforced with glass fibres - Turka GS/CSB (Stick Tech). Silane agent is applied to the inner aspects of the bridges and a 3-Step adhesive system is used (Optibond (Kerr / Hawe). Luting is carried out with resin cement (RelyX Ultimate Adhesive Resin Cement (3M ESPE)), following the manufacturer's instructions. All clinical procedures are carried out by one of the researchers – V.H.

USPHS criteria, modified by the authors, are used for clinical evaluation of the restorations (Table 1).

**Table 1.** Modified USPHS criteria for clinical evaluation

<b>Criteria</b>	<b>Method</b>	<b>Score</b>
Fracture	Visual Inspection	A
		B
Chipping	Visual Inspection	A
		B
Debonding	Visual inspection and explorer	A
		B

Criteria	Method	Score
Marginal discoloration and integrity	Visual inspection and explorer	A
		B
		C
Color match and change	Visual Inspection	A
		B
Anatomic contour	Visual Inspection	A
		B
		C

Assessment of the FPD's is scheduled at predefined time periods. Clinical evaluations are performed by one of the researchers – N.M. All participants are asked to inform the researchers immediately, if any complications occurs between the scheduled control appointments.

Analysis of the results is performed with descriptive statistics and Kaplan-Meier longevity test. Two main components are investigated:

- Survival – the percentage of FPD's still in function regardless of a prior need of intervention;
- Success – The percentage of restorations that didn't require any intervention during the evaluation period.

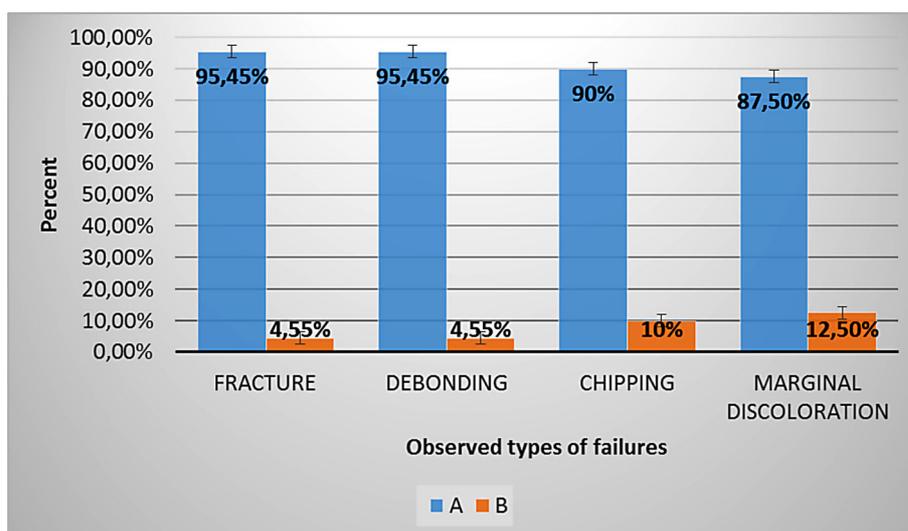
A comparison between genders and type of distal abutment preparation is made.

## RESULTS:

The evaluation period is 4 years for all FPD's. Regular control appointments are conducted at 6 months, 1, 2, 3 and 4 years post cementation. For demonstration purposes photographs of selected patients and procedures are made.

The modified USPHS criteria showed Alfa scores on colour match and anatomic contour for the whole evaluation period. The types of failures as well as their percentage are presented in Diagram 1. Throughout the evaluation period 2 cases of complete fracture, 2 cases of debonding (one repairable), 5 cases of chipping and 6 cases of marginal discoloration are registered.

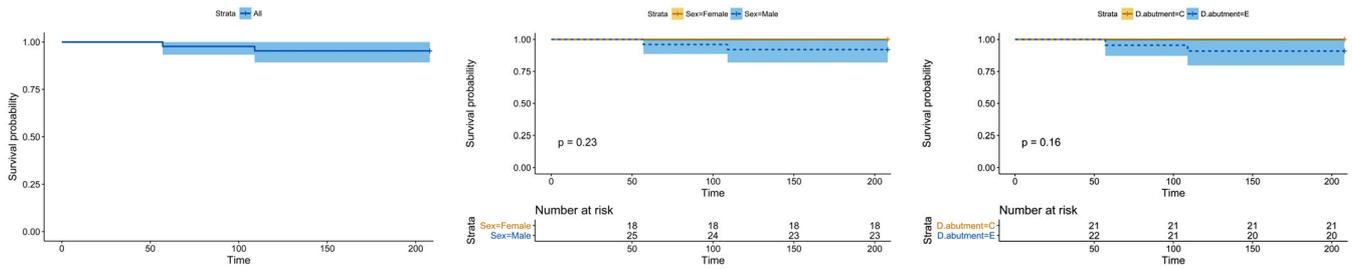
**Diagram 1.** USPHS scores for the different evaluation criteria.



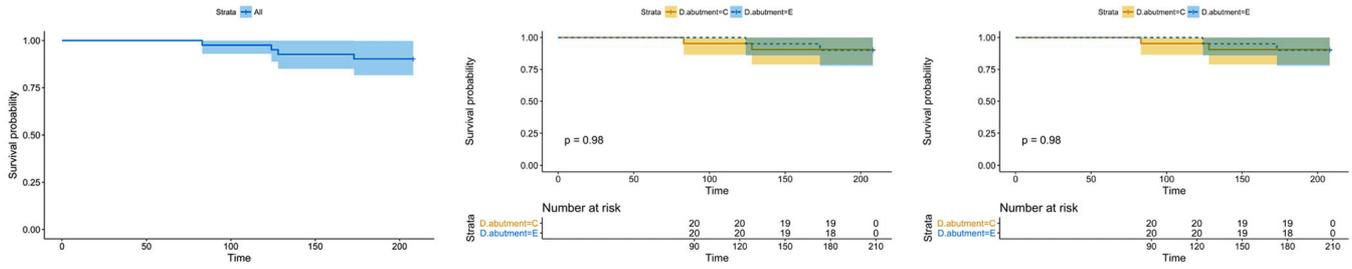
Kaplan Meier analysis showed 93.22% survival rate for all FPD's – conventional and endocrown retained. The different modalities of the USPHS criteria as well as the comparisons between genders and distal abutment teeth preparation according to longevity are presented in Diagrams 2 to 5.

No statistical difference is observed between the different types of distal abutments as well as between genders with an exception for the variable "Chipping", which occurred only in female patients ( $p=0.018$ ). The success rates are lower than the survival rates at 71.45%.

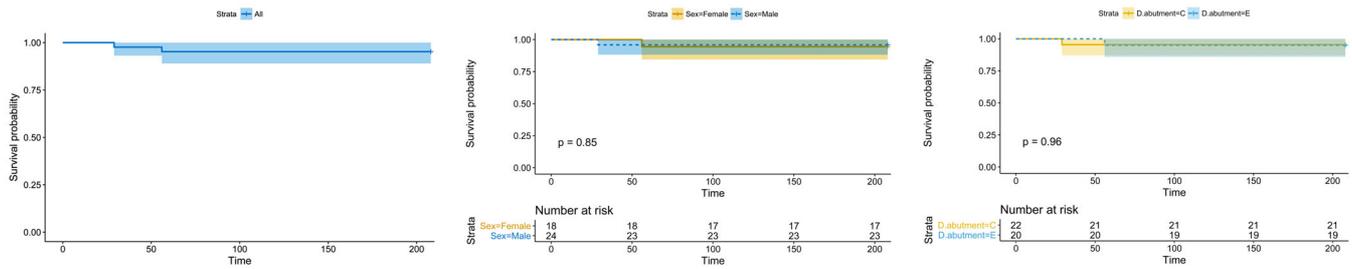
**Diagram 2.** Survival curves for the variable “Fracture” in weeks



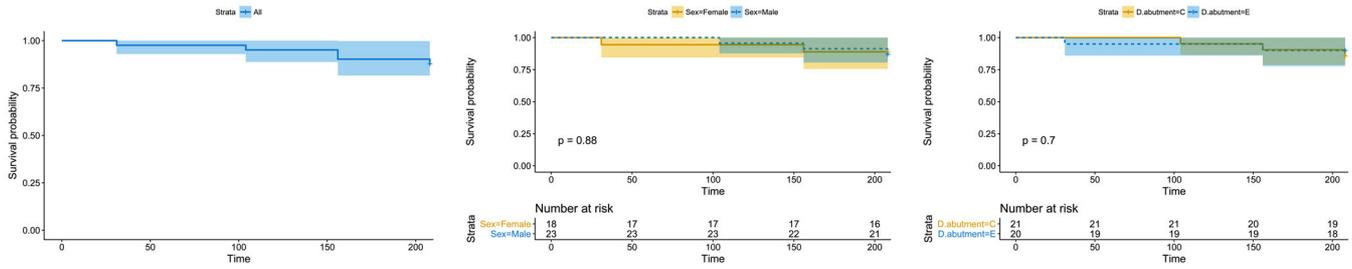
**Diagram 3.** Survival curves for the variable “Chipping” in weeks



**Diagram 4.** Survival curves for the variable “Debonding” in weeks



**Diagram 5.** Survival curves for the variable “Marginal discoloration and integrity” in weeks



**DISCUSSION:**

This study reports a 4 year clinical follow-up and comparison of FRC FPDs luted in the posterior area with a classic or endocrown preparation design for the distal abutment teeth. The aim of the researchers is twofold – to assess the longevity of metal-free restorations in the distal area and to compare the two preparation modalities. Regarding the first part of the hypothesis the number of patients and constructions is low, therefore those results can only be viewed as preliminary or complementing other published studies. Another limiting factor is the short time period for evaluation, but since the study is prospective additional information is going to be collected. However em-

ploying the split-mouth method and the fact that the clinical procedures are performed by a single operator ensures a sound basis for the second part of the hypothesis and may become a starting point in the development of a data base regarding the usage of endocrowns as FPD retainers, since to our knowledge till date there are no published controlled clinical studies regarding the subject.

For better visualization and accuracy the authors considered “weeks” as the preferred time interval for the Kaplan Meier analysis tests.

An interesting observation, for which we cannot find an explanation, is the occurrence of chipping only in female patients. The second most frequent complication –

Marginal discoloration, is also hard to clarify since in most cases no debonding (in one case), loss of integrity or carious lesion development is present. Probably insufficient oral hygiene, which is present in all the cases with Bravo scores is the direct cause of the event. The results of the current study, regarding success and survival rates of the fixed partial dentures, are in accordance with the literature on FRC FPDS, considering the limited follow up period. [12]

#### Acknowledgments:

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#### CONCLUSION:

Within the limitations of this study it is concluded that both classic and endocrown retained FPD's have a satisfactory performance for the 4 year evaluation period. Their equal performance allows us to recommend a post-free solution for restoration of endodontically treated teeth even when the restoration is a short span bridge.

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