



## Prosthodontics treatment using Post and Core Design: An Evaluation of Dental Collaborative Practice Contribution on the Outcome

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### Abstract

Prosthodontics treatment using a post to restore fractured crowns on where an endodontic procedure had been performed, might be suffered to some failures. This event remains a significant health issue that can benefit an intradisciplinary approach, involving both the endodontist and the prosthodontist, as an alternative to improve the outcomes. This article purpose is to review the opportunities for coordinated intradisciplinary care between those specialties through the concept of complementarity relationship under “configuration” theories, by testing whether intraprofessional collaboration in dentistry, through an integrated practice, can improve the prognostic of prosthesis crown & bridges using dowel posts on endodontically treated tooth and estimate how it affects treatment failure.

We had conducted a longitudinal cohort study (retrospective study) using data collected from two dental facilities in Port-au-Prince, where patients had received treatment from 2006 to 2013.

Our analysis revealed that factors like the duration of treatment (2.20 (1.6-3.0); 4.80 (4.0-7.0)) and the number of roots (1.50 (1.3-2.0)) which have significant proficiency statistically ( $p < 0.001$ ) to induce failure to appear to be increased in effect when considering a solo-based practice. It also appears in our findings that using cast gold posts to restore fractured crown might be regarded as a protective factor (0.78 (0.56 - 1.08);  $p < 0.1$ ) for the restored tooth. Although some articles have supported the use of prefabricated post/core in restoring endodontically treated teeth, our findings suggest that permanent coronal restorations should have taken place as soon as possible to prevent fracture and then failure, whatever the type of materials we made the post/core.

Intradisciplinary action among dental colleagues on caring issues requires, to be successful, that all parties to be involved in reducing post-treatment complications and failures, by addressing on a common front all that can be considering as a potential risk and compromising to the final restoration. This paradigm appears to be the feature of the complementary system, which allows through an integrated approach the way to apprehend coercive elements.

**Key words:** Oral Practice, Dentists, Integrated practice, Intradisciplinary collaborative approach, Complementarity relationship, “Configuration” theories, Post and Core support, Prosthodontics, and Endodontics treatments

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### Introduction

Dental posts have been performed for decades, and according to the literature, it has been designed with different materials over the past years, like metal, wood, and fiberglass<sup>(1, 2)</sup>. A post is a tenon, which is placed in the roots to serve as an anchorage to provide appropriate support for a final crown or bridge<sup>(3,1)</sup>. This technique is used in prosthodontics to restore fractured teeth when an endodontic procedure can be performed<sup>(4)</sup>. In prosthodontics, it is not only about the restoration of structures lost; we also must preserve the remaining part of the tooth<sup>(5)</sup> and assure in the meantime the quality of the treatment. All this requires, according to Perel<sup>(6)</sup>, an analysis of the crown to root ratio and a root canal procedure that is relied on endodontics criteria's, and inevitably an assessment of the periodontal tissues that surrounded the root<sup>(7)</sup>. Thus, when the coronal structure of the tooth is lacking, one of the highest possible approaches in dentistry is the use of the root canal space, but the success in the survival of endodontically treated teeth will require such treatment an optimal quality procedure<sup>(8)</sup>. Like we observe during practice and corroborate in the literature, with appropriate quality endodontic treatment and observance of therapeutic guidelines, pulpless teeth can serve as support for the

final fixed structure. However, some factors like the thickness of the dowel (post), the position into the root where it places, and other elements that could create stress on the tooth, have been considered parts of the risks that could cause treatment failure<sup>(9)</sup>. The literature has also mentioned as a risk factor, the waiting time between the endodontic procedure, regarding the time of filling material, and the one to restore the crown with fixed ceramic<sup>(40)</sup>. But, what about the relation between dental intraprofessional collaboration on the procedure? Intraprofessional collaborative practice (IPCP) is related to the interaction between at least two professionals in the same field. According to Fiquet<sup>(41)</sup>, professional collaboration promotes the share of knowledge, expertise, skills, and responsibilities to ensure patient safety and quality of care<sup>(42)</sup>.

If there is abundant literature on the type, the quality, and techniques related to post dental procedure<sup>(43)</sup>, much controversy and empiricism remain, particularly around the appropriate methods. Although the adequate procedure system requires competences from the practitioner, there is lacking study in this area of dentistry, showing that IPCP contributes to more significant results. Thus, talking about competency in post endodontically treated teeth, the question is: how skills through IPCP, regarding the state of practice, can help reduce failure in dental post-treatment, using team clinical decision making about choosing and placing the post?

To fully understand how an integrated approach through interprofessional collaboration, with regard of the state of competency (abilities skills to perform endodontic and prosthodontic treatment), can interfere with the outcome of the restorative procedure, we conducted a longitudinal clinical evaluation. To do so, we used most of the patient's chart that is coming from two privates' institutions localized around Port-au-Prince, where a high incidence of teeth had been receiving endodontic therapy for ceramic restoration.

In this study, our goal is to test whether intraprofessional collaboration in dentistry, through an integrated practice, can improve the prognostic of prosthesis crown & bridges using dowel posts on endodontically treated teeth and to estimate how it affects treatment failure.

We obtained approval from the head manager of dental facilities and the dentists at the respective clinics to carry out this study. The authors were not involved in the process of selecting the patients' files. We made a copy of each data that has been chosen and provides identification for each of them with a combination of both the first letter of their first and last name, the year of birth, and their rank. The ethical guidelines considered throughout the study came from the 70th General Session of the IADR (IADR, 1992).

## Materials and Methods

This study adheres to the theoretical framework related to the concept of complementarity in a partnership<sup>(44)</sup>. Complementarity involves the notions of the "internal coherence of practices" and falls under "configuration" theories. According to these theories, the ideal combination of practices is the one that achieves the highest level of internal consistency, with the highest potential to influence organizational performance<sup>(45)</sup> and, thus, outcomes of care. Therefore, we hypothesized that dental team collaboration using integrated practices and corporate performance strategies is inversely related to post-dental failure. To verify this consistency through the integration practices, we conduct a longitudinal cohort study (retrospective study), using data as mentioned in the section from two dental facilities in Port-au-Prince, where patients had received treatment from 2006 to 2013. A total of 3800 dental patients' records, including film-based X-ray, was selected from those who received prosthodontics treatment at these facilities, using first, a systematic sampling with a sampling rate of 4.

## Selection Criteria & Data Collection

We should mention that in order to get the final sample after collecting the data through the patients' recorded files, we have retained cases which have respected the following criteria:

**Inclusion criteria:** were enrolled in the study, first, all clinical patient's records presenting a full-coverage fixed restorative prosthodontics treatment with the post (cast or core), where an endodontically treated roots was performed. Secondly, the procedure must have performed by dentists who work at those two facilities and must have been started between the period of 2006 and 2013. Data from patients' records must present elements regarding the first step process diagnosis, therapeutic process (restoration), follow up with X-ray evaluation from endodontics treatment, initials of the dentists (to assign his department), or the full dentist name.

**Exclusion criteria:** were not considered in this study; all patient's records without a prosthodontic treatment or with a prosthodontic treatment without a post (cast or core) placed in endodontically treated roots, non-sign records procedures. Or patients who had had a follow up for any prosthodontics issues regarding an ancient post, which was put in endodontically treated dental roots but was not performed by the dentists who work at those two facilities.

A total of 3000 dental records were extracted from the pool, and we create a standardized form from which we collected data. From that number of patient's records, the 3000 were up to standard to be used for the study.

## Studied Variables

The analysis included data on the type of professional practice, and patient outcome data were collected on all patients using the standardized form. The added variables for the study were:

### A- Predicted variables

**Age:** From the data patient record documents, we verified for the clients specific date of birth and determined their age, and we categorized this variable into two groups (<20 years; ≥20 years), to better understand the influence of biological development base on the stage of maturation of both crown and root<sup>(46)</sup> and reduce bias.

**Treatment duration (months):** We categorized this variable into three categories (below six (6) months; between 6 and 12 months; more than 12 months), considering the effects of the short and long-term restoration on endodontic treatments<sup>(47,48)</sup>. We determined the duration of the treatment by examining the date of the initial preparation of the access cavity of the endodontic procedure (Time from access to obturation) and the one for definitive fixation of the ceramic prosthesis (Time from obturation to fixed crown or bridge).

**Tenon type:** we categorized this variable into two types/ groups, based on the current procedure and materials that we used in the restoration of endodontically treated teeth<sup>(49,7)</sup>.

Two different posts preparations were used (Cast gold posts; Prefabricated posts/core) after removing a portion of the gutta-percha from each filled canal from the desired root.

**Number of roots:** was defined as single if one post appeared to be used in a dental root with no extension to other roots and multiple, which means that was using more than one root.

**Practice:** this variable was measured using the step by step procedure on the patient's chart and treatment notes. It was based, besides, on the fact that whether the overall process was made by one dentist or by a team according to the patient's chart using the signature and the department on the patient's records as criteria. This variable was then categorized into an integrated practice (collaborative partnership)<sup>(50)</sup> and silos of professional practice (overall procedure made by one person).

**B- Dependent variable**

Treatment outcome:

This variable is categorical, and it describes the issue in two groups:

**Success:** to explain the ability of the root complex structure (post and teeth) to remain undamaged after a long period and provide functional retention;

**Failure:** was considering when any biologicals or mechanicals damage affected the root complex structure of the restorative tooth, considering the Bernard G. N. Smith classification<sup>(21, 22)</sup>.

**Statistical analysis**

Data were cleaned, checked for errors, and missing data before doing our analysis. For our study, we conducted data analysis using Epi-info package, version 7.2. To show a description sample, we carried out analysis using the usual methods of descriptive statistics. All our variables were categorized and recorded in groups. For contingency table analysis, we performed Pearson’s test using the Chi-squared tests to assess the differences in distribution between groups. All reported p values were two-tailed, and statistical significance was set at 0.05. Crude and adjusted prevalence with a 95 % confidence interval was

reported across the demographic and structures indicators. We used Logistic regression models to control potential confounders.

Therefore, each explanatory variable included in the logistic regression models was selected according to a stepwise procedure. As a result, we maintained only statistically significant variables for the model. We presented our results as odds ratios (OR), to indicate risk with a 95% confidence interval (CI). The observations and analysis concerned the two facilities we have mentioned above, and we matched the findings by the expected outcomes. We let the multilevel association modeling test settle the results for the sake of obtaining the optimal predictors.

**Results**

Due to errors regarding the signing procedure or disintegrated X-ray images and data entry, the sample that we used for the final analysis was subject to some variations. Those attrition were responsible for approximately 10% of data missing, which could have eventually lead us to restrictive bias.

**Descriptive characteristics of the study sample**

Table 1 summarizes the characteristics of the sample and his distribution.

Variables		n	%
Age (years)	< 20 yrs	2400	51
	≥ 20 yrs		49
Length of treatment (months)	< 6	2200	33
	[6 - 12]		51
	> 12		16
Tenon type	Cast gold posts	2600	6
	Prefabricated posts/core		94
Number of roots/canal	1	2700	45
	> 1		55
Practice Approach	(Integrated)	2700	80
	(Solo)		20

**Table. 1:** Characteristics of the sample

Included in Table\_1 are the clinical and demographic data that presented predicted factors in proportion. It showed that more than 90% of tenon used in those facilities were prefabricated. It also revealed that

two-thirds of treatment had lasted more than six months and that the integrate collaborative practice was the most applicable approach over there.

Variables		n	%	p-value	
Age (years)	< 20 yrs	2400	41.6	0.06	1
	≥ 20 yrs		37.9		1.2(0.9-1.4)
Treatment duration (months)	< 6	2200	28	<0.0001	1
	[6 - 12]		42		1.86 (1.52 - 2.28)
	> 12		58		3.55 (2.72 - 4.64)
Tenon type	Cast gold posts	2600	46	0.1	0.78 (0.56 - 1.08)
	Prefabricated posts/core		40		
Number of roots/canal	1	2700	66	<0.0001	1.52 (1.3 - 1.77)
	> 1		55		1
Practice Approach	(Integrated)	2700	56	<0.0001	1
	(Solo)		70		1.83 (1.49 - 2.24)

**Table-2:** Association measure (OR) of the different variables with the outcome/failure

Table\_2 shows the association of the predicted element/factors with the outcome/failure. In this table, the estimated causes of the failures can be expressed by treatment duration, which remains more than six months, by number root/canal that is less than two, and by solo practice approach which appeared to be significantly associated with failure of the prosthodontics treatment.

The failure score is higher when an individual practice is perceived as

compared to integrated practice. This score appears to be significant when a single root/canal has been used, corresponding to the use of multiple roots/canals or extensions and for treatments that lasted more than six months compared to those whose duration of the whole procedure was shorter (Table 2).

However, it appears that using cast gold posts might be a protective factor for the restored tooth, but this relation was not statistically significant ( $p=0.1$ ).

Practice Approach (Solo)		(57.19%)	
Variables			
Treatment duration (months)	< 6	<0.001	1
	[6 - 12]		2.20 (1.6 – 3.0)
	> 12		4.80 (4.0 – 7.0)
Number of roots	1	<0.001	1.50 (1.3 – 2.0)
	> 1		1
		P-Wald	OR (IC95%)

  

Practice Approach (Integrated)		(69.49%)	
Variables			
Treatment duration (months)	< 6	<0.33	1
	[6 - 12]		1.50 (1.0 – 2.40)
	> 12		1.30 (1.0 – 2.50)
Number of roots	1	<0.41	1.20 (1.0 – 2.00)
	> 1		1
		P-Wald	OR (IC95%)

**Table-3:** Association measure (OR) adjusted for different variables with stratified outcome/failure by Practice Approach

Table\_3 presents ORs adjusted by logistic regression of the outcome/failure categorized with practice. About the care approach, considering a “solo-based practice,” after adjusting for the other variables of the model, the duration of treatment (2.20[1.6-3.0]; 4.80[4.0-7.0]) and the number of roots (1.50[1.3-2.0]) remain significantly associated with the failure, while also projecting an increase in the strength of the association. On the other hand, for integrated collaborative practice, after adjusting for the other variables in the model, no variables were significantly associated with failure (Table 3).

## Discussion

### Characteristic of the findings

Significant progress has been mainly made now and days, regarding the placement techniques and procedures, the roots canals treatments and the materials also used in the post for management of endodontically treated tooth. This work evaluated the treatment status of the endodontically treated tooth using core/post in the prosthodontics department with a dental intraprofessional collaborative approach, as well as the association between some potential predictors like placement techniques, endodontics treatment steps, and materials that could influence the outcome. This study may suffer inherent limitations due to missing values and to the fact that the two clinics have a different management structure regarding the intraprofessional collaboration. The first one could impact our sample and the second one how to estimate the result better. Fortunately, the use of a multi-level modeling test is enabled to considering those gaps and was used

to be able to spare some bias by using a fixed-effects model where the effects of both types of a variable can be estimated and be adjusted. The study design is also helping by limiting some effects like those of confounding factors.

The results obtained indicate, when assessing the prognosis for final restoration crown or bridge, that an integrated practice approach, a procedure with adequate time for the root canal and definitive restorative procedure, then using more roots/canals or space to place the posts are offering proper therapeutic prosthodontic treatment. Our findings seem to support then the evidence that links to “configuration” theories related to collaboration in dental integrated approach care. Some of the issues encountered in endodontically treated teeth regarding prosthodontics restoration according to our findings were the length of the treatment and the practices’ approach. Our results also add to the literature essentials facts.

First, a lot of progress has been made in placement techniques and materials using a dental post with an endodontically treated tooth. Most of the tenons (post/core) currently available are mainly made of either carbon fiber, and more recently manufactured systems involve carbon-fiber-reinforced posts covered with composite<sup>(23)</sup>. But, as we can see, the traditional custom-cast dowel core made of metal provides a better adaptation, and it was considered a protective factor in our study. This support Coelho’s assertion, who find that using cast gold post tends to affect less the dentine by causing a minimum deformation<sup>(24)</sup>. Even though the cast gold post was the most implicated



in failure in our study. This fact contrasts with some results in other studies that suggest more retention, more elastic, and more stability with some prefabricated post-and-core systems like fiber-reinforced composite resin post-and-core system<sup>(25, 26)</sup>. Perhaps, it is because, in our study, gold was the most used metal, while for them, it was more stainless steel. Second, we collected data from two institutions over seven years (from 2006 to 2013), and that allowed us enough time to observe the outcomes and the incidence of all the other factors. The use of this strategy as a design for our study, as we have indicated in the first paragraph in the section above, helps improve the validity of our findings. Although we conducted our research over a shorter episode of time compared to Fokkinga ones, which have lasted more than ten years to clinically observe the result of post systems and crowns restoration<sup>(27)</sup>, one fact is that the long-term clinical studies are essential for evidence-based dentistry and clinical making decision.

#### **Predicted factors that appeared to be affecting the outcome of the final crown restoration**

Another relevant fact, most of the patients in our study, like fifty percent (50%), appear to be in their twenties. This fact is not entirely different from the findings in Lee study's, which was conducted in a dental teaching hospital where seventy percent (70%) of the patient were crossing their fifties<sup>(28)</sup>. Patients' age is a preoperative prognosis key because it seems like older people are probably the most vulnerable to have failure root canal treatment, base on the physiological aging process<sup>(29, 6)</sup>. This effect can be a possible explanation for the risk of failure in the late thirties like it shows in our sturdy. However, the results demonstrating this was not statistically significant.

One of the problems encountered in managing endodontically treated tooth for prosthodontics treatment is the length of the treatment. Even though proper endodontics procedures and dowel placement have been performed adequately, according to our study and the findings in Imura<sup>(30)</sup> study, who have evaluated the treatment outcome of initial endodontic treatment and nonsurgical retreatment performed by an endodontic specialist, the treatment duration that has been lasted more than twelve months like in our study and twenty-four months in Imura study had a significant impact on treatment and can jeopardize the outcomes. These findings suggest that a recall for any doubt or signs of symptoms after endodontic treatment must be addressed in less than twenty-four months. Other studies also found that a long-term period of recalling more than five years affects the success of the procedure<sup>(31)</sup>.

According to our results, most of the restoratives procedures where a single root/canal was used after the endodontic procedure to retain the post have led to a higher risk of failure. This finding is probably the result of the higher risk of cracks on the root's wall when areas of high-stress concentration involve only one canal.

The pattern of a silos practice shows that there is a considerable increase in the risk of failure base on the results of this study. It appears, in this pattern mainly, when the duration of treatment tends to be longer, or when the number of root/canal use is not sufficient. Nevertheless, other analyzes made from other studies similar to the same issues find different results. For those studies, the element incriminated much more in the failure appears to be the endodontic procedure, the quality/quantity of dentine surrounding the root, and the choice of the root itself<sup>(32)</sup>. Indeed, in the study of Ricucci et al. (Ricucci, D. et al., 2011)<sup>(33)</sup> who underwent endodontic treatments which had performed by a single operator, in a periodically controlled for five years, the risk of failure was lower when endodontic treatment was performed on a single root in a patient. That sounds to be reasonable because it offered fewer operative procedures for a single operator and not to mention the minimum biomechanical risk of failure that represents an

endodontic treatment in a single root<sup>(34)</sup>. While in integrated practice, the number of practitioners attenuated the risk and holds great potential to improve patient satisfaction and health outcomes, as Chinn H. Courtney shows in his article<sup>(35)</sup>, integrated care not only assures excellent potential to improve patient satisfaction but also guarantee better health outcomes.

Therefore, problems related to the duration of the treatment and the number of treated roots using a post as a support for the definitive prosthetic restoration can be detected and addressed using an integrated approach like collaboration capability, which enables dynamic capabilities and interactive performances. This type of practice is an opportunity for new ways caring in which dentistry professionals must involve in the resolution of dental and health problems in general through an interprofessional and collaborative approach<sup>(36,37,38)</sup>. About, substantive results in this review suggested that two related factors like better accessibility in managing appointments to reduce delays and an integrated approach to anticipating complications can lead to better outcomes and effectiveness.

#### **Conclusion**

Cooperation between dental practitioners can offer a great perspective in promoting high-level standards of dental care for patients. Interprofessional and intraprofessional collaboration in other fields in the health sciences fulfills the requisites of evidence that this form of practice helps improve quality health care. While the literature seems to report little difference in the outcomes between the type of practice regarding the failure of prosthodontics treatment using post and core design on the endodontically treated tooth, our findings, therefore, seem to show that factors which appear to affect the outcomes are more imply statistically had increased in intensity.

Our work might suffer some limitations. The use of restricted factors over others, like the absence of coronal ferrule, occlusal loads, or the gender that could also be considered as a critical risk for potential fractures, has not allowed us to extend our findings to other communities of dental practice. Our study took place in facilities where an integrated approach exists but not in a formal manner or strictly implemented yet. This strategic approach could have probably created a selection bias. That is why we choose the multilevel modeling test, which was essential for our statistical analyze and to prevent this from affecting our results.

Moreover, our findings cannot pretend to address a lack of competency when it comes to analyzing the quality practice of silos of professional practice. Also, the lack of comparative studies with similar risk factors and outcomes criteria with comparable time intervals limited the comparison of these standards of practice when it comes to prosthodontics treatments using this procedure. These two elements then do not allow us to conclude in the way that there could be a lack of competence when it comes to comparing the two forms of practice. Despite these limitations, this study allowed us to observe some facts: first, after endodontic treatment, the procedure for the post and core placement and permanent coronal restorations should replace any interim materials as soon as possible to prevent subsequent tooth fractures, which will probably conduct to failure.

Second, the use of endodontically treated teeth for prosthodontics treatment using post and core design must carefully proceed when one root is involved in the crown's restoration, mainly when this kind of procedure includes silos of professional practice. Because this kind of process and management demonstrated a rate of failure that is significantly higher than other types of procedures or practices in our findings.

Third, there are many controversial conclusions concerning the best material to use for the post when it comes to restoring endodontically

treated teeth. While our findings showed that gold could serve as a protective factor, post and core in any material must be used when the coronal structure is insufficient to provide support to the restorative material, as it shows in Louis's case study (Louis, W., 2015)<sup>(7)</sup>. In this article, we have highlighted the concepts of complementarity, relationship capital, and intraprofessional collaboration to show the impact of different practice characteristics on the performance related to restoring endodontically treated teeth. Considering that intraprofessional cooperation in this area is a promising approach to reduce the failures reported during endodontic and prosthetic treatment by anticipating what each actor concerned in their field may lead to lowering failure by addressing a common front the potential risk factor. This new approach is the motivation for current research and the forms of clinical practice. Since a few parts of the literature reports on dental procedures and human aspects are less considered in prosthetic failures, we thought it was relevant to lay the groundwork. As such, we hope that the elements collected in this study can be useful to develop future research and practice. Notably, subjects related to dental practices and interprofessional collaboration in the dental field with a client-centered approach. Since teamwork should be considered a strength that can bring different skills, clinical judgment together for the potential quality of care, the complementarity approach will lead to surprising outcomes and quality care for the clients.

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